



KATRADIS MARINE ROPES INDUSTRY S.A.

USER'S MANUAL

SYNTHETIC MOORING TAILS

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Synthetic Mooring Tails

The use of mooring tails is highly recommended with low elongation lines, such as steel wire ropes and High Performance synthetic ropes (UHMWPE, Aramid and LCP) for the mooring of the tankers, LNG's & LPG's, but also for the Cruise ships & Bulk Carriers.

Synthetic tails provide the necessary elasticity and safety in the mooring system and therefore lower the peak loads on the main mooring line. This elasticity provides protection from surging and shock loading to the main mooring rope and deck equipment and safer operation especially in exposed mooring berths. Tails also provide long-term performance benefits and longer service life of the lines attached to them (reduction of the peak loads, wear mitigation).

Tails may be constructed from various materials of moderate to high elasticity, including Polyester, Polyester/Polyolefin composites or Nylon (Polyamide).

Tails should be properly matched to the mooring line to which they are attached. Tails of different lengths should be used depending on the location of the berth.



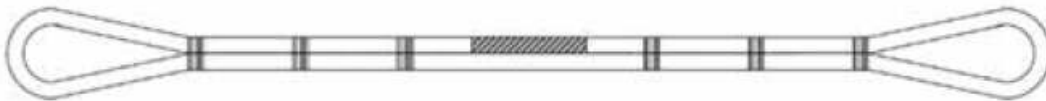
TAIL CONFIGURATIONS

Single-Leg



Standard single-leg tails have a 1.8 meter (6.0 foot) soft eye on one end and a 0.8 meter (3.0 foot) soft eye on the other end protected with special NIKA Eye Protectors. Terminations on either end and abrasion (chafe) protection on the body can be added on request. Splices must have at least 5 tucks each.

Grommet



Standard grommet tails (also called strops) have 1.8 – 2.0 meter (6.0 - 6.6 foot) and 0.8 – 1.0 meter (3.0 - 3.3 foot) soft eyes formed by lashings. Eyes are adequately protected with special NIKA Eye Protectors. The body of the grommet is lashed together 3 meters (9.8 feet) from each eye lashing. Grommet strength is 1.6x the single-leg rope strengths. Terminations, abrasion (chafe) protection on the body and/or additional seizing can be added on request.

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 twisting machines
- The stranding level includes the construction of the strands in special one-for-one stranding machines.
- The braiding of the rope is completed in the braiding level in Herzog's braiding machines
- Then, the rope coil is weighed and specimens are prepared for breaking load testing
- After all quality control tests have been satisfactorily finalized, we place the coil on a rotating base, unlay and measure the required length (for the slack on deck final length). Then the special NIKA-Eye Protectors are inserted for each eye splice section, the eye splice is formed (with minimum 5-tucks fabrication per splice). Then follows the marking and packaging to give a complete final product which is taken away for storage and/or transport.

Description of quality control arrangement

The product quality control involves the following quality control steps/procedures:

- Tenacity testing of the **yarns**.
- Yarn-To-Yarn abrasion test of the **yarns**
- UV resistance tests of the **yarns**
- Breaking strength testing of the rope yarns (**twisted yarns**)
- Breaking testing of rope specimens per batch order.



Table 1. Tail constituent yarns technical information

Property	Nylon	Polyester	NIKA-Steel®
Density	1,14 kg/dm ³	1,38 kg/dm ³	0,92 kg/dm ³
Tenacity	> 9gr/den	> 9gr/den	8gr/den
Elongation (at break)	25%-30%	18%	15%-18%
Melting point	218 °C	265 °C	165 °C
UV resistance	Excellent	Excellent	Excellent

MOORING TAIL TYPES

NIKA-Nylon tails are produced from 100% Polyamide fibers, UV stabilized, in standard 8-strand construction, while also 12/24 strand and double braided construction is also available upon request. Elongation at breaking load is approx. 30%.

- ⚠ **When wet, Nylon loses approx. 10% of its dry strength while other mechanical properties (such as abrasion resistance) are also affected. As per MEG4 requirements, all tails are tested in wet conditions and the declared strength (Tail Design Break Force) is also in wet conditions.**

NIKA-Flex tails are produced from Polyester & Nikasteel® (KATRADIS Polyolefin grade) combination of 50%-50% per weight, in standard 8-strand construction. Nikasteel® fibers are a special melt mixture of high quality European raw materials (Polypropylene, Polyethylene, UV stabilizer). When wet, NIKA-Flex tails retain their dry strength. Elongation at breaking load is approx. 18%.



NIKA-Nylon



NIKA-Flex

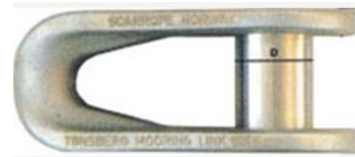
CONNECTION TO THE MOORING LINE

The connection of a primary mooring line 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, the connection should be 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





IMPORTANT: Ground/ dock personnel that handle the mooring tail must make sure that the tail-rope line has no induced twisting. If twists have been induced, care must be taken to straighten the assembly by rotating the tail until both parts (tail and primary mooring rope) are in a straight-line status with no twists. If twists are left on the assembly, the primary mooring line's strength will be reduced by as much as 7% per turn per meter.

“STANDARD” LENGTH

The standard recommended overall length for mooring tails is 11 meters. However, for exposed mooring berths a 22-meter tail provides additional elongation in the mooring arrangement and is considered as standard for such open berth moorings. However, specific projects may require even longer tails due to special conditions. Dedicated ships in these situations may be equipped specifically beyond the “standard” considered lengths.

REMARK: For the tails, the length supplied is measured as slack on deck and not under tension as per ISO 2307.

MINIMUM BREAKING LOAD REQUIREMENTS

According to OCIMF MEG4, the **Tail Design Break force (TDBF)** of the mooring tails must be at least **25%** greater (when wet) than the ship design Minimum Breaking Load of the mooring line.

(MBL_{SD}) Ship Design Minimum Breaking Load: The MBL of a new, dry mooring line for which a ship's mooring system is designed. The MBL_{SD} 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 MBL_{SD}**

(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. **TDBF = 125% - 130% of MBL_{SD}**

Determination of NORMAL / EXTREME Operating Conditions

Generally, mooring tails operate in various weather conditions, types of ports (sheltered or exposed – open sea), mooring arrangements and loading conditions. Such factors highly affect the service life of mooring lines and should be taken into consideration when evaluating their condition and performance.

Below, there is a table for determining the normal or extreme operating conditions.

NORMAL OPERATING CONDITIONS	Operating temperatures up to 50°C
	Mooring at sheltered port
	Low wind forces (1-4 beaufort)
	Typical mooring layout
	Absence of swell
EXTREME OPERATING CONDITIONS	Operating temperatures exceeding 50°C
	Mooring at exposed terminal
	Ship-to-Ship operations
	High wind forces (over 5 beaufort)
	Presence of swell
	SPM, CBM or Multi Buoy Mooring layout



Typical mooring at sheltered berth

MAINTENANCE, STORAGE & INSPECTION

After each use, please inspect the full length for signs of abrasion, cuts or for possible chemical contamination. Always wash with fresh water and let dry in order to remove any dirt or sea salt (that will act as “razors” and damage the fibers when dry).



Store the tails 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 acid (especially sulfuric acid) and alkaline environment. Good ventilation of the storage place is also preferable



CAUTION: Do not cover the tails if wet, especially the Nylon and do not leave them connected to the primary mooring line on the winch drum (they need free space for effective drying).

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



NO GREASE

RETIREMENT & RESIDUAL STRENGTH

According to OCIMF MEG4 guidelines, it is recommended to retire mooring tails that exhibit residual strength reduction to 75% of the ship design MBL. Discard / retirement criteria are described in Annex A.

For estimating the condition of a mooring tail please consult the following images:



Mooring Tail
New – Unused.
 For spare tails please check the storage conditions



Used Mooring Tail in good condition.
 No significant abrasion signs



Used Mooring Tail with obvious signs of external abrasion.
 Check for internal condition.
 Need for maintenance (removal of dirt and sea salt) and appropriate storage conditions.



Used Mooring Tail suffering extreme level of abrasion and wear.
 Best action: Replace and check for residual strength.

Safety issues

The underlying factors



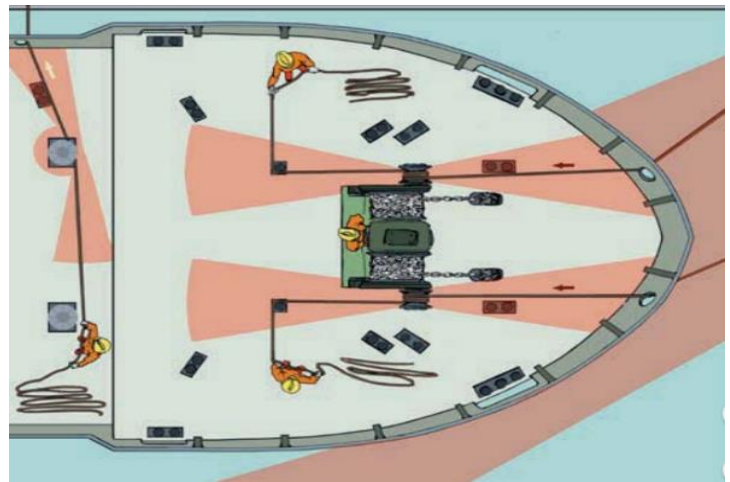
▲ STAY AWAY from the snap back area, as indicatively shown in the drawing below, when the line is under tension.

NOTE: 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.

High Modulus ropes have a much-reduced snap back reaction, limited and almost negligible, however, it is good for the personnel to get acquainted with the behaviour of the synthetic ropes, especially after having worked many years with wire ropes (that also have no snapback reaction).



It is impossible to work the lines without the crew standing in such a large and high-risk snap-back area.



The crew can work the lines without standing in high-risk snap-back zone.

▲ 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.

ANNEX A – DISCARD / RETIREMENT CRITERIA

CONDITION	Repair (if localized)	Retire
-Rope suspected of being shock loaded		X
-Exposure to excess temperature as specified for type of fibre		X
-Burns or melting visible for a length of over four rope diameters	X	X
-Rust (might indicate chemical damage)	X	X
-Oil and grease	Wash in mild detergent	
-Heavy surface fuzz-progressive	X	X
	Remove source of abrasion	
-UV degradation, splinters on yarn surface		X
For braided cover and core ropes		
-Multiple cut yarns of filaments within distance of one pitch length	X	X
-Strand cut to 5% of diameter within one lay length	X	X
-Hockle or backturn	X	X
-10% abrasion of one strand within one lay length	X	X
<u>Thermal damage</u>		
-Hard, melted, flattened areas of the rope which can indicate serious damage to the rope		X

Information regarding packaging and traceability

The marking on the tails consists of **metal labels (2 metal labels per tail)** where the unique code number of 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.



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