Fact Sheet

Ti-flex® Series
Inspection and Discard

Safety...

What we produce and supply needs special care...,
...Care about consequences in case of failure.
It's not just quality, it's safety that matters.

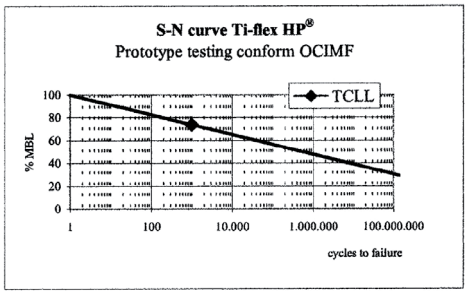
06.08.2011

General

The decision to discard, repair or continue using a Ti-flex® mooring hawser can never be taken on the grounds of exact standards. For correct use of the criteria given here general knowledge of, and experience with, fibre ropes in general and Ti-flex® hawsers in particular are essential. In case of doubt it is advised to consult the rope manufacturer.

In general, mooring hawsers can be rejected because of:

- Failure: Mooring forces were exceeding the maximum design force. This is unlikely, assuming a sound design basis.
- Chemical deterioration: Unlikely for existing operations. Any problem should already been identified.
- Fatigue: The fatigue life of T-flex ropes is excellent, see curve. With normal safety factors (2 to 3,5) the rope should not fail because of fatigue loading.
- Hawser damage. This will be discussed here.



Therefore evaluating the rope damage can primarily assess Safe Working Life of the rope. As a guideline the Residual Breaking Strength of the damaged rope should not be less than 75 % of the New Breaking Strength. Consequently, the number of cycles (tanker discharges) are expected to be the main driver for mooring hawser disposal. However, this principle should be well understood.

Inspection

The lifetime of a rope is strongly influenced by its construction, the environment it is used in and the type of application.

Typically the Safe Working Life of the mooring hawser can be expressed in the number of operations the hawser has seen and the conditions of the operations. Thus for a good estimate it is recommended to keep a logbook of the number of operations and the environmental conditions thereof.

Inspections can then be conducted after an agreed number of operations. In general it is recommended to conduct eight inspections over the expected / estimated lifetime of the hawser.

In general the damage of the rope is repetitive. Therefore, using this experience an operator will probably be able to identify the area(s) of the rope where damage is most likely to occur, for example the one end of the rope is handled most. In that case an inspection can concentrate to that area.

The residual breaking strength of the rope should be quantified using the procedures described below in order to obtain a clear view of the strength decay and remaining lifetime.

Discard criteria

The following factors may warrant removing a rope prematurely from service:

- wear and abrasion
- friction burns
- creep
- crushing/pinching
- local damage
- pulled cover braid yarns or strands
- cut yarns or strands
- others

If local damage is observed then a length of 50 times the diameter before and after that position should be closely inspected and all reductions in strength should be added together.

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Wear and abrasion
Wear and abrasion are the most common causes of rope failure. Rough surfaces, sharp edges, burrs, rust and dirt can cause serious damage to a rope. Winches, pulleys, chocks, bits, etc. should be clean and in good condition.

Wear and abrasion can occur over greater lengths or locally. Particular attention should be paid to the splice area and the eye.

Frayed and broken yarns should be removed and the damaged area should be estimated.

Friction burns
Friction burns can occur over greater lengths or locally. Direct contact with hot objects should always be avoided (e.g. exhaust pipes). Also when using the rope on a winch, capstan, sheaves, etc. care should be taken to avoid surging the rope while it is under load. When the rope slips a lot of heat can be generated through friction.

When friction burns are detected, then the rope should be opened and it should be estimated how much of the rope is fused. The damaged area should be considered to be about twice the fused area.

Crushing/pinching
When a rope has been crushed or pinched it should be removed from service. Typically with this type of problem the resulting damage in the rope is a combination of broken/cut yarns and pulled yarns or strands, which makes for very unreliable estimates of the resulting reduction in strength. A knot has a similar effect.

Local damage
Depending on the extent of localised damage it may be possible to repair the rope rather than remove it from service. Options include local repair plus downgrading or removal of the damaged section and re-splicing.

A second, independent evaluation by a competent person (e.g. the rope manufacturer) is strongly recommended before re-splicing.

Pulled yarns or strands
Individual yarns or strands can be caught behind objects (nails, burrs, etc.) and be pulled out of the rope. This damage makes the rope very unsafe, because the pulled yarns can easily snag behind an object. Thus care should be taken to work the yarn or strand back into the rope.
If a cover yarn is pulled and the pull is too severe, the yarn can be cut and the ends worked back into the rope. A pulled core yarn or strand should not be cut. Rather, the pull should be buried back into the interior of the rope.

The number of pulled yarns or strands should be counted and noted in the inspection card. The cause should be traced and alleviated.

Cut yarns or strands
Individual yarns or strands can be cut through chafing against sharp objects (e.g. the side of a steel plate).

The number of cut yarns or strands should be counted and the damaged area per strand estimated.

Others
No attempt is made here to list a complete catalogue of discard criteria. Many different types of damage to a rope are possible. Thus common sense during inspection to assess the Residual Strength is paramount.

Estimating residual strength
The Breaking Strength of a rope is reduced by damage to the Ti-flex yarns. Through inspection this reduction in strength is estimated per damaged spot. All damages over the inspected length of the rope should then be added together. On the basis of that total estimate the rope is downgraded or removed from service.

On specific request the manufacturer can complete a residual lifetime assessment for a discarded mooring hawser. The result can be used as input for further future lifetime assessments. Typically a length of 2 meter is sufficient This assessment is considered to be effective and fully comparable with a full hawser break test.

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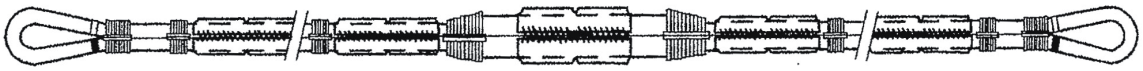
INSPECTION CARD Ti-flex® rope

1) General: by:_____



Braiding pitch: _____ mm date: ___ / ___ / ___
Rope yarns per strand: _____ code:_____

General wear: none severe

1 2 3 4 5

Location and type of damage (note in sketch and table):

location	type of damage	location	type of damage
	wear / cut / pulled / melted		wear / cut / pulled / melted
	wear / cut / pulled / melted		wear / cut / pulled / melted
	wear / cut / pulled / melted		wear / cut / pulled / melted

Remarks:

_____

_____

_____

2) Local or splice damage:

location	no. of yarns damaged	% damaged	average %	location	no. of yarns damaged	% damaged	average %

3) Estimate of Breaking Strength:

_____

_____

_____

4) Cause of danger:

_____

_____

_____