KATRADIS

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GROUP OF COMPANIES

USER'S MANUAL

Siri® High Performance Ropes

KATRADIS GROUP OF COMPANIES

MANUFACTURER OF SYNTHETIC, HMPE ROPES & SACRIFICIAL ANODES

PROVIDER OF WIRE ROPES, ANCHORS & CHAINS, VESSEL DECK EQUIPMENT, PORT EQUIPMENT

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Contents Pages

Siri® High Performance Ropes

Siri® High Performance ropes are developed for the most demanding operations and are manufactured using innovative rope technology.

When compared to conventional fiber ropes and wire ropes, Siri® ropes have the following advantages:

- higher strength at lower weight
- Easy handling
- superior fatigue, abrasion and UV resistance

The application of coating & preformation procedure gives an enhanced structural stability and an improved coefficient of friction, necessary for efficient mooring & anchoring operations. This technology provides increased rope strength and controlled alignment of the fibers before their first use.

Considerable annual savings for the ship-owner / operator derive from the much faster mooring procedure with the use of the lightweight yet steel-like strong Siri® ropes, with reduced maintenance costs, easy storage, zero human injuries, clean deck (free from grease) and high performance.

Finally, Siri® ropes have the lowest snap back reaction under load, which is an advantage in favor of the safety on board for the personnel working near the ropes.

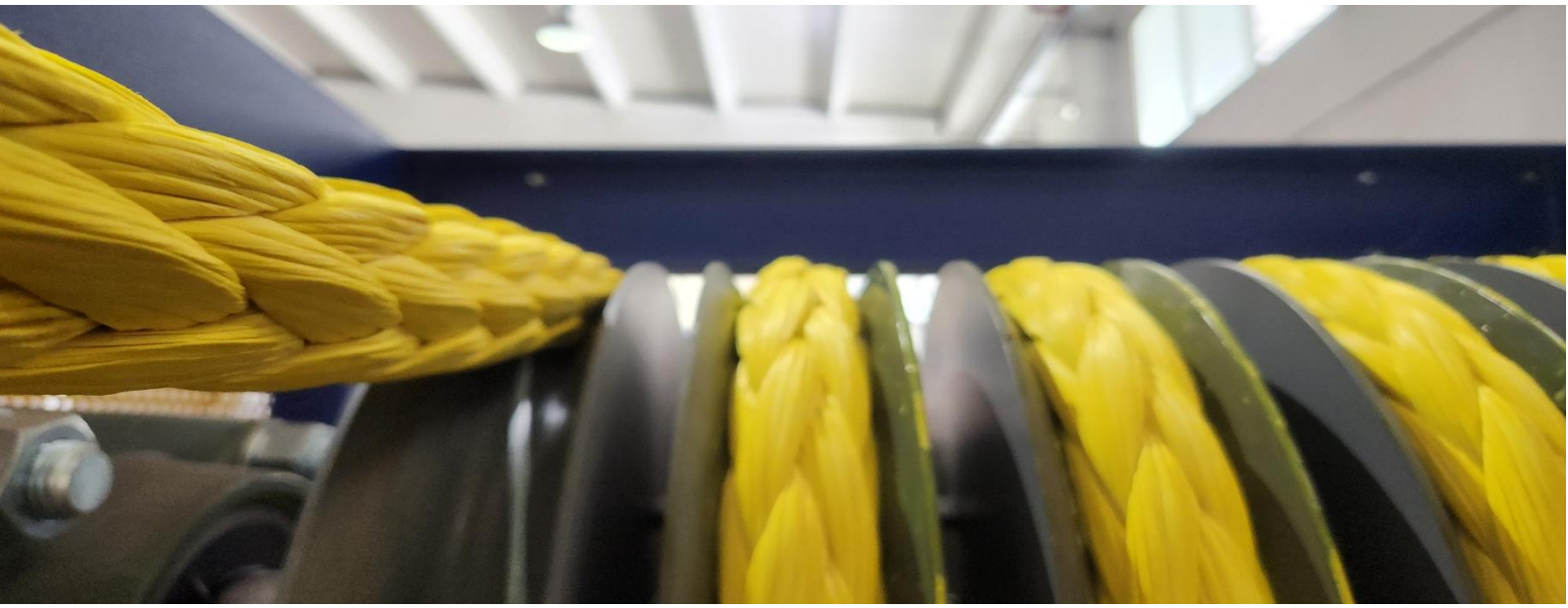
Brief description of manufacturing process

The manufacturing process follows ISO 9001:2015 quality system and includes the following basic production steps:

- The twisting level where the yarns are twisted in rope yarns
- The twisting of rope yarns into strands
- The braiding of the rope is completed under good-practice braiding laylengths
- **Linear Structural Preformation - LSP**
- Overbraiding of the jacket, in cases of covered construction.
- After weighing of the final product and cutting specimens for breaking load testing, the eye splices are made in one or both ends.
- Then follows the marking and packaging to give a complete final product which is taken away for storage and/or transport.

Linear Structural Preformation - LSP

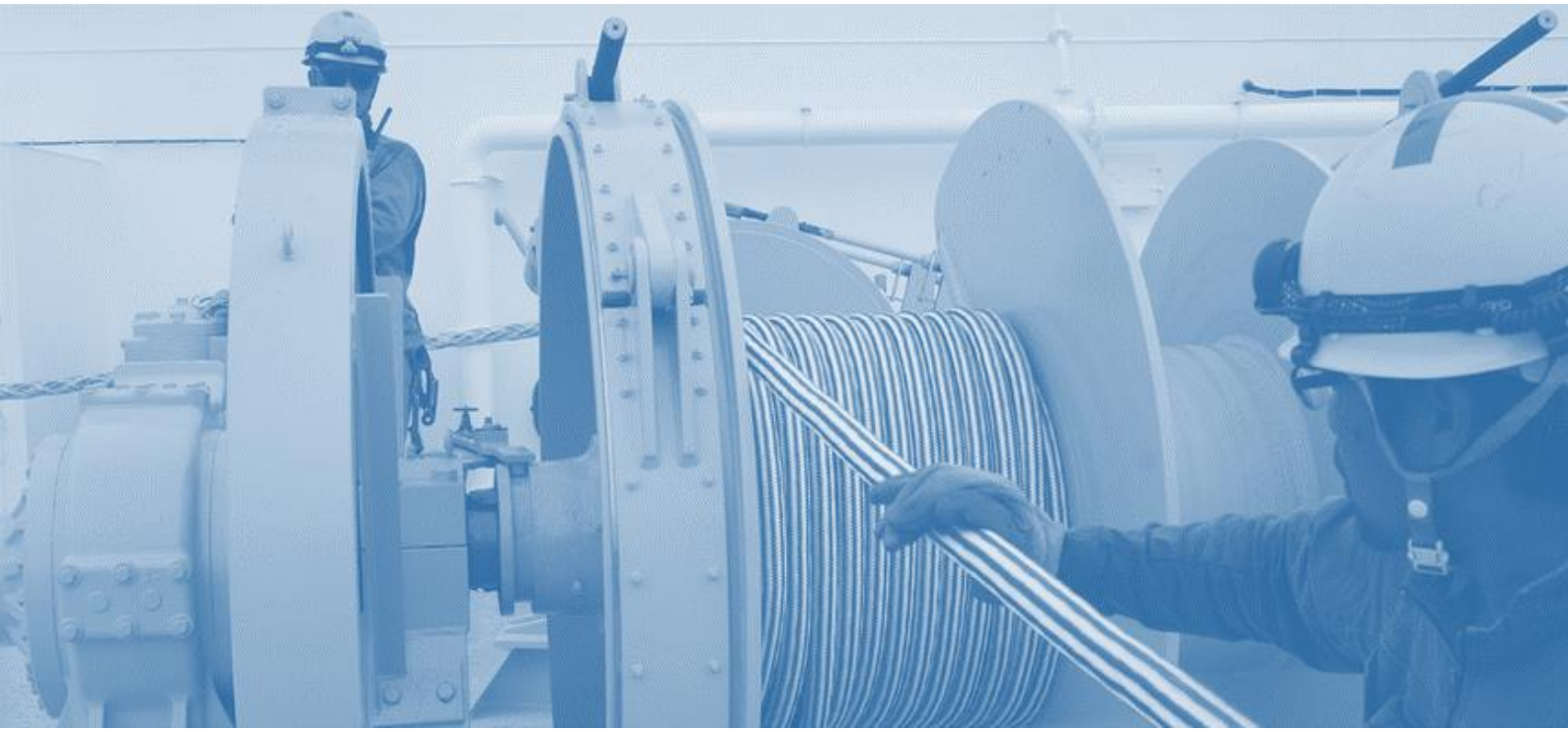
For enhancing the rope mechanical properties



KATRADIS MARINE ROPES INDUSTRY SA has developed the Siri® Linear Structural preformation, a two-step procedure integrated in the rope manufacturing process, resulting in increased structural stability and improvement of the mechanical properties of Spectra-Siri ropes. This procedure consists of the following stages:

- **Coating Process -** Polyurethane protection (NIKA-Thane coating) upon each fiber increasing the abrasion resistance
- **Rope Formation under heat conditions -** Providing under control uniformity of the whole rope length, structural stability and faster adjustments on the working conditions.

ON-BOARD INSTALLATION



Before the use of Siri® ropes in mooring operations, it is important to give attention and care on the deck equipment, where the rope will be placed.

Below there are given instructions for proper installing of the ropes on winches in order to avoid unwanted damages.

Hardware / deck preparation

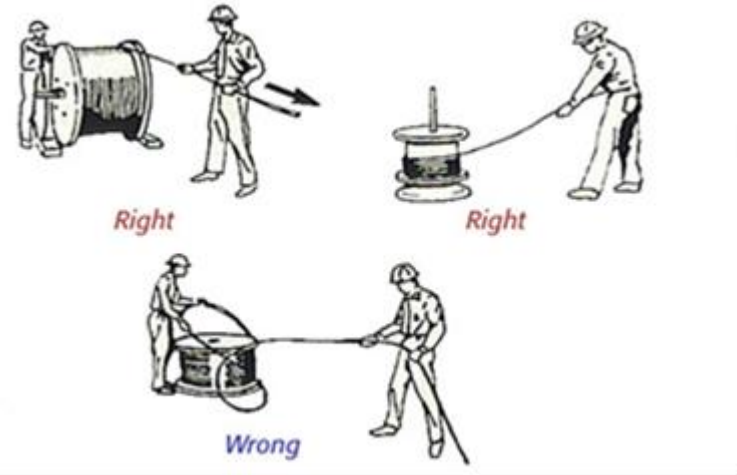
In case of deck equipment where wire ropes have been used as mooring lines, the following actions should take place:

- Smooth / regrind all surfaces on deck and on equipment (drums, bitts, chocks etc.) that are rusty and sharp.
- Repaint all surfaces on deck and on equipment that were in contact with steel wire rope.
- Check for sharp edges on flanges, winch drums and general in every hardware equipment on deck that the rope comes in contact with.

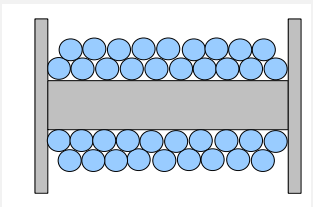
- Take special care in chocks, as these contact points are crucial during the mooring operation.

Installation on a winch

Uncoiling from a coil: The coil must be free to rotate (vertically or horizontally) and unwind the rope. Wind carefully the rope on the storage drum using an appropriate device. Apply a small reference tension but mind the tension as well as the speed level to avoid the generation of excessive heat due to friction/abrasion. The first wraps must be as tight and firm as possible to avoid the slipping of the wraps from the top of the coil.



The first layer must be wound on as close as possible. The next layers should be stacked on the valleys of the previous layer (as shown in the below pictures).



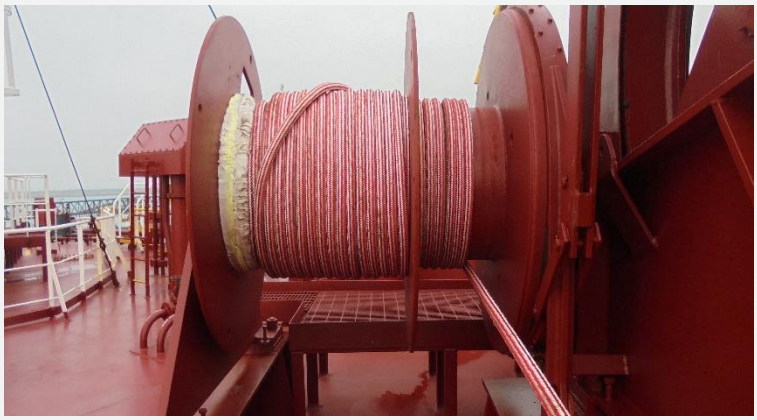
Be careful of the twist that may be introduced to the rope while winding it on the winch. Studies have proved that loss of strength amounts to 20% per turn per meter.

Make sure to remove the twisting after each operation. Spread the twisted length of the rope along the deck and align in order to straighten the rope.
If the twisting is not removed after each mooring, there is risk of increasing the twists at every operation of the vessel.

⚠ **In cases of split mooring winch drums, the drum separator should have rounded edges where the rope passes through.**

These metal surfaces that come in contact with mooring lines must be rounded and not sharp.

On the tension drum, the rope must have at least 8 wraps.



Only 6 wraps are positioned on the tension drum

When deploying the mooring lines and adjusting the layers on the tension drum, the user can operate temporarily some wraps on second layer. This is recommended in order to make sure that at least 8 wraps-turns are provided on the tension drum as per above guideline.
After the deployment of the lines, the user can remove the second layer and operate ONLY with one layer for mooring as recommended by MEG4.

OCIMF recommends that the primary brake should be set to hold 60% of the ship design MBL on the first layer. The brake holding capacity for this type of winch is always quoted for the first layer on the tension drum. If more than one layer is wound onto the drum, then significant loss of brake holding power will result. For undivided drums, it is recommended to ask the winch manufacturer for guidance on maintaining the value for brake rendering.

(sdMBL) Ship Design Minimum Breaking Load: The MBL of a new, dry mooring line for which a ship's mooring system is designed. The sdMBL meets standard environmental criteria restraint requirements.

(LDBF) Line Design Break Force: The minimum break force at which a new, dry, spliced mooring line will break when tested acc. to CI1500B:2015. This value is declared by the manufacturer on each mooring line certificate. LDBF = 100% - 105% of sdMBL

MOORING OPERATION

Mooring operation is one of the most critical and hazardous tasks carried out on vessels. Mooring arrangements differ from port to port and careful re-planning of the mooring operation is essential.

Deck crew has to consider various safety precautions and understand working principles of deck machinery and systems. When it comes to mooring operations, additional precautions need to be taken to ensure crew members' safety.

- ✓ **As the ship nears the port the mooring winches are tried out, the breaks are tested and the mooring ropes are checked and positioned.**
- ✓ **Mooring lines must be as symmetrical as possible about the midship line of the vessel.**
- ✓ **Two or more lines leading in the same direction should always be of the same material (also tensile strength, elongation etc.) and construction.**
- ✓ **MIXED MOORING MUST BE AVOIDED.**

Rope Protection

Use chafe protection.

Every Siri® rope includes a NIKA®-Protector (special HMPE braided sleeve, installed from the production process, intended for the rope protection against external abrasion in areas such as chocks, bitts etc.). This easy-to-handle (user friendly) braided sleeve is highly wear and abrasion resistant and will substantially extend the service life of your mooring line.

NIKA®-Protector adjusted on the chock for the protection of the rope against abrasion. The material's low coefficient of friction reduces the operating local temperatures.

NIKA®-Eye Splice Protector is fixed on every rope eye, for maximum protection from internal and external abrasion and excellent efficiency for the cow-hitch connection.

If chafe protective sleeves are used on chocks, make sure they are adjusted properly as otherwise they can cause serious damage to the rope.

Chock protective sleeve that has been folded during operation. This creates difficult contact surface and can result in abrasion and temperature damages.

Use of mooring tails

When Siri® ropes are used as mooring line, this line must always include a mooring tail. The tails must have good elongation properties in order to avoid shock loads. A shock load may damage the rope and lead to instant failure (even if the rope looked and/or was in good condition). Proposed materials are Nylon, PES and Mixed PES / Polyolefin.

The **Tail Design Break force (TDBF)** of the mooring tails must be **25%-30%** greater (when wet) than the ship design MBL of the Siri® High Performance rope.

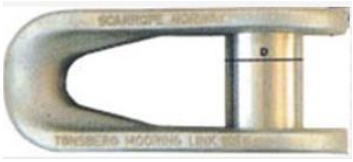
(TDBF) Tail Design Break Force: The minimum break force at which a new spliced mooring tail will break when tested (in wet conditions) acc. to CI1500B:2015. This value is declared by the manufacturer on each mooring line certificate.

TDBF = 125% - 130% of sdMBL

The connection of a Siri® High Performance rope with the mooring tail can be done with the use of a mooring link (bolt type) or shackle (roller type) or directly with cow-hitch.
The SWL of the link or shackle must be equal or greater than the WLL of the mooring line.

For longer service lifetime & safety reasons, Siri® ropes must be connected as advised below:

Mooring Link: The main mooring line is attached to the body of the link and the synthetic mooring tail is attached to the bolt.



Mooring shackle: The main mooring line is attached to the roller of the shackle and the synthetic mooring tail is attached to the body.

Connection with shackle

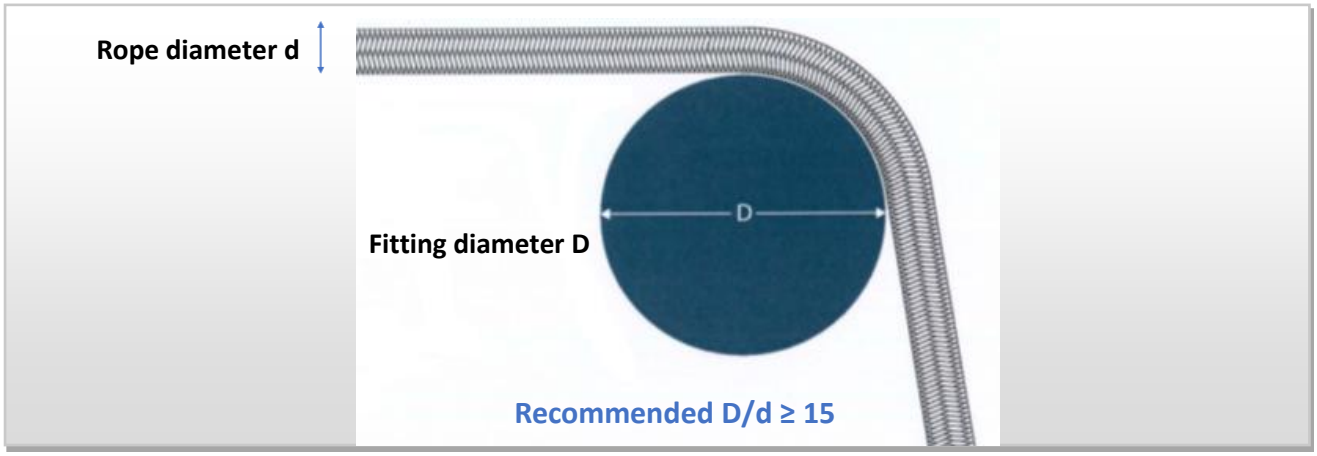
Connection with cow-hitch

Minimum safety usage factors

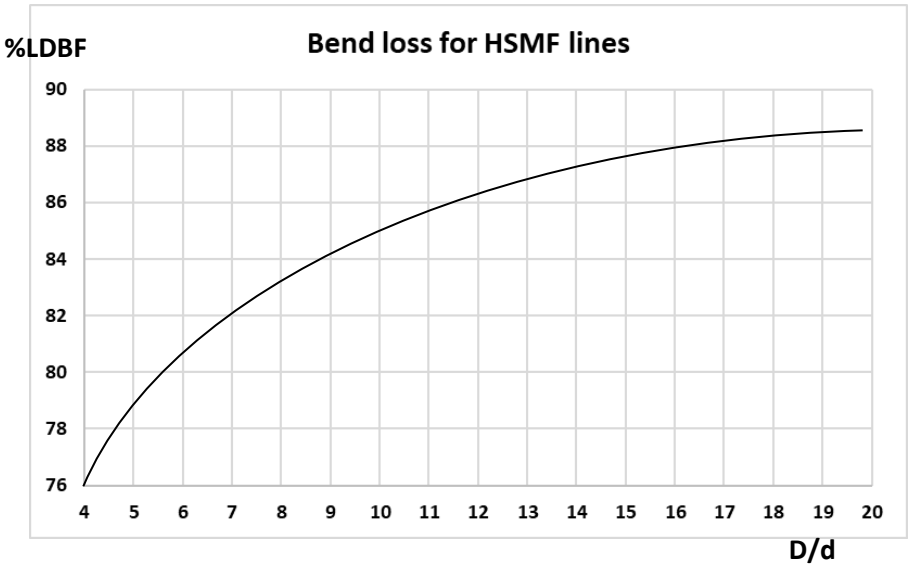
The maximum Working Load Limit (WLL) of Siri® mooring lines must not exceed 50% of the ship design MBL.

The SWL of the bitts and other deck hardware should be equal or greater than the MBLsd of the employed mooring line.

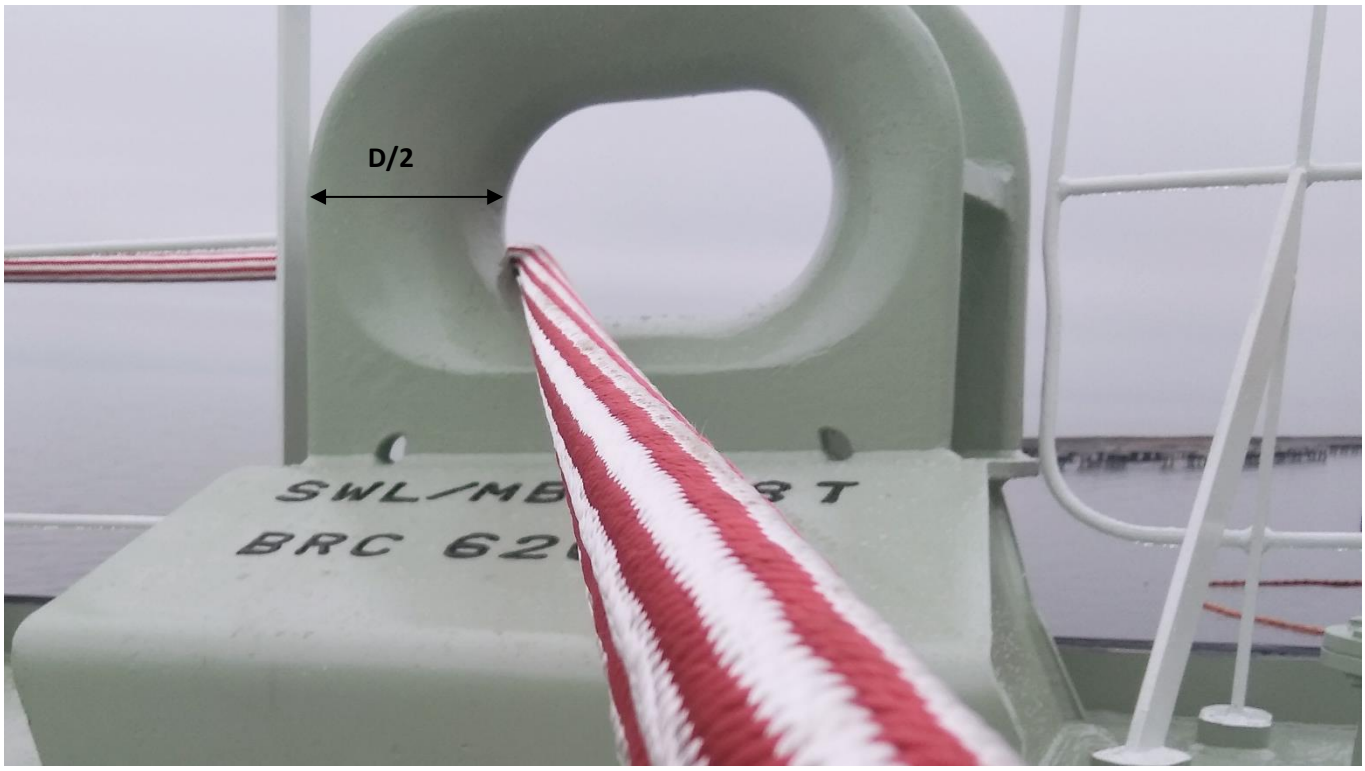
Any bending of mooring lines will instantaneously reduce its breaking strength. Repeated bending will reduce the service life of the line. The D/d ratio (D: diameter of fitting, d: diameter of mooring line) should be as large as possible to maximize mooring line strength and working life.



OCIMF (MEG4) recommends that the diameter D of bitts, pedestal fairleads, etc. that come in contact with mooring lines should be at least 15 times larger than the diameter of the line.

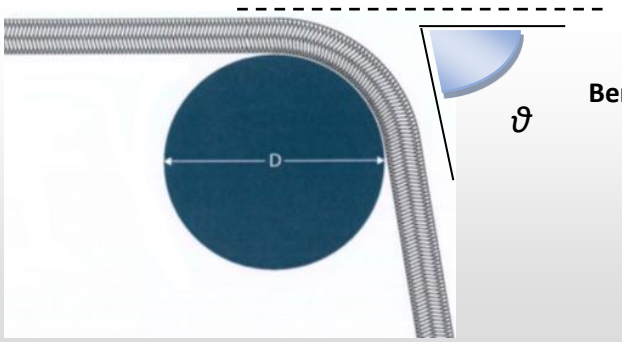


Graph showing the %LDBF in relation with the D/d



NIKA-Siri rope passing through closed chock. Half the diameter of the chock is showed for reference.

Mooring line arrangements often require redirection from winches and bending of lines around pedestal rollers. Users should keep in mind that high bending angles can cause compression of the inside strands and yarns and also extensive wear when the line is under loading and unloading conditions.

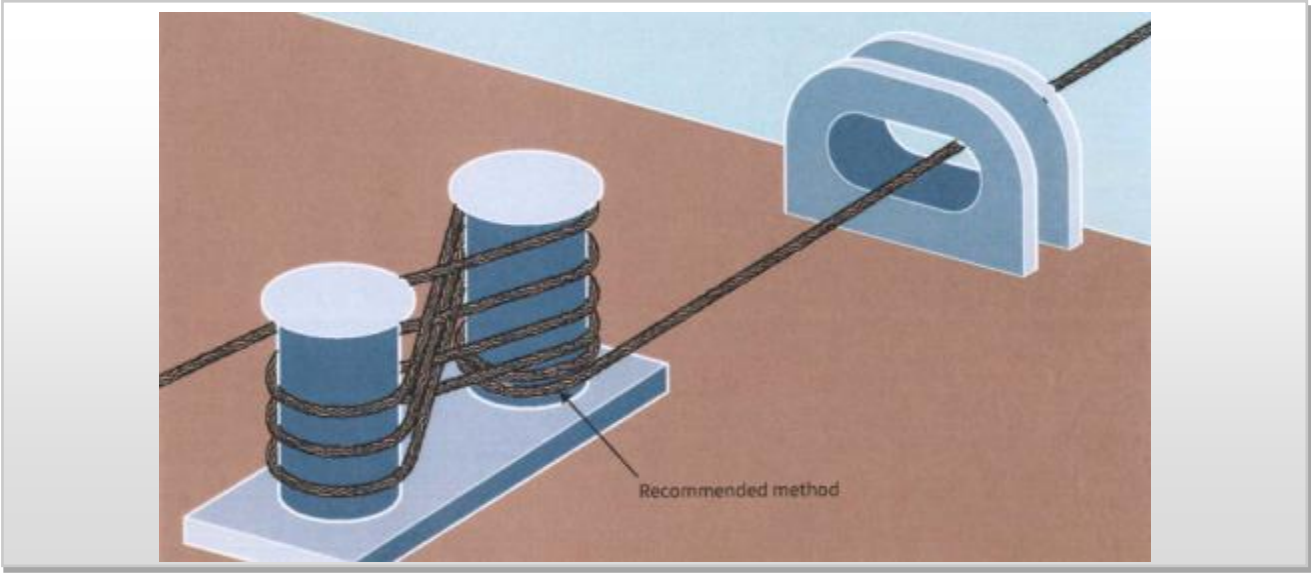


Bending Angle

Larger bending angles cause longer wear zones of mooring lines and increased fatigue due to bending.

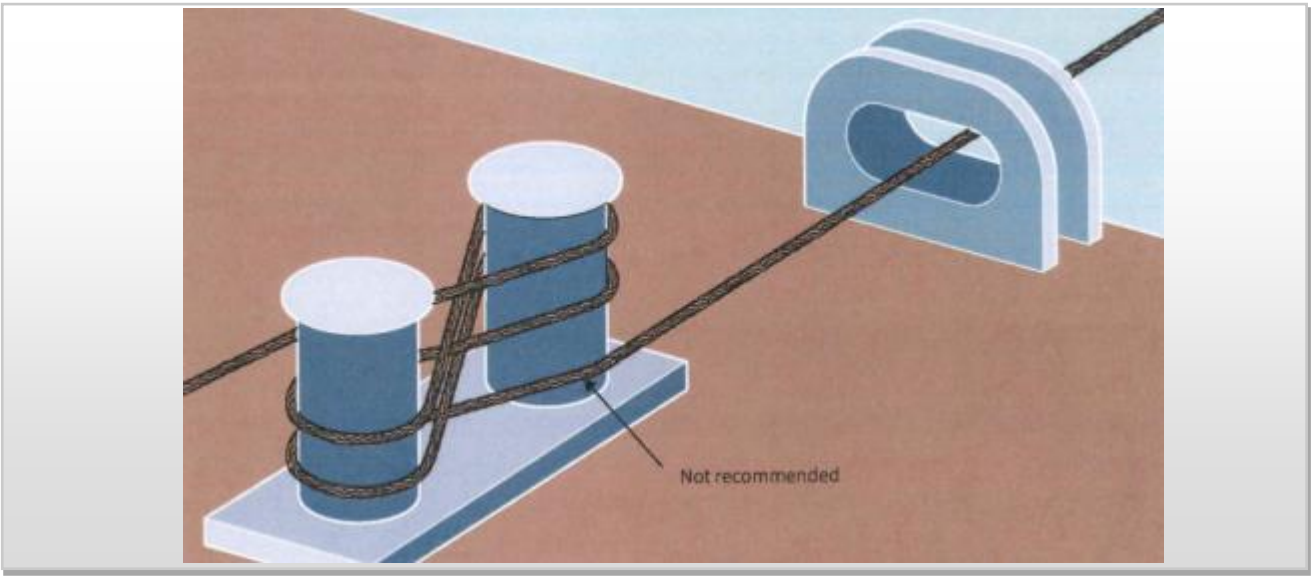
Securing Mooring Lines in figure 8 arrangement

It is recommended by MEG4 that when securing mooring lines to double post mooring bitts, two turns should be placed around the first post before beginning to belay figure of eights.



Recommended method of turning up a mooring line on bitts (two full turns around leading post)

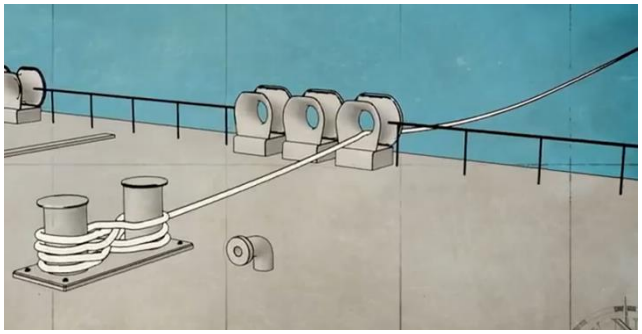
If the two full turns of the mooring line around the first post are missing, a higher stress is induced in each post creating a tendency for the bitts to be pulled together. This method is not recommended and is illustrated below:

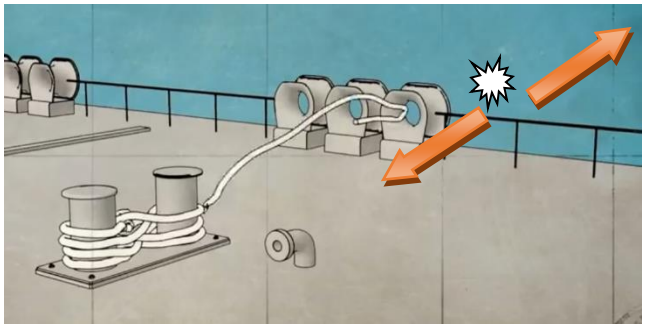


Incorrect figure of eight method for attaching a mooring line on mooring bitts

Safety issues

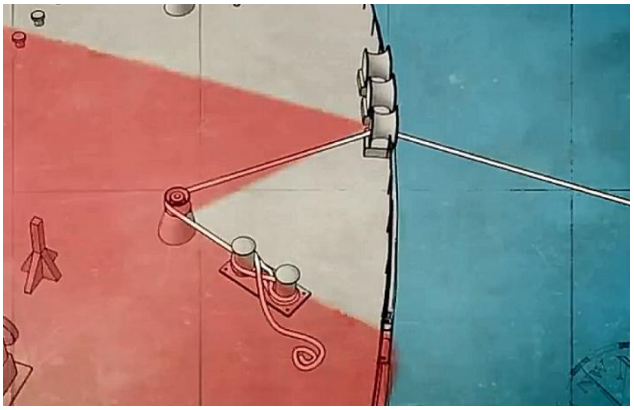
ALWAYS CONSIDER the high-risk areas regarding snap-back effect of mooring ropes, as it can be proven lethal.

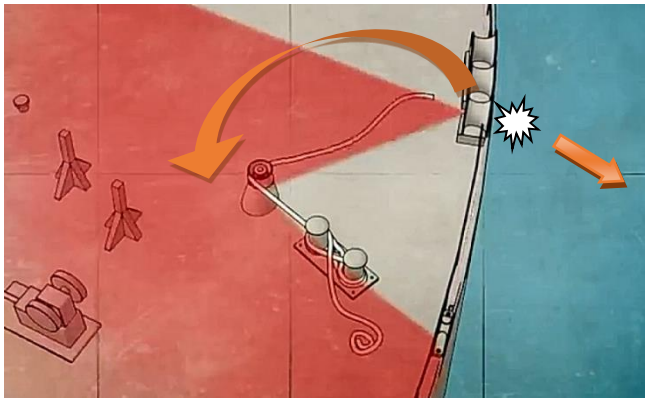




Snap-back is the extreme recoiling during a rope partition and it is a result of released energy that is stored in the rope. The direction of recoiling is unpredictable due to the variation of bending angles and rope direction.

Siri® ropes due to the very low elongation and lightweight, do have much reduced snap back reaction compared to conventional ropes, but in any case the user should be aware at all times.





In the above example, the rope parts on the outside of the vessel. In case the partition takes place on the inside of the vessel, the resulting snap-back reaction can be very different.

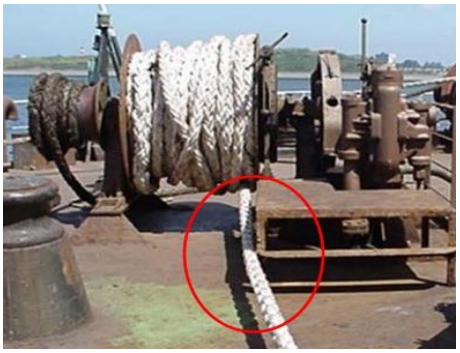
MEG4 Guidelines suggest that a snap-back area should not be marked on deck because such an approach gives a false sense of safety for the crew outside the marked areas. It is suggested that during mooring operations, all crew and personnel should become aware of the snap-back dangers and not be in close proximity of the tensioned mooring lines.

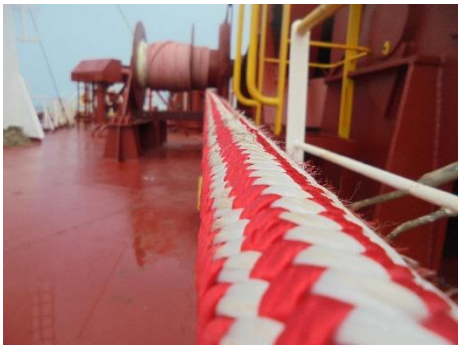
Any work that must be performed near to a mooring line under tension must be performed as quick as possible, but NOT HASTY, and with extreme caution.

⚠ **Never let two ropes rub one another when they are under tension. There can be excessive heat build-up that will damage the fibers locally and impose a weak point in the line.**

⚠ **AVOID keeping mooring lines on drum ends.** Lines must be kept in storage drums with appropriate wraps.

⚠ **MAKE SURE that there are no obstacles on the mooring line's directions.** Parts of the vessel's construction that come in contact with mooring lines must be removed as they can cause rope damages that could lead to unexpected premature failure of the mooring line.

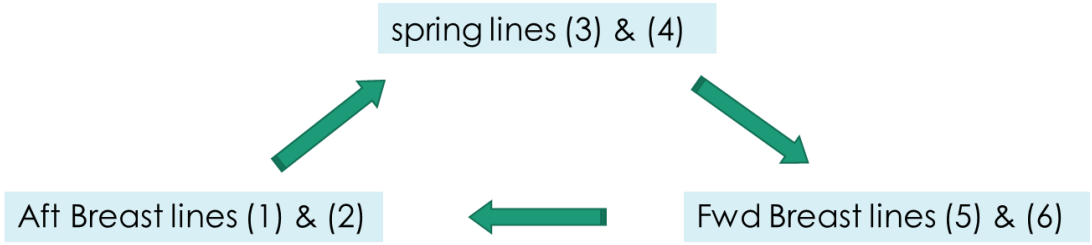


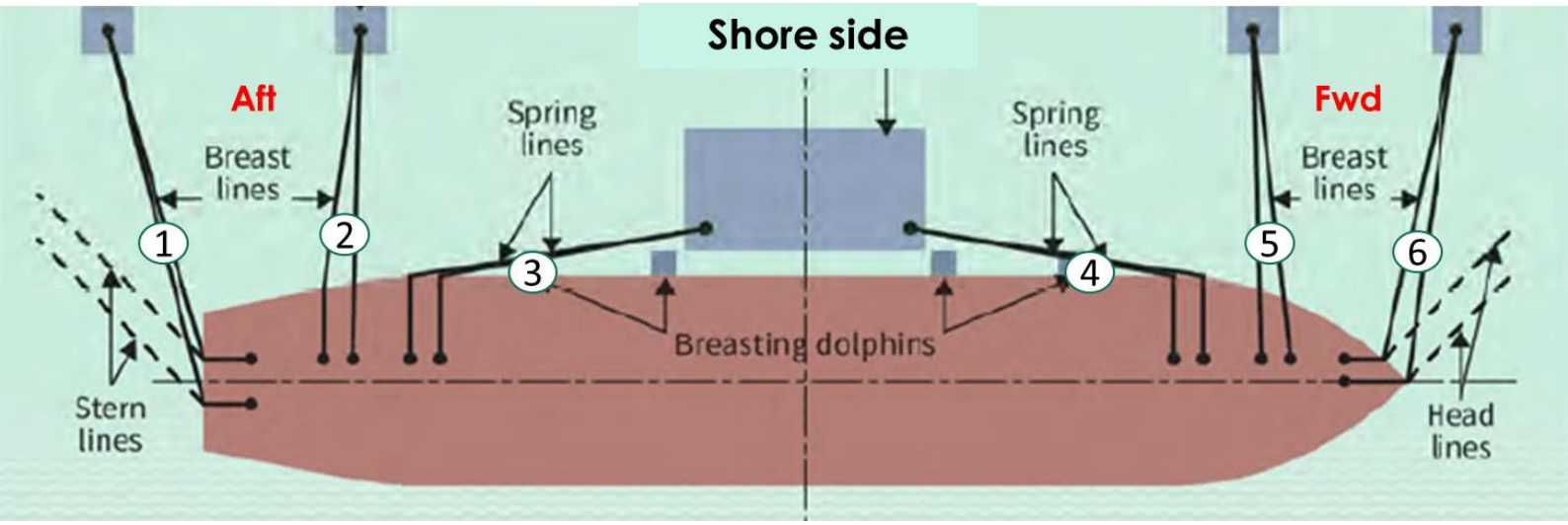


ROPE CARE AND MAINTENANCE

- **Reverse your mooring line end-for-end: bring the rear part of the rope in front and vice versa so that the wear is distributed and get a longer service life. Recommended at 5 years timeframe.**

- **Rotate the positioning of mooring lines as per below general scheme in order to get an efficient wear zone management.**





Line winch rotation general plan:

Aft Breast lines (1) & (2) – to replace spring lines (3) & (4)
Spring lines (3) & (4) – to replace Fwd Breast lines (5) & (6)
Fwd Breast lines (5) & (6) – to replace Aft Breast lines (1) & (2)

Avoid making knots at all costs. They can reduce the line's strength by up to 50%. If needed, make eye splices instead.

Keep the ropes clean: wash them with tap water on a regular basis (the time frame is to be decided upon operators' experience) to remove any dirt or sea salt. Such particles will act as "razors" and damage the fibers when dry.

Spread the mooring line on the deck and after the tap water scouring let it dry normally.

Nylon tails must be carefully dried as their strength starts to decrease in wet conditions.

Conduct regular inspections on the rope and the hardware (see more on the inspection practices).

Under no circumstances the rope should contain oil/grease material, as it may cause chemical contamination and also foreign particle adhesion (which will create abrasive conditions).

NO GREASE

Use NIKA-LUBE special lubricant for fiber ropes

NIKA-LUBE is a special lubricant (wax based) that is used to improve the abrasion performance of synthetic fiber ropes by reducing the friction coefficient of the contact surfaces. It is indented for applying on chocks, bits etc. where the abrasion is critical for the service life of mooring lines.

NIKA-LUBE spay kit is supplied by order including application instructions.

Storage conditions

Store the ropes in a clean environment under mild environmental conditions (avoid storage in high temperatures) and away from direct sunlight.

Store the ropes away from heat generating sources and chemicals. Good ventilation of the storage place is also preferable.

INSPECTION PRACTICES AND RETIREMENT CRITERIA

Ropes should be inspected after each operation. An experienced person from the crew, assigned by the master or by the company, must be charged with the visual inspections. A diary log must be kept where as much information as possible must be recorded (mooring line history, hours of mooring operations, visual findings as per KATRADIS inspection guidelines).

INSPECTION TYPES & GUIDELINES

Below there is given guidance for determining the routine or detailed inspection as well as inspection and evaluation criteria regarding the visual condition of the ropes.

Type of Inspection		
	Routine Inspection	Detailed Inspection
Description of line inspection	The in-service section of the line length (typically on the tension side of the mooring winch) is inspected. This is visual inspection according to below evaluation methods.	The full length of the line, which includes both the storage and tension side of the rope. This is visual inspection according to below evaluation methods.
Frequency	Every mooring operation (before or after usage)	Annually

Below there are given guidelines for visual inspection (for uncovered and covered ropes).

The visual inspection does not give the output of the exact residual strength of the rope, but it can determine if a rope can be fit for further use or not.

The indication of residual strength can be addressed by break testing of cropped lengths of a mooring line. MEG4 includes this recommendation for end users, so they can build strength analysis data based on their specific application requirements.

Not all lines on-board need to be tested. Taking an indication from 1 or 2 lines of a vessel (best practice is to test the ropes of the most worn condition) can help evaluate the conditional state for others of similar manufacturing type. Always consult KATRADIS SA regarding the recommended mooring line testing.

It is recommended that mooring lines and tails that their strength has reached the 75% of the ship design MBL (respectively) must be replaced.

Inspection for unjacketed ropes:

One strand of the rope is pulled out. If it is possible, try and work it back to the rope, if it is in good condition (no significant wear). RETIRE THE ROPE? NO

Pulled out strand. The user must look out for the cause (possibly some snagging on deck equipment).

- **The rope has suffered compression but there are no fused/melted fibers**. Try to flex the rope with a plastic hammer in order to decompress and restore the initial round shape. RETIRE THE ROPE? NO

Compression caused by bending of the rope. This can be a result of incorrect installation or critical angles during mooring operation.

- **Significant wear due to abrasive conditions**. Always protect this part of the rope when in contact with metal surfaces. RETIRE THE ROPE? NO

Using NIKA-Protector can prevent such damages and extend the service life of Siri® ropes

- **Extreme wear and/or reduced volume**. The percent of the volume decreased means greater decrease in line's strength.
  REPAIR THE ROPE (CUT AND RESPLICE if damage is local and if remaining length is sufficient for mooring operations) OR RETIRE
  (*RESPLICE: forming a new rope eye after cutting the undesired length of the rope. The term does not refer to an end for end splicing of two rope lengths as this is considered as knot.)

Extreme wear and reduced volume

- **The rope is contaminated by chemicals.**
  There may also be some fiber fusion or some fibers may have become brittle. Urgently consult the manufacturer and provide further information on the chemical substance nature.

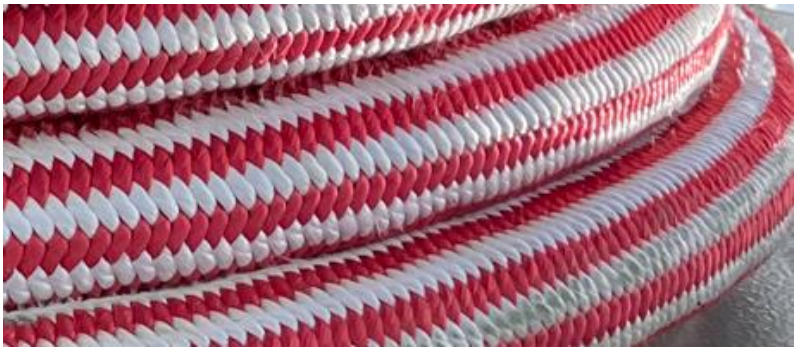
- **Avoid twisting of ropes because it affects their strength efficiency.**

Mooring rope suffering a large number of twists. When not in use, spread the twisted length on deck and remove the twisting.

Inspection for Covered ropes:

In case of a worn cover, the end user can perform local repair with Katradis Repair Kit (See below sections: Small repairs & Extensive repairs).
Below there are given several examples of various conditions of the rope cover, followed by further recommendations for the end user.

- **Excellent condition of the rope cover**



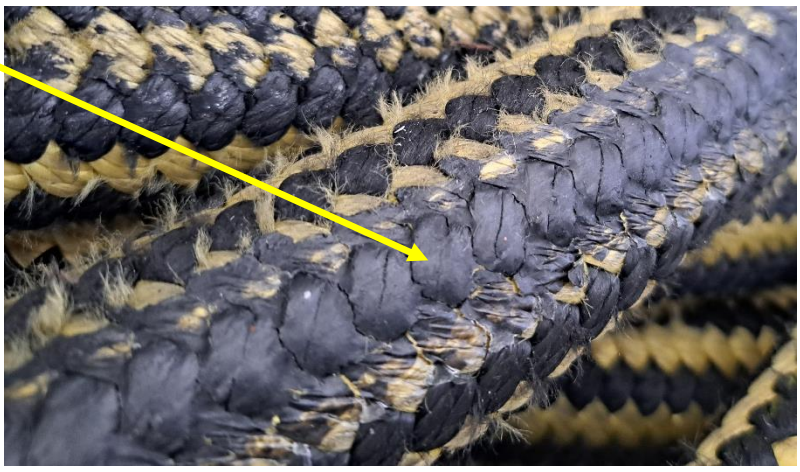
- **Abraded rope cover**

  The level of abrasion does not require immediate actions. Always protect the rope with the NIKA-Protector on the chocks.

- **Glazed/Melt cover fibers**

  Most probably the cover has been in contact with deck equipment (drums, chocks, bitts, etc.) under heavy abrasion conditions resulting in increase of temperature locally.

  Very often encountered when the rope is working with only few wraps on the tension drum.



Cover is locally torn off.
The rope breaking strength is not affected as long as the core rope is in good condition and free of damages. This is due to the fact that the jacket is non-load bearing and its main function is to protect the internal core from external abrasion.

Jacketed rope with external damage of the jacket.

The core remains in good condition resulting in no loss of breaking strength of the rope.

The rope is fit for further use after repairing of the jacket.

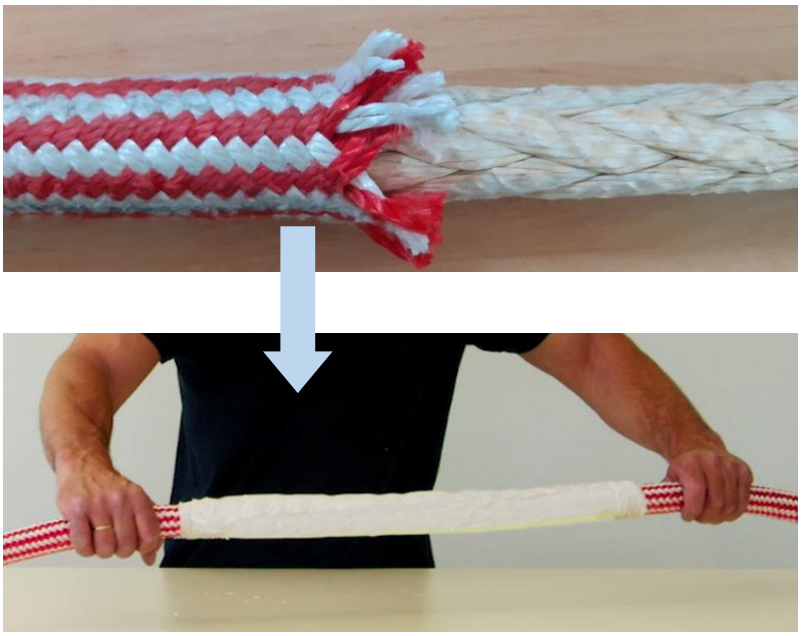
In case there is local damage of the jacket and the core is damaged as well, then the rope breaking strength is affected.

The core is highly abraded with melted fibers.

Recommended retirement or cut locally and resplice.

In case of a total jacket partition:

Bring the two jacket parted sides as close as possible and cover the exposed core using the Repair Kit (see below instructions: Extensive repairs).

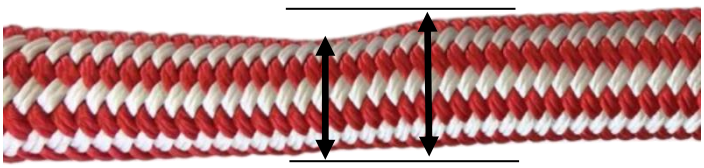


Broken internal strands

A broken internal strand can be recognized from significant diameter's reduction (more than 15%). Most likely the inside of the rope will become softer in the particular area.

BEST ACTION:

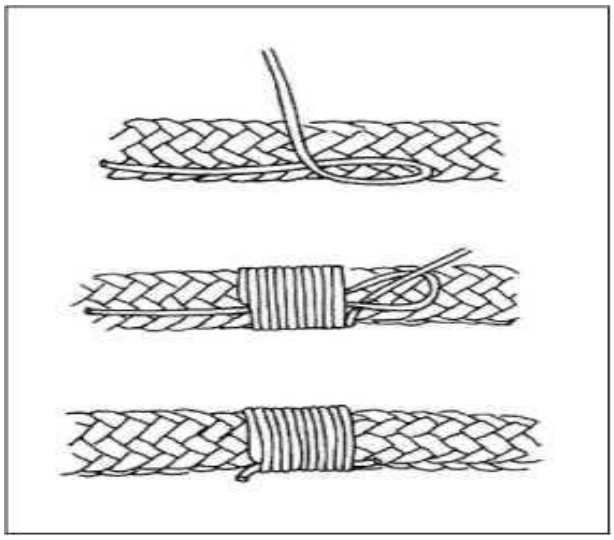
- REPAIR THE ROPE IF DAMAGE IS LOCAL (CUT AND RESPLICE, followed by TESTING FOR RESIDUAL STRENGTH) OR RETIRE.



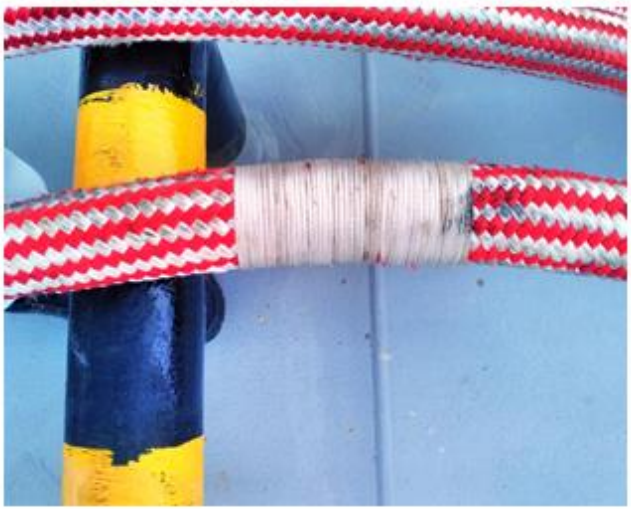
Small repairs

The most durable method to make small repairs on the jacket braid requires the use of whipping twine and polyurethane glue.

Remove all the damaged yarns and coat the free yarn ends with the glue, in order to prevent further unraveling of the cover. Start whipping at least three centimeters away from the damage, as shown in the drawing. Lay a loop of twine across the rope, leaving a free tail after the damage zone of about ten centimeters. This tail has to be grasped later, so avoid covering it completely with whipping. With the working end of the twine, make multiple wraps around the rope from the tail end toward the apex of the loop, covering the loop until the whipping is at least three centimeters beyond the damage.



To finish the whipping, insert the working end of the small twine through the loop. Pull on the very end or tail of the small twine until the loop slides completely out of sight. Clip the ends close to the whipping.



Small repair by whipping

Extensive repairs

For extensive repairs the following tools are needed: replacement cover, sewing twine and a large sewing needle.

A full set of such repairing tools can be obtained from the Repair Kit by KATRADIS SA.

Remove all the damaged yarns and inspect the rope. After inspection, coat the free yarn ends with the glue, in order to prevent further unraveling of the cover. Wrap the damaged part in the replacement cover.

Stitch the web together, with a special knot that will prevent the stitching yarn from loosening when it is torn.

Protect the beginning and the end of the replacement cover with whipping. Start whipping at least three centimeters away from the edge, as shown in the drawing. Lay a loop of twine across the rope, leaving a free tail after the damage zone of about 10cm. This tail has to be grasped later, so avoid covering it completely.

With the working end of the twine, make multiple wraps around the rope from the tail end toward the apex of the loop, covering the loop until the whipping is at least three centimeters beyond the damage.

To finish the whipping, insert the working end of the twine through the loop. Pull on the very end or tail of the twine until the loop slides completely out of sight.

Clip the ends close to the whipping.

Information regarding packaging and traceability

The ropes are packaged in Polyethylene heat shrinking film. On this, there is a glossy label where it is marked /stated:

a) Product name / type b) Weight of the coil c) Length of the coil d) Construction of the rope (e.g. 12Strands) e) production code number and f) Date of Production

The marking on the product, also involves **metal label** where the unique code number of the rope coil is marked permanently for traceability purposes. This marking is being carried out in a way that it is visible, legible and indelible. This unique product code number is the reference to the manufacturer's certificate.

Storage conditions

Store the ropes in a clean environment under mild and dry environmental conditions (avoid storage in high temperatures) and away from direct sunlight.

Store the ropes away from heat generating sources and acid (especially sulfuric acid) and alkaline environment. Good ventilation of the storage place is also preferable.

DISCLAIMER

Katradis Marine Ropes Industry S.A., to the best of its knowledge, makes reasonable efforts to include accurate and up-to-date information in this manual. However, it makes no warranties or representations, either express or implied, regarding the accuracy or completeness of the information provided. All material and information in this manual are presented "as is," without any warranties of any kind, including but not limited to warranties of merchantability, fitness for a particular purpose, commercial viability, title, or non-infringement.

Katradis Marine Ropes Industry S.A. and its affiliates accept no liability or responsibility for any errors or omissions within this manual's content. The user is responsible for the correct use, handling, maintenance, and regular inspection of Siri® ropes. Under no circumstances, and under no legal theory, shall Katradis Marine Ropes Industry S.A., its affiliates, suppliers, or any party involved in creating, producing, or delivering this manual's content be liable to users for any indirect, direct, special, incidental, or consequential damages arising from any cause whatsoever.

Visual Illustrations

The images of damages and deformations included in this manual are intended solely for illustrative purposes, serving as general guidelines to help users recognize common forms of wear, tear, and damage. Actual damages or deterioration in equipment may differ substantially in appearance, extent, and causation.

These images are not intended to be the sole basis for assessing the safety or condition of any equipment. For a thorough evaluation and recommendations regarding repair or replacement, users are advised to consult a qualified professional or contact Katradis Marine Ropes Industry S.A.

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