ROPENET

# USER'S MANUAL

## Synthetic Mooring Lines

In accordance to
OCIMF MEG4 Guidelines

CAUTION

# THE IMPROPER USE OF MOORING LINES MAY BE DANGEROUS

Mooring Lines WILL FAIL if worn-out, overloaded, misused, damaged or improperly maintained or abused. Mooring Ropes failure may cause death, serious injury or property damage.

## HOW TO ENSURE YOUR SAFETY

- ALWAYS INSPECT mooring line for WEAR, DAMAGE or ABUSE.
- NEVER USE mooring lines that are WORN-OUT, DAMAGED or ABUSED.
- Mooring lines are used for a variety of applications.
- To minimize the risks associated with product misuse, obtain the appropriate training for the specific application before using the mooring line.
- Use the right size and type of rope for the intended application.
- Never stand in line with or in the general path of the rope under tension to avoid the risk of injury caused by recoil.
- Avoid mooring rope contact with abrasive surfaces.
- Do not overload mooring rope, shock load mooring rope or bend mooring rope over sharp corners.
- Check temperature rating of mooring line product before using rope in hot environment.
- If in doubt about the condition of the mooring line, discard it.

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# Foreword

## Mooring Equipment Guidelines (MEG4)

The MEG4 publication aims to help ship designers, terminal designers, ship operators and mooring line manufacturers improve the design, performance and safety of mooring systems.

Compared with MEG3, MEG4 is the new safety guideline that intends to develop a more robust framework for mooring line design, selection, operation and ultimately safe rope retirement. Amongst others, it defines the whole process for purchasing and testing mooring lines and tails.

Although standards, guidelines and recommendations have already been available for mooring systems, incidents that harmed ship and terminal personnel have occurred nevertheless during mooring.

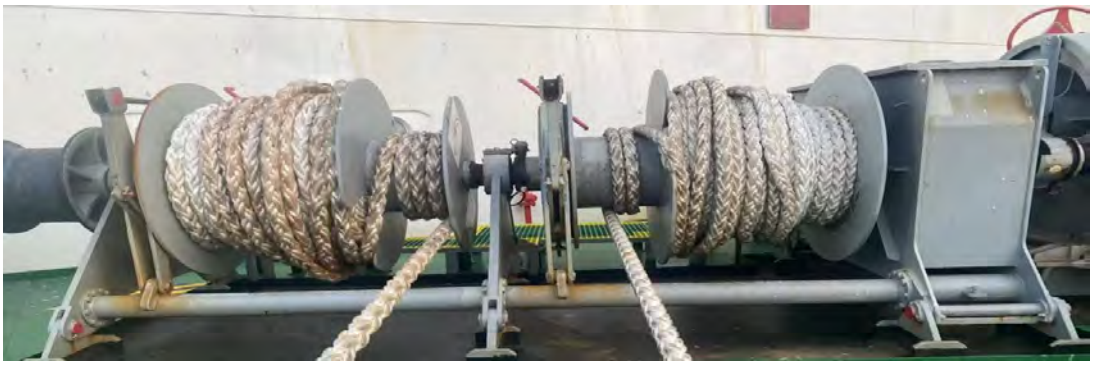
*"Our investigation revealed widespread misunderstanding over the properties, use and maintenance of specific types of line."*

Steve Clinch MNM, Chief Inspector of Marine Accidents

A more human-centered design, equipment selection, inspection and maintenance of mooring lines is necessary to ensure safer operations. Thus, the fourth edition of the Mooring Equipment Guidelines (MEG4) came to establish the best known mooring technology and practices till today.

The guidelines provide mooring rope manufacturers and users with the following:

- Process for purchasing and testing mooring lines and tails.
- Records of mooring hours.
- Line inspection records and plans.
- Manufacturer and operator retirement criteria.
- New testing / Inspection reports use new terminology and definitions.
- Manufacturer's recommendations following tests or inspections.



## NEW SOLAS REQUIREMENTS FOR SAFE MOORING

The new guidelines MSC.1/Circ.1620 outline requirements for the inspection and maintenance of mooring equipment, including lines. These guidelines will be retroactive, meaning they will apply to existing vessels as well as new ones.
Paragraph 9 of the amended SOLAS Regulation II-1/3-8 references the MSC.1/Circ.1620 guidelines for the inspection and maintenance of mooring equipment, including lines. This regulation applies to all ships in service from 1 January 2024 onwards.
MSC.1/Circ.1620 specifies recommendations and guidance for maintenance and in-service inspections of mooring equipment (including lines and tails), criteria for identifying worn-out lines and tails for removal from service before failure, and criteria for selection of replacement mooring lines and tails etc. It is expected that all SOLAS ships from 1 January 2024 shall have documented maintenance plans, procedures and records for mooring operations, inspection and maintenance of mooring equipment (including mooring lines) as per the guidance provided in the circular MSC.1/Circ.1620.

# Company Profile

ROPENET is a leading manufacturer and solution provider of synthetic mooring, towing, lifting ropes for Shipping, Offshore, Oil and Gas, Lifting and Industrial applications.

Driven by a spirit of innovation, we offer optimal solutions for customers facing challenging situations. Our commitment to the highest standards of product performance, service quality, sustainability, and innovation guides all our actions.

Every rope is manufactured in compliance with OCIMF recommendations and ISO standards. To bolster our operations, we've built a strategic global network at major key ports, such as Singapore, Dubai, Rotterdam, Houston, Brisbane, Panama, and the primary ports in China. This, coupled with our technical expertise, robust inventory, and unwavering commitment to service, allows ROPENET to deliver optimized value and cultivate enduring relationships with our customers.

# Our Credentials

## ***Members***

Member of IMPA

Member of CI

Member of WSTDA

Member of CINTA

## ***Certificates***

ISO 9001:2015

ISO 14001:2015

ISO 45001:2018

LLOYD'S TYPE OF APPROVAL FOR UHMWPE FIBRE ROPES

LLOYD'S TYPE OF APPROVAL FOR MIXED FIBRE ROPES

LLOYD'S TYPE OF APPROVAL FOR NYLON FIBRE ROPES

LLOYD'S TYPE OF APPROVAL FOR POLYESTER FIBRE ROPES

LLOYD'S TYPE OF APPROVAL FOR MIXED POLYOLEFIN ROPES

ABS'S TYPE OF APPROVAL FOR UHMWPE FIBER ROPES

ABS'S TYPE OF APPROVAL FOR MIXED FIBRE ROPES

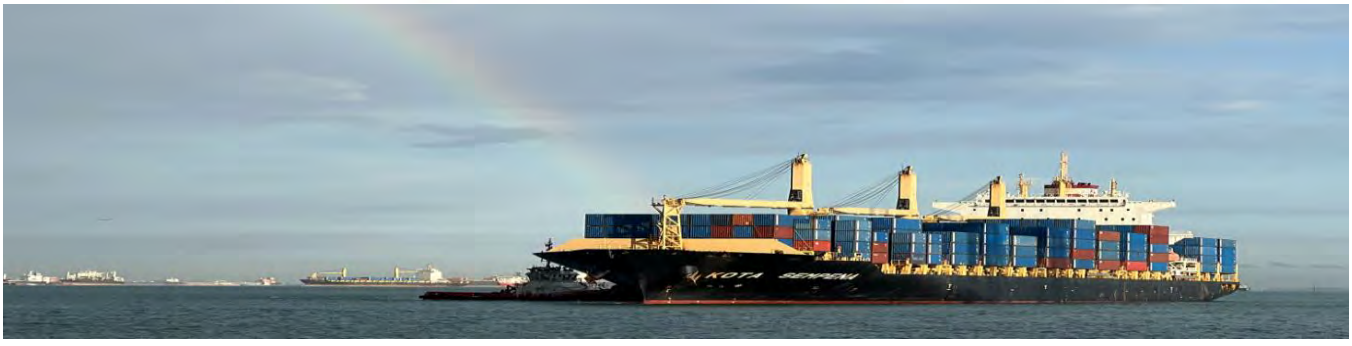
ABS'S TYPE OF APPROVAL FOR NYLON FIBRE ROPES

ABS'S TYPE OF APPROVAL FOR POLYESTER FIBRE ROPES

ABS'S TYPE OF APPROVAL FOR MIXEDPOLYOLEFINROPES

CCS'S CERTIFICATE OF WORKS APPROVAL

NK'S APPROVAL OF MANUFACTURING PROCESS OF SYNTHETIC FIBRE ROPES



# Objective

The objective of the Mooring Line Maintenance Manual is to provide comprehensive guidance and procedures for inspecting, maintaining, and caring for mooring lines used in maritime operations. This manual aims to ensure the safe and effective use of these lines.

# Definitions

**Bend radius (D/d ratio)** means the diameter, D, of a mooring fitting divided by the diameter, d, of a mooring line that is led around or through the fitting. The D/d ratio is used by mooring line manufacturers to specify the minimum radius of a fitting around or through which a mooring line of diameter "d" should be led, in order to reduce or mitigate bend loss of strength of the mooring line.

**Line Design Break Force (LDBF)** means the minimum force that a new, dry, spliced, mooring line will break at. This is for all synthetic cordage materials.

**Mooring arrangement** means the configuration of the mooring equipment and fittings and other design features of the ship related to the mooring operation, i.e. lighting and communication equipment.

**Mooring equipment and fittings** means items such as winches, capstans, bollards, bitts, fairleads, rollers, chocks, etc. and also includes mooring lines.

**Mooring line configuration** means all components of an individual mooring line, including tails, eye splices, etc. Any change or replacement of a component is a change to the line's configuration, unless a component is replaced by a part having the same specification as in the original configuration.

**Mooring operations** means normal mooring and unmooring of the ship, including associated in-harbour towing movements.

**Mooring personnel** means personnel tasked to assist in the activity of mooring and unmooring ships, either ashore or from mooring boats, carried out within the framework of port marine services.

**Rotation of mooring lines** means periodical change of mooring lines for respective mooring drums to equalize the wear of mooring lines.

**Ship Design Minimum Breaking Load (MBLSD)** means the minimum breaking load of new, dry, mooring lines for which shipboard fittings and supporting hull structures are designed in order to meet mooring restraint requirements.

**Tail Design Break Force (TDBF)** The TDBF needs to be higher thanthe LDBF because tails experience more wear in service than lines. The TDBF of tails should be 125-130% of ship design MBL. TDBF is tested and defined in wet condition (see testing guidance outlined in appendix B of MEG4) and accounts for any material strength loss when wet.

The relationship between SWL, WLL and ship design MBL of loose and permanent equipment is explored in figure as below,

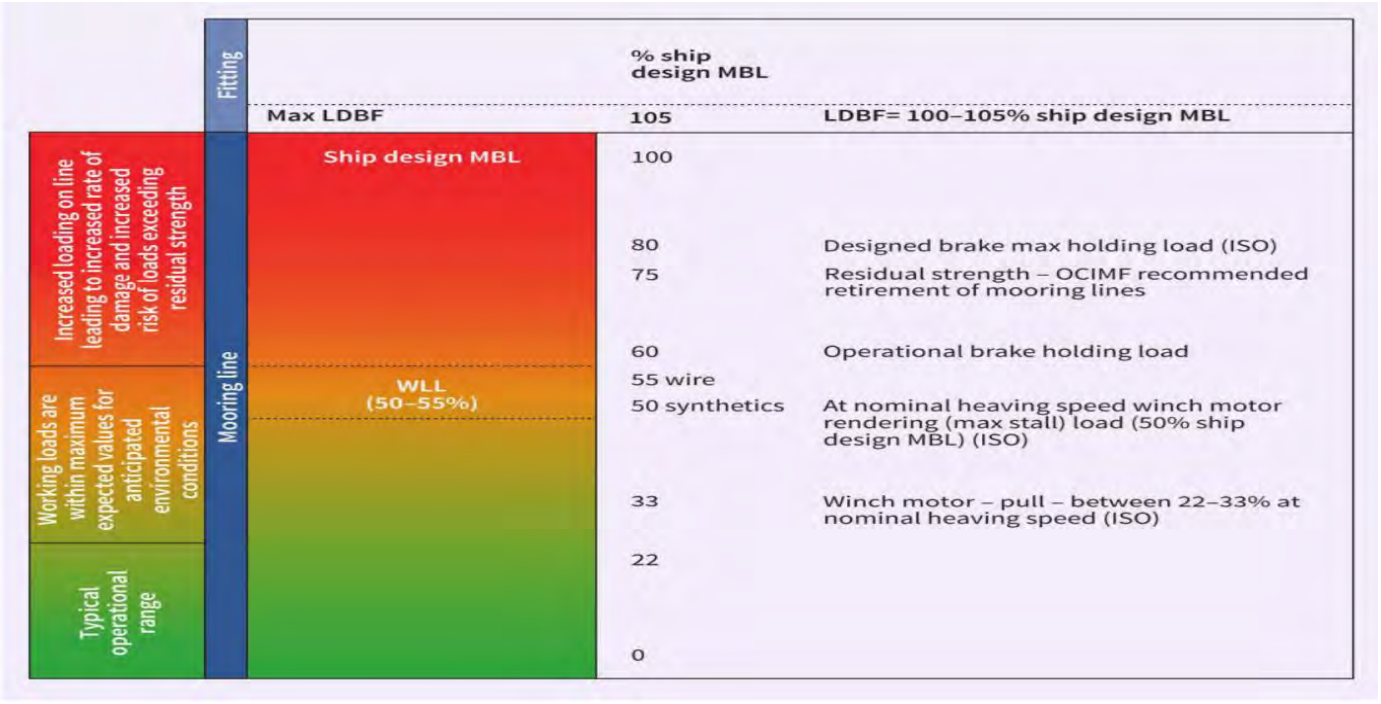



***Figure:*** *Illustration of operational and limiting values for mooring lines*

# 1. GENERAL

## *1.1 Mooring Lines Introduction*

Mooring lines used to secure a vessel to a dock or to vessels. Mooring ropes play a critical role in keeping a vessel safely secured to a dock or another vessel, preventing damage to both the vessel and its surroundings. As an integral component of mooring system, it is one of the most important and frequently undertaken activities on board any ship. The manual will help stakeholders understand their intended lifecycle and create a more robust framework for how mooring lines are selected, cared for and replaced. The full lifecycle of each mooring line should be recorded in a Line Management Plan (LMP) that is maintained by the ship operator and should be passed to any future operator of the ship. The manual is focus on Synthetic Mooring Lines - manufactured by ROPENET, used in mooring operations and provide information and guidance regarding the proper usage, installation, safety issues, inspection & discard criteria.

## *1.2 Types of Mooring Lines*

Synthetic mooring ropes encompass a broad range of materials and constructions, generally categorized as Nylon, Polyester, Polypropylene, Mixed Polyolefin/Polyester, UHMWPE, and Aramid.

**Nylon Ropes**

DURA-PA™ ropes are predominantly used in the shipping industry due to their elasticity and shock load-absorbing properties. These ropes are primarily employed as mooring tails but can also serve as main mooring lines. The nonfloating ropes tend to lose approximately 15% of their breaking strength when wet; however, this effect is reversed once they are dried.

**Polyester Ropes**

DURA-PES™ ropes are renowned for their strength, durability, and resistance to abrasion, UV rays, and water absorption. They exhibit less stretch compared to nylon ropes and are less susceptible to mildew, making them a preferred choice for long-term mooring applications.

**Polypropylene Ropes**

DURA-PP™ ropes are lightweight and inexpensive, making them a popular choice for short-term mooring applications. However, these ropes have low strength and elasticity and are prone to UV damage and water absorption, making them unsuitable for long-term use.

**Polyolefin Ropes (Mixed of Polypropylene/Polyethylene)**

TOUGH-HS™ ropes are high-tenacity ropes that are ideal for a wide range of applications. They offer superior temperature stability, as well as excellent strength and toughness.

**Mixed Polyolefin/Polyester Ropes**

TOUGH-MIX PLUS™ ropes are made from a reinforced composition of high-tenacity polyester and mixed polyolefin, resulting in superior breaking strength. The technically designed construction provides higher tensile strength, greater flexibility, and better abrasion resistance than normal composite ropes. It maintains stability, safety, and higher residual tensile strength after repeated mooring operations.

**UHMWPE Ropes**

HOPEX™ ropes are manufactured using ultra-high molecular weight polyethylene fiber and advanced technology, resulting in a product that is high-strength, lightweight, and has low elongation. Due to its woven construction, rather than being twisted, it does not rotate when loaded.

**Aramid Ropes**

DURA-AR PLUS™ ropes are made from aramid fibers, a class of strong, heat-resistant synthetic fibers. These ropes offer high strength, durability, and heat resistance. However, they are susceptible to axial compression fatigue, which occurs when tightly constrained fibers are forced into axial compression.

All the above rope types can be manufactured in 3/8/12/24/32/64-strand construction.

## 1.3 Mooring Rope Lifecycle

The lifecycle of a mooring line includes four phases, Design phase, Select phase, Operate phase, as shown in figure 1.1.

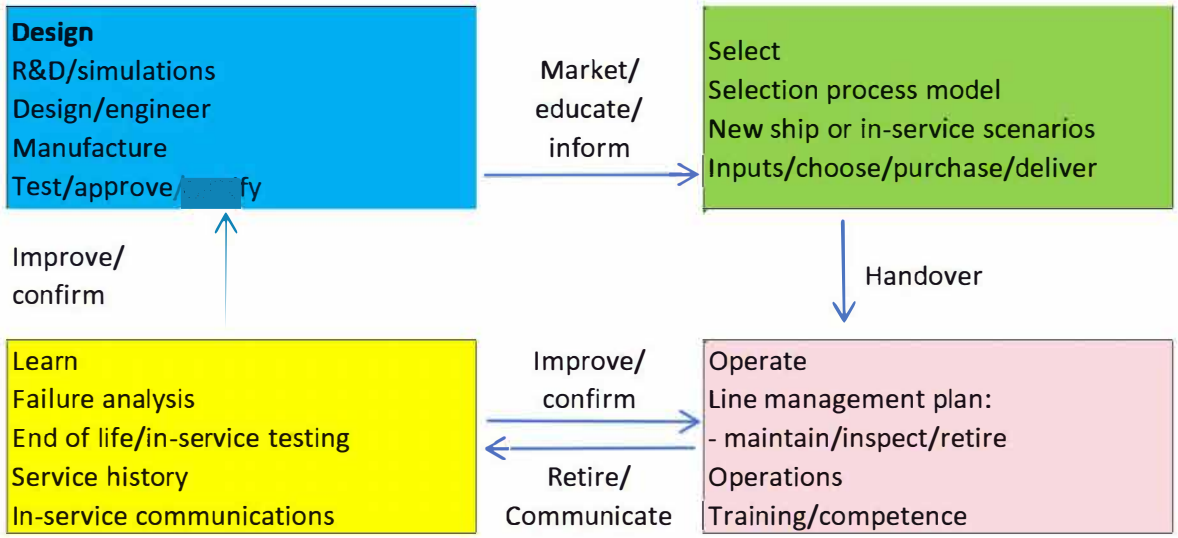



***Figure 1.1**: Mooring line lifecycle*

## 1.4 Mooring Ropes Identification

The lines are defined as follows:

- Breast Lines
  - Used to hold the vessel alongside the quay wall.
- Head and Stern Lines
  - Used to hold the vessel alongside and control its longitude position.
- Springs
  - Usually the first lines sent ashore and the last 'let go'.
  - They prevent the vessel ranging' (moving ahead and astern along the quay wall)

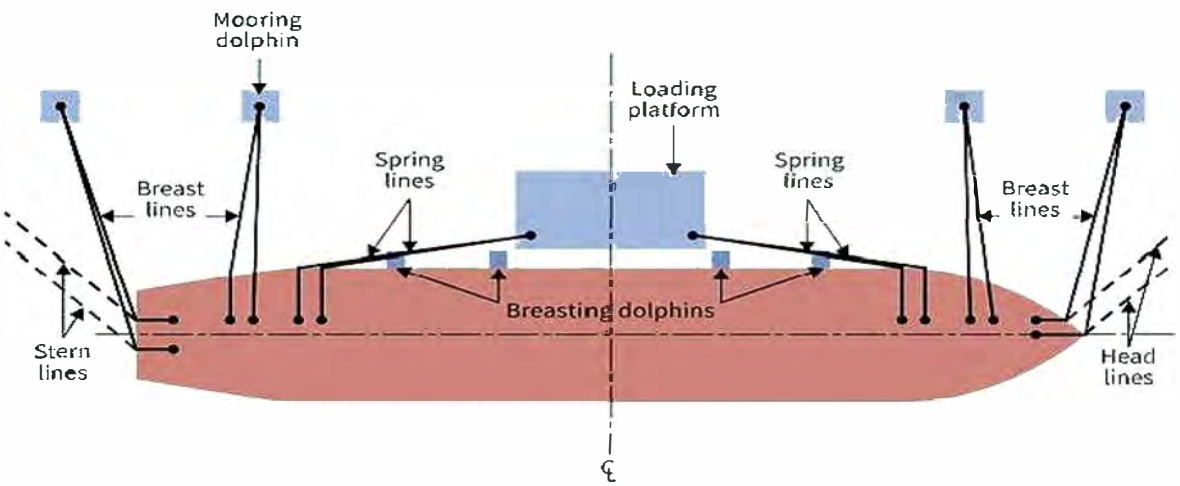



***Figure 1.2**: A typical mooring pattern at a conventional tanker terminal*

## *1.5 General Mooring Guidelines*

Moored Ship may be exposed to strong winds or current from any direction, as such the following guidelines should be considered when planning mooring line arrangement.

Mooring lines should be arranged as symmetrically as possible to ensure good distribution of load.

- The vertical angle of mooring lines should kept as minimum as possible.
- Mooring lines of the same size and material should be used for all leads. If this is not possible, all lines in the same service should be the same size and material.
- All lines in same service should be about the same length between ship and shore bollard.
- Mooring lines should lead from winch drums directly to shipside fairlead. If pedestal roller cannot be avoided the change of angle should be minimum and snap back zones must be considered.
- Allow minimum distance between bollards and fair leads for the use of rope stopper.
- Consider fleet angle of winches for mooring line arrangement, it should not exceed 15degree.
- It is recommended that all mooring line should be deployed from winch drums.

## *1.6 Factors to Consider When Selection*

A ship should be provided with mooring ropes appropriate for its type and size. Also be provided with mooring ropes appropriate for the equipment and fittings installed on board.

When selecting mooring ropes for marine applications, several factors should be considered to ensure the ropes are suitable for the specific requirements of the vessel and the mooring conditions.

### 1.6.1 Strength

Usually, strength requirements are already established during the line type selection process at the ship design stage. However, it was found that ship owners, operator prefer to select higher breaking strength lines during replacement. This might not be in line with the other components of the mooring systems and create a unsafe mooring environment.

The Line Design Break Force (LDBF) should be 100% to 105% of the MBLSD.

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

### 1.6.2 Stiffness

The stiffness of a mooring line is a measure of its ability to stretch under load.See table below for the load extension characteristics for different type of mooring lines. Nylon, polyester, polypropylene have lower stiffness for the same load compared to wire ropes and HMSF rope.

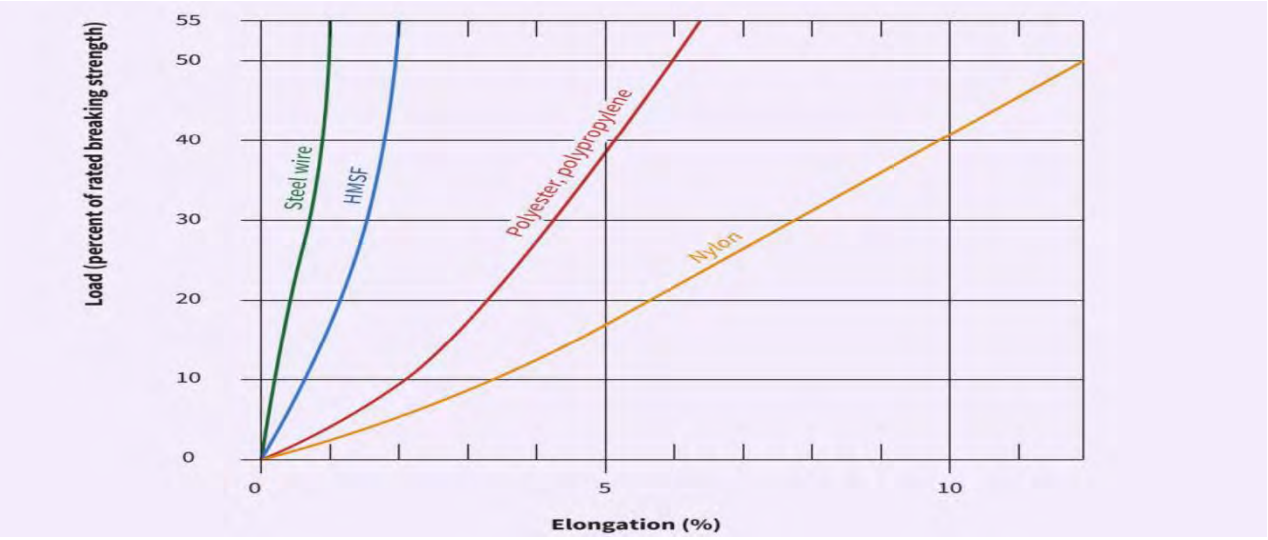



***Figure 1.3**: Typical load/extension stiffness characteristics of wire and synthetic fibre lines up to 50% of LDBF and 55% LDBF for steel wire ropes*

### 1.6.3 D/d Impact On Line Performance

The D/d ratio is the diameter of the bend divided by the diameter of the mooring line. Any bending of the line will immediately reduce the breaking strength. Repeated bending will reduce the service length of the mooring rope

The D/d ratio should be as large as possible to maximize the mooring line strength and working life.

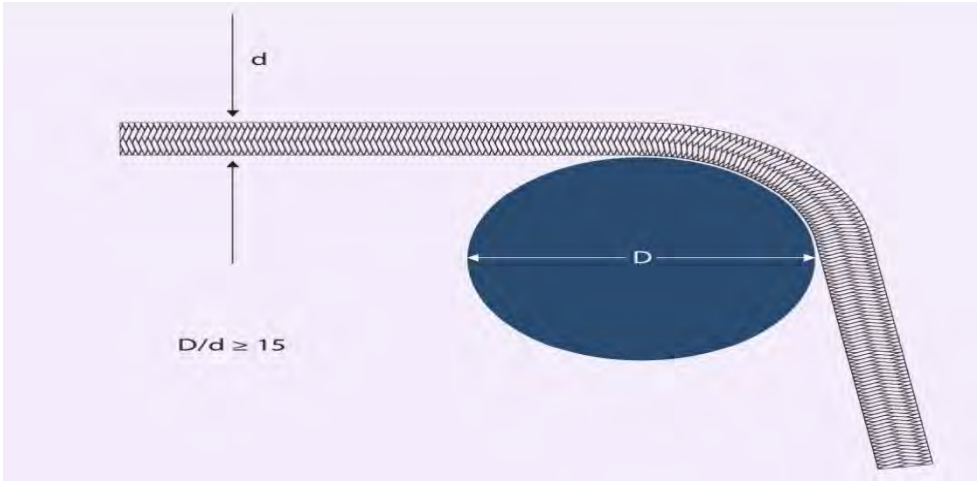



***Figure 1.4**: D/d ratio of mooring line to deck equipment*

The figure below provides estimated instantaneous strength loss for HMSF ropes and wire ropes. Other fibre ropes such as nylon, polyester, polypropylene and mixed ropes are general larger in diameter. This should be indicated by the manufacturer in the angled break force and endurance testing results on the certificates.

Larger D/d requirements may pose physical constraints, as such we should practice more conservative retirement criteria for the lines, if the D/d ratio cannot be achieved.

Existing ships may have deck equipment that results in a lower D/d ration than is optimal. This may be address by either replacing fittings or adjusting maintenance activities to account for the shorter service life.

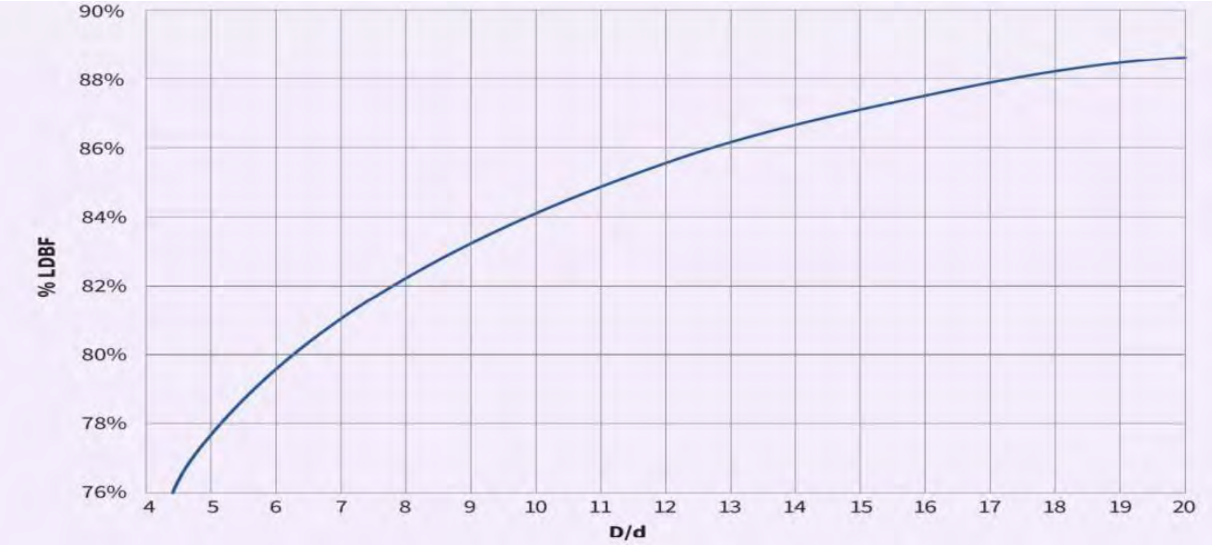



***Figure 1.5***: *Instantaneous bend loss estimation for HMSF lines and steel wire ropes*

### 1.6.4 Line Type selection

The type of lines chosen can affect the design and specification of other deck equipment and vice-versa. It is recommended that the line selection is integrated to the mooring equipment specifications. Below is an overview process of line selections,

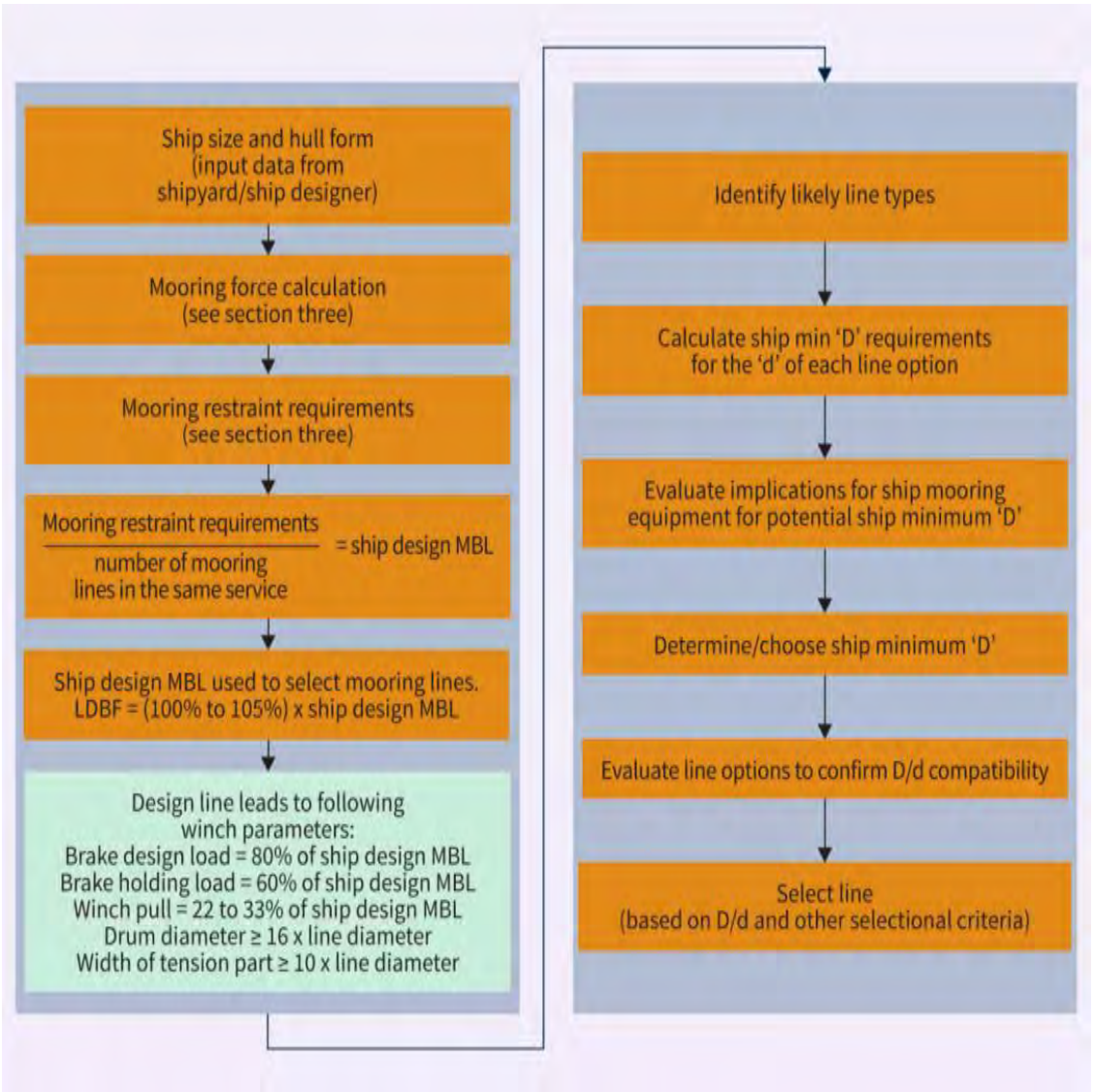



***Figure 1.6***: *New build line selection flow diagram*

During a ship's operational life, there will be times when lines are replaced or line type is change. It is important to consider the mooring system design specification to make sure that the line selected is compatible with mooring equipment.

The below gives a detailed outline of the line selection process.

The purchaser should provide the line supplier with general information about the propose application and intended service of the line such as below:

- Ship type/size
- Winch Design and arrangements
- Information of mooring fittings
- Berthing info and environment

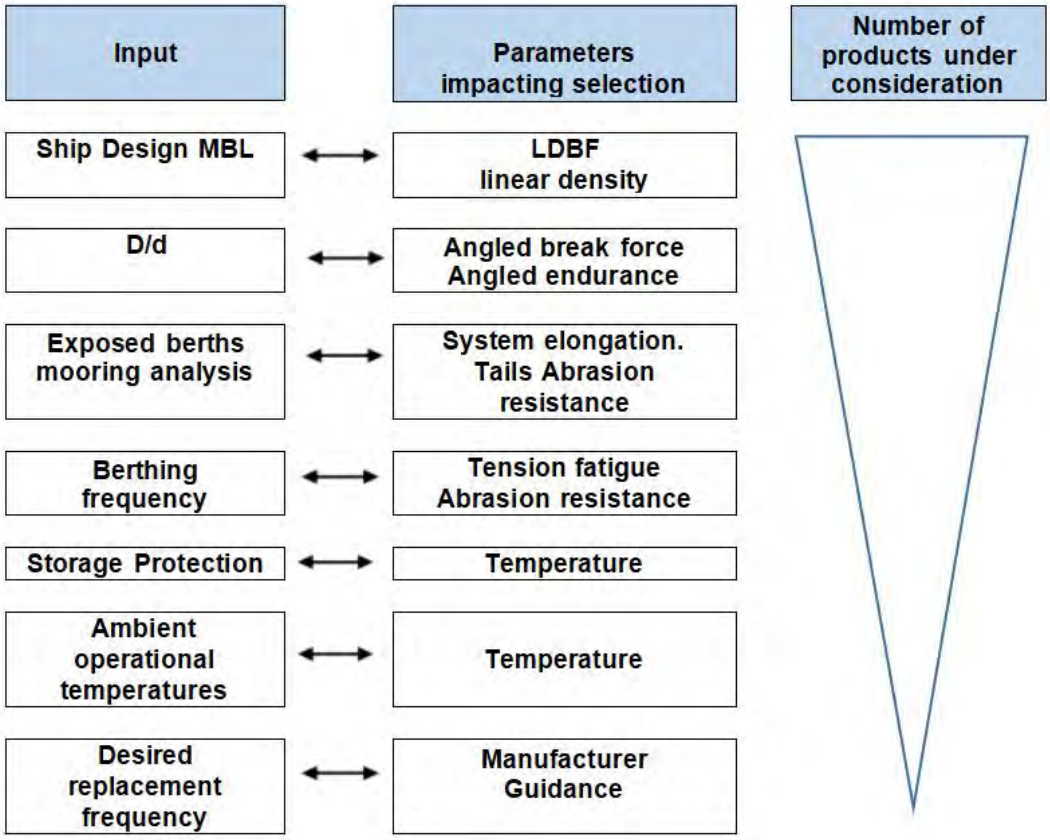



***Figure 1.7**: Mooring line selection funnel*

## MATERIAL PROPERTY

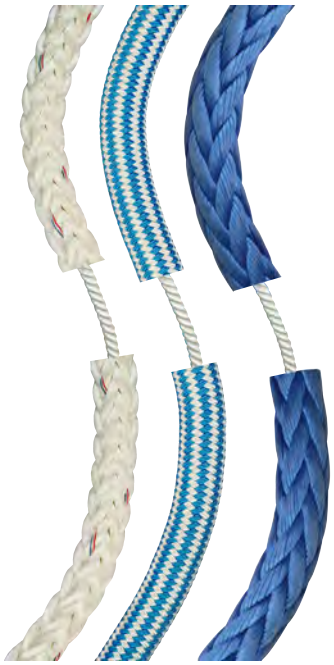
| MATERIAL ADVICES | | | | |
|---|---|---|---|---|
| **FIBRES** | **UHMWPE** | **LCP** | **ARAMID** | **PBO** |
| Brands | Dyneema® Spectra Ralon™ | Vectran® | Technora® Kevlar® | Zylon® |
| Tenacity in g/dan | 30-38 | 22-25 | 20-25 | 37 |
| Elongation at Break | 3.80% | 3.30% | 3.40% | 2.80% |
| Specific Gravity in g/cm² | 0.97 | 1.4 | 1.45 | 1.52 |
| Melting Point in ℃ | 140℃ | 330℃ | Carbonisation at 500℃ | Carbonisation at 650℃ |
| Resistance to short-term heat in ℃ | 70℃ | 200℃ | 450℃ | 500℃ |
| UV-Resistance | excellent | limited | limited | limited |
| Resistance to Abrasion | very good | good | good | good |
| Resistance to Alkalis | excellent | excellent | predominantly good | excellent |
| Resistance to Acids | excellent | excellent | predominantly good | good |
| Resistance to Petroleum Based Products | excellent | excellent | excellent | excellent |
| Creep | creeps at high loads | immeasurable | hardly measurable | immeasurable |
| Knot Strength | 30-50% | 30-50% | 30-40% | 35-55% |

| MATERIAL ADVICES | | | |
|---|---|---|---|
| **FIBRES** | **POLYESTER** | **POLYAMID** | **PP** |
| Brands | | | XPM |
| Tenacity in g/dan | 8-9 | 7-8 | 6-7 |
| Elongation at Break | 10-18% | 14-28% | 13-19% |
| Specific Gravity in g/cm² | 1.38 | 1.14 | 0.91 |
| Melting Point in ℃ | 265℃ | 220℃ | 165℃ |
| Resistance to short-term heat in ℃ | 170℃ | 130℃ | 80℃ |
| UV-Resistance | excellent | good | sufficient |
| Resistance to Abrasion | excellent | excellent | sufficient |
| Resistance to Alkalis | good at room temp. | good at low conc | excellent to most |
| Resistance to Acids | predominantly good | predominantly good | excellent |
| Resistance to Petroleum Based Products | excellent | good | excellent |
| Creep | hardly measurable | slight creep under load | creeps at high loads |
| Knot Strength | 50-60% | 60-65% | 55-65% |

### 1.6.5 The hazard of snap-back

Snap-back (also known as recoil) is the tendency of the broken ends of a tensioned line to draw back rapidly after a line breaks. As a line comes under tension, it is stretched and stores energy. Snap-back is the result of the sudden release of that energy.

Measures to manage the risk of snap-back include:



- Provide safe access to winch controls
- Position supervisors and ship and shore personnel with unobstructed views of the operation
- Provide operating and personnel management procedures
- Provide adequate line of sight to the whole mooring deck workspace
- Use lines with the most direct leads possible from winch to shipside fairlead
- Minimize lines that traverse the deck area
- Minimize the use of pedestal rollers
- Avoid sharp angled leads
- Use personnel trained in mooring operations
- Brief personnel on the planned mooring operation, including the layout, winches and lines to be used, and hazards including snap-back

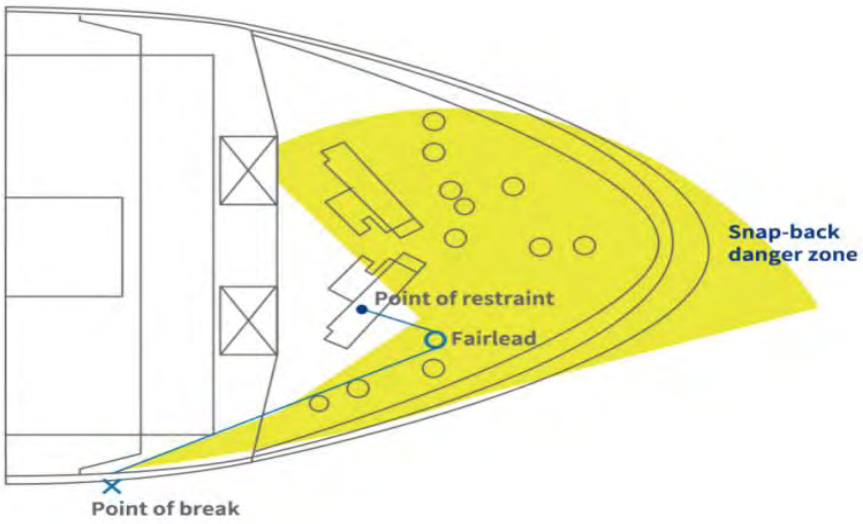



***Figure 1.8:*** *Snap back zone as yellow marking.*

# 2. 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.

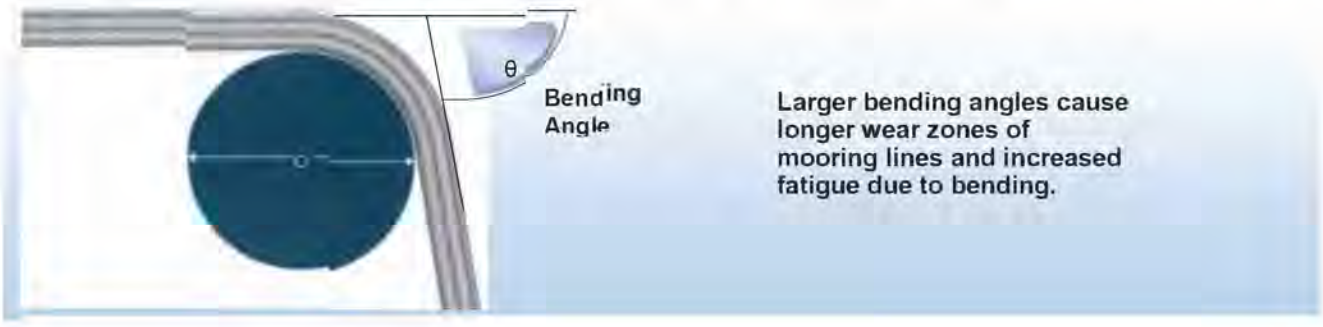
- As the ship nears the port the mooring winches are tried out, the breaks are tested, the mooring ropes are checked and positioned.
- Mooring lines must be as symmetrical as possible about the midship line of the vessel.
- Two or more lines leading in the same direction should always be of the same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

## 2.1 Minimum safety usage factors

The maximum Working Load Limit (WLL) of synthetic mooring lines must not exceed 50% of the ship design MBL (MBLsd).
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 bend, d: diameter of mooring line) should be as large as possible to maximize mooring line strength and working life.


***Figure 2.1**: The diameter D of bitts, pedestal fairleads, etc. that meet mooring lines should beat least 15 times larger than the diameter of the line.*

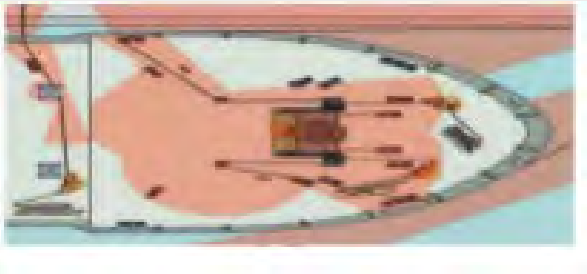
Mooring line arrangements often require redirection from winches and bending of lines around pedestal rollers. Users should keep in mind that high bending angles can cause compression of the inside strands and yarns and also extensive wear when the line is under loading and unloading conditions.



## 2.2 Safety issues

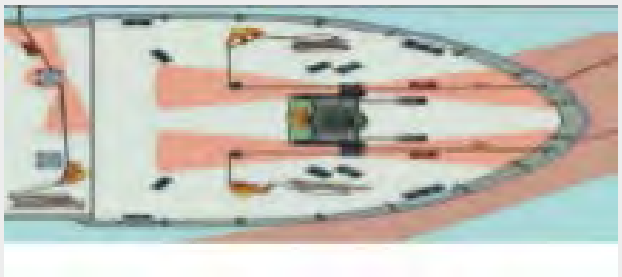
- ALWAYS CONSIDER the high risk areas regarding snap-back effect of mooring ropes, as indicatively shown in the drawing below, when the line is under tension.verely affect the performance of the lines.

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.



**YES**

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



***NO***

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.

- **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.
- **Directing** more than one mooring line through fairleads, chocks etc. is a bad mooring practice because of local compression and abrasion, which can severely affect the performance of the lines.

Mooring lines that come in contact with each other create high-risk working conditions.

***NO***

- **All mooring lines** must be equally tensioned, otherwise the most tensioned line will be exposed to overloading.

Mooring lines that come in contact with each other create high-risk working conditions.

*NO*

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

*NO*

*YES*

- **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.

*NO*

*NO*

*YES*

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

## 2.3 ***Emergency Response***

Mooring line emergency refers to an unexpected or urgent situation that occurs during mooring operations, including rope breakage、severe weather、 equipment failure、personnel injuries and other situations.
The Manual's Emergency Response section includes detailed procedures for handling emergencies related to mooring lines.

- Immediate Actions: Instructions for immediate actions to be taken in case of emergencies, such as stopping operations, securing the area, and ensuring the safety of personnel.
- Notification: Procedures for notifying relevant personnel, including emergency services and management, about the emergency.
- Emergency Equipment: Information on the location and proper use of emergency equipment, such as fire extinguishers, life jackets, and emergency communication devices.
- Evacuation Plans: Plans for evacuating personnel from the mooring area in case of emergencies, including designated assembly points and evacuation routes.
- Emergency Communication: Protocols for maintaining communication during emergencies, including establishing a communication center and using emergency communication channels.
- Response Teams: Identification of personnel responsible for responding to emergencies and their roles and responsibilities.
- Emergency Procedures: Step-by-step instructions for responding to specific emergencies, such as rope breakage, fire, or personnel injuries.
- Post-Emergency Actions: Guidelines for conducting post-emergency assessments, reporting, and documentation.
- Training Requirements: Recommendations for training personnel on emergency response procedures and conducting regular drills.
- Review and Improvement: Procedures for reviewing emergency response actions and implementing improvements based on lessons learned from previous emergencies.

These guidelines are crucial for ensuring the safety of personnel and minimizing damage to property during emergencies involving mooring ropes.

# 3. MAINTENANCE

Maintaining mooring ropes is essential for their longevity and ensuring they remain safe and effective. Below is an example overview of the type of information that could be included in the LMP for maintenance.

| | Activity | Information to be Included | Supporting Documents |
|---|---|---|---|
| Maintenance | Line installation | •Methodology.<br>•Tools required<br>•Equipment | •Line manufacturer's splice guidelines.<br>•Winch manufacturer's guidelines (where applicable).<br>•SMS |
| | Storage | Duration,including:<br>•Impact on lines over prolonged storage times<br>•Effective use of labels for tracking lines and traceability | •Line manufacturer's guidelines |
| | Repair | •Splicing methods<br>•Cover repair methods.<br>•Tools required. | •Line manufacturer's guidelines<br>•Line manufacturer representative<br>•Line manufacturer's splice methods. |
| | Line maintenance | •Lubrication/greasing.<br>•Cover/chafe gear adjustment<br>•Twist removal process. | •Line manufacturer's guidelines<br>•Industry guidelines (e.g.CI, ISO,etc.).<br>•Line manufacturer's splice methods |
| | Wear zone management* | Definition of minimum length of mooring line.<br>Frequency of:<br>•Line/winch rotation<br>•Line end-for-end.<br>•Outboard crop | •Ship schematic.<br>•Line manufacturer's guidelines<br>•Line manufacturer's splice methods<br>•SMS/planned maintenance records. |

# 3.1 Line Installation

## 3.1.1 Hardware/Deck preparation

The ropes need to uncoil and lay on the deck before installation.

Never install ropes directly to the winch as it may cause induced twist. Induced twist may reduce a mooring line strength as the outer fibers in the longer path are under tension and the inner lines are forced into compression.

| | |
|---|---|
| Mooring rope that has suffered several twists, which cause considerable strength reduction. The handling of braided ropes should be with care to avoid twists as much as possible. |  NO |
| After removing the twists that may have been induced, wind it carefully back to the winch. |  YES |
| Alternatively, when installing ropes onto the winches, it is recommended to make use of an Anti-Twist Turntable. |  YES |
| Consider mooring ropes with identification line to identify any twist of mooring lines during installations and operations. |  YES |

### 3.1.2 Installation on a winch

- **Split Drum Winches**

On the tension drum, the synthetic rope must have at least 5 to 6 wraps to avoid slippage. Also, the tension drum is operated with only one layer of mooring line. However please note that for HMPE ropes, minimum recommendation is 10 turns.

- **Undivided Drum Winch**

An unequal load sharing between the lines can cause brakes to render at different loads and sudden transfer of loads to other lines in the same lead.

Such events can cause unexpected failure of lines if the other drums fail to render. This situation may also arise when line embedding issues are encountered at the time of mooring.

## *3.2 Storage Conditions*

Store ropes in a clean environment under mild and dry conditions, away from direct sunlight, heat-generating sources, and acids.

## *3.3 Repair*

Repairs of Mooring Lines can be conducted when:

- Less than 15% of the strands are pulled out of position.
- Leg junction shows cut or ragged strands. The old splice can be cut away and a new splice made.

### 3.3.1 Repair: 8-Strand Splicing

This is a general method to make 8 eyes and can apply to all ropes Polyester, Nylon, Polypropylene and Mixed Ropes.

● To make the eyes, you will need a splice device, a small knife, scissors, adhesive tape (in two colors) and a marking link.

● The eye should generally be more than 500 mm but may be adjusted to suit the application.

● Normally, the yellow tape would signify Z-twist and the black tape would signify the S-twist.

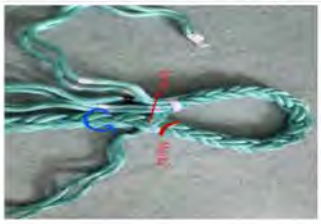
Cover lines when not in service. Store ropes in a clean environment under mild and dry conditions away from direct sunlight and heat generating sources and acid.

1. From the end of the rope, count a distance of 16 picks and apply tape securely around the rope immediately after the 16th pick, as shown in the illustration. This is Mark 1. Apply the tape securely enough so that it will not move during the splicing procedure.

2. Form the desired size of the evy, being careful not to add twist to the rope. Mark the rope adjacent to the tape. This will be Mark 2.

3. From the end of the rope, mark the first 16 picks up to the tape at Mark 1. Continue marking the length of the eye and at least an additional 6 picks past Mark 2. Mark all strands that rotate left on both sides of the braided rope.

4. Tape the ends of each of the 8 strands individually. Tape the ends of each pair together.



5. Physically form the eye. Make certain there is no twist in the rope.

6. Place the Z-twisted pair that is closest to the standing part of the rope over the rope at Mark 2, as shown in picture.
Note:be careful not to add twist to the rope.

7. Beginning with the left rotating marked S-twisted on top, make your first tuck under the right rotating Z-twisted closest to Mark 2. Pull the strands completely through.

8. Turn the eye over and tuck the other marked S-twisted under the Z-twisted directly opposite the previous tuck .

9. Continue tucking the S-twisted under the Z-twisted and the Z-twisted under the S-twisted until at least 6 full tucks (with all 4 strand pairs)have been completed.

10. With the remaining 4 half-volume single strands, perform 3 full tucks Tape the strands after they have been tucked and cut them off as done with previous strands. The completed splice should look like Fig. J.

11. Finished product

### 3.3.2 Repair: 12-Stand Splicing


1. Place the rope flat on the ground. The rope on the right in the picture is the ferrule end (leave the ferrule length)
Note: not kink the rope

2. Make a mark on the same strand of rope.



3. Leave 1.85m at the end of the ferrule and mark it, as mark X
Note:The length of the ferrule end is generally 0.3 times the whole length of the rope.

4. Confirm the size of the eye desired and mark it ,as mark Y.

5. Tapering the tail, wrap the tape around mark X.

6. Mark the S-twist of the 1.85m rope segment with S-twist apart.

7. The Z-twist are distinguished in the same way by different markers.
Note: In the picture,1 black vertical line = S-twist
2 black horizontal lines = Z-twist.
8. Pull out the S-twist, the end of each strand wrap the green tape.

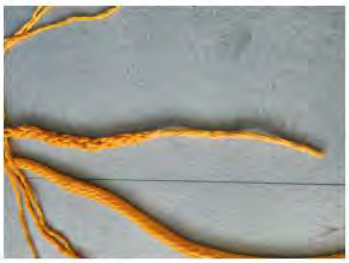
9. Pull out the Z-twist, the end of each strand wrap the green tape.
Note: Don't leave the strand unfasten.

10. This should leave 6 strands still braided down the middle. On 1 side you should have 2 S strands and 1 Z strand. On the other side, you should have 2 Z strands and 1 S strand.

11. Leave 60cm at the end of the rope, as mark Z, and make a cone.
Note: Generally, the length of the leaved rope is 1/3 of the length of the whole rope.

12. Form the mark Z,pull out one strand every other for a total of 3 strands.

13. Cut off the pull-out part.



14. The remainder is wrapped with tape.

① 

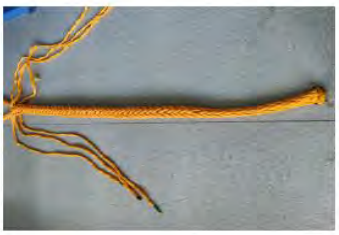
② 

15. Splicing the eye. Please do not kink the rope during operation.
(Picture ① is the kink condition, picture ② is the correct state.)

16. Form the entry point, count 2 picks down the rope and mark 6 strands around the circumference of the rope. This will be 3 Strands.

17. The first 3 strands are now routed from the entry point at Mark 2 to the exit point. Each strand is routed separately, entering at the entry point and exitinbg at its own exit point. Do not pull the strands up tight yet. Leave slack at the entry point.

18. Attach a fid to the end of the tapered tail and bury it form the entry point through the rope to exit beyond Mark Z. Pull the tail until Marks X and Y meet. Leave the tail exposed.
19. The 3 remaining strands are now routed from the entry point at Mark 2 to the exit point. Each strand is routed separately, entering at the entry point and exiting at the entry point and exiting at its own exit point. Do not pull the strands up tight yet. Leave slack at the entry point.
With all 6 strands routed and the tail buried, pull each of the 6 routed strands to remove any slack, and make sure the rope is smooth and tight at the entry point.

20. At Mark Z, pull the tail out until Marks X and Y meet.
21. Pull any slack out of the 6 strands that are routed. Pull out the tail and mark Z consecutive strands as shown.


22. Pull out all 3 and cut off and tucking the strands.

23. The strands are now tucked into the braid of the rope.


24. 1 complete tuck consists of passing a strand over 1 strand and under 2 strands.

25. The tucks proceed down the same row of picks straight down the body of the rope.


26. Do 5 complete tucks for all 6 strands.


27. Each strand is always tucked under the same line of the braid so that the tucks progress straight down the body of the rope.

28. After completing the first 5 tucks, remove 1/2 of the volume of the twisted yarns. Cut yarns from each of the 6 strands near the taped ends and complete 3 more tucks with the reduced volume strands.


29. After completing the second set of 3 tucks, cut off the excess strands and tape the ends.

30. Eyes finished, leave enough of an end protruding so that the end does not slip back into the rope when the rope is loaded.

## 3.4 Chafe Protection

Chafe protection is crucial for safeguarding ropes from abrasion and wear, ensuring their integrity for safe mooring and towing operations. Our range of chafe protection solutions is specifically designed to extend the service life of your ropes and slings in demanding environments.

Made of High Tenacity Polyester or Velcro
Orange color for higher visibility
Will not split or crack when bunched or compressed

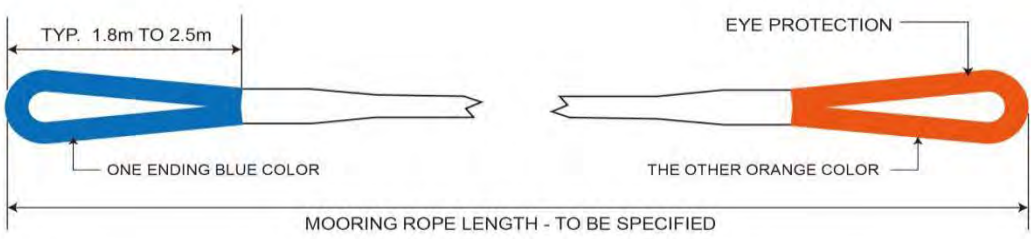
Made of UHMWPE Fiber
Special abrasion resistant coating
High cut resistance
Usable on rope body or eye
Greatly improves lifespan of the rope
Especially suitable for high performance fibre ropes

Covers and protects the entire eye length
Made from high tenacity polyester
Abrasion resistant weaving
No sewing seams, no weak points susceptible to tearing
Much stiffer than canvas, less likely to bunch up and expose the eye

Protects a rope and reduces its abrasion in use
Longer life time in service
Improves abrasion resistance through special coating
Velcro type available

## 3.5 Wear Zone Management

Some ports recommend that Mooring Lines shall be turned/rotated end to end every 2 years.
We will recommend to rotate every 6 months, consider different colour eye protection to identify the orientation of the ropes on the winch. During the rotation, ship crews should wash the ropes to remove any dirt or sea salt. These particles can damage the ropes when dry.



# 4. INSPECTION

## *4.1 GENERAL*

Conducting ongoing inspections of the mooring line system is a vital task to ensure the maximum service life and safety in every setup. It is important to be aware of and to define when inspections are to be undertaken and by whom.

The inspection should follow the procedure of the Inspection Checklist provided in this manual. An Inspection Record (logbook) is to be maintained for each inspection and, if necessary, entries should be made to record any incidents, irregularities or observations. The defined rope retirement criteria are to be strictly observed.

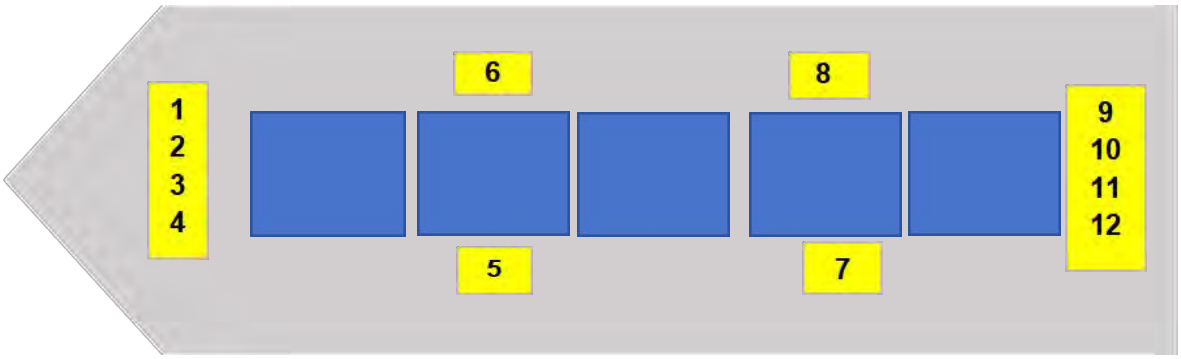



***Figure 4.1**: Vessel Mooring Configuration (S/N)*

| S/N | Location | Tag No. | Maker | Material | Cert | Dia. | Length | LDBF | In Serv |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | | |
| 2 | | | | | | | | | |
| 3 | | | | | | | | | |
| 4 | | | | | | | | | |
| 5 | | | | | | | | | |
| 6 | | | | | | | | | |
| 7 | | | | | | | | | |
| 8 | | | | | | | | | |
| 9 | | | | | | | | | |
| 10 | | | | | | | | | |
| 11 | | | | | | | | | |
| 12 | | | | | | | | | |

a) **Deployment Inspection**

| | |
|---|---|
| Frequency | Upon each use |
| Description of line inspection | The working length of the line (outboard of the tension side of the winch) is inspected for defects which may impair the performance of the line. This is typically completed during mooring operation. |
| To be Carried out By | Mooring Team |
| Output | Inspection Checklist and Reports |

**b) Routine Inspection**

| | |
|---|---|
| Frequency | 250 mooring hours or six months, whichever occurs first. |
| Description of line inspection | The full length of line on the in-service section of the line (typically on the tension side of the mooring winch) is inspected.This is a visual inspection,externally and internally where possible (i.e.unjacketed lines). |
| To be Carried out By | Qualified and experienced Ship Personnel |
| Output | Inspection Checklist and Reports Evaluation and Recommendations |

**c) Detailed Inspection**

| | |
|---|---|
| Frequency | 1,000 mooring hours or ship special survey (e.g. five years), whichever occurs first. |
| Description of line inspection | The full length of line on the in-service section of the line (typically on the tension side of the mooring winch) is inspected. This is a visual inspection, externally and internally where possible (i.e. unjacketed lines). |
| To be Carried out By | Manufacturer's representative, third party expert or adequately trained ship personnel |
| Output | Inspection Checklist and Reports Evaluation and Recommendations Repair requirements and Details of repairs undertaken |

## 4.2 WEAR ZONE MANAGEMENT

Mooring line systems are subjected to potential damage day in, day out, due to regular mooring activities. Also having an effect on this are the individual trading patterns of the ship including the design of the terminals being berthed at, the specific type of mooring system setup, the environmental conditions and ship movements while in port as well as the degree to which the ship is loaded.

As the wear zone management techniques will vary with each vessel, it is important that these are assessed for each application and documented within the LMP in order to reduce the risk of rope damage most effectively.

Some effective techniques that can be included in an LMP to manage the wear zone include ensuring that:

- Deck fittings are smooth to ensure mechanical damage is avoided
- All sections of the mooring line system are protected from the elements and other environmental damage when not in use
- Sharp deflections are avoided and that the D/d ratio is maximized
- Interaction with deck fittings is controlled as swell, waves and wind will influence rope fatigue
- Insufficient wraps around drums are avoided to minimize slippage
- Mooring system lines are turned and interchanged to enable abrasion to occur evenly on rope sections

## 4.3 SERVICE LIFE

MEG4's mooring rope replacement criteria recommends retiring mooring lines when the residual strength has reached 75% of the Ship Design MBL. But different kinds of ropes wear off at a different pace. In more severe applications or under different conditions, mooring ropes may degrade.

- Typical Service Life of a Class Approved HMPE Mooring Lines
  - 10,000 mooring hours or 8 years (4 years use and end-for-end), whichever occurs first.
- Typical Service Life of Class Approved Conventional Mooring Lines
  - 1,000 mooring hours or 4 years (2 years use and end-for-end), whichever occurs first.
- Typical Service Life of Class Approved Tail Ropes
  - 700 mooring hours or 18 months, whichever occurs first.

Notes:

- The above service life is based on a typical operating range. Not consider dynamic loading and extreme weather condition.
- Generally, spring lines and breast lines get damaged rather than other lines, ship operators should take more precautions.
- UHMWPE lines should use tail rope to reduce dynamic loads induced in the mooring line and tend to distribute the loadings more evenly among mooring lines in the same service.
- It is recommended to use polyamide (nylon) mooring tail due to more elasticity. However the terminal's cargo transfer system should be consider.
- Before end-for-ending the rope, especially for UHMWPE mooring lines, residual strength test is recommended to figure out the line's actual residual strength.
- Mooring operators should consider their voyage route and mooring port condition and establish their own service life plan.

A range of design and operational factors can influence mooring line performance and service life. These factors vary by line type and design and may be accounted for through equipment design,line selection,maintenance routines and operational best practices.

## *4.4 INSPECTION PROCESS*

A thorough inspection will assist the operator in identifying the cause of the problem, thereby allowing corrective action to be taken before the rope is severely damaged. Since the rope is just one part of a complex system, any inspection should also include those components that come into contact with, or have a direct influence on, the condition and overall performance of the rope.

### 4.4.1 Inspection Records

Prepare Mooring Line Inspection Record (see Appendix I) and make necessary entries including data on the type of rope, time in service and description of intended use. Fill-in know rope information, such as Type, diameter/circumference, fibre material, length, manufacturer and type service. Add name of inspector, date and location

Prepare Mooring Line Inspection Checklist (see Appendix II) and make necessary entries including data on the type of rope, time in service and description of intended use. Fill-in know rope information, such as Type, diameter/circumference, fibre material, length, manufacturer and type service. Add name of inspector, date and location.

### 4.4.2 Inspection Procedure

Lay out the rope in a straight line, on a smooth surface, under hand tension. Attempt to apply enough tension to straighten the rope in increments if space is limited). Small diameter ropes may be inspected by pulling segments hand-over-hand. For long lengths of larger ropes, it is best to utilize a mechanical advantage to apply light tension on the rope while it is being inspected.

If a rope is long, it may be marked and coded in evenly spaced intervals. For easier identification, marked each fifth and tenth interval more strongly. If the rope is very dirty, intervals could be marked by using knotted twine pieces passed through the rope. Tape is also appropriate if wrapped completely around the rope.

Start by Visually Inspecting the entire length of the rope.

Look for signs that may weaken the rope due to damage or deterioration

Make a note of the type, location and level of damage such as, number of broken or noticeably damaged yarns, depth and length of abrasion or wear spots, frequency and spacing of damage is one strand or multiple strands. Estimate the loss of strength comparing abraded or cut fibers as a percentage of the rope diameter or strand diameter.

If there are signs, record all findings in the Inspection Checklist

- Photograph the rope and attach the photo on the spaces provided
- Identify end-to-end location of detectable damage areas.
- Record

### 4.4.3 Rope Inspection Points

**a) Abrasions**

Abrasion is the tearing or wearing of surface filaments. When a new rope is placed in service, contact with various abrasive surfaces will break some of the outer filaments over the entire surface of the rope, giving it a slightly "fuzzy" appearance. This condition is normal and, to a certain extent, beneficial as the broken filaments act as a protective cushion.

This condition should stabilize after the rope has been in service for a period of time. If abrasion continues at an accelerated rate then fibre mass is being lost and the performance properties of the rope have been adversely affected the distance of the sign from the soft eye.

While uniform surface abrasion is to be expected, isolated areas of extensive abrasion or definite abrasive patterns along the length of the rope indicate a problem somewhere within the system. As an example, a pattern of extensive abrasion running down the body of the rope in a line usually means that the rope has come into contact with some rough surface while it was moving under load. This may be a damaged winch drum, pulley or other contact surface. An attempt should be made to identify the cause(s) of this type of damage.

The effects of abrasion on the strength of the rope may be estimated in the field. Since abrasion results in the loss of fiber mass, the residual strength in any damaged section may be estimated by comparing the remaining bulk of the damaged strands to a section of undamaged rope.

Look for signs of fraying or Abrasions that may indicate damage.

**Abrasion**

**b) Cuts**

Although not as common as abrasion in the course of routine applications, cuts represent a greater potential hazard to overall rope performance. Cuts may be identified by the even, squared-off fiber ends at the point of damage. Obviously, rope strength is affected at the location of a cut, with the amount of strength loss dependent upon the depth and extent of the cut. The strength loss at the point of the cut may be estimated in the same manner as that used for abrasion.

While small surface nicks have very little effect, deeper cuts can substantially reduce rope strength. Cuts extending at right angles to the rope's axis can cause the rope to become "unbalanced" since the damaged strands can no longer carry their share of the load. Cuts that extend along the length of the rope for even a few inches have probably damaged a significant portion of the strands making up the rope. Consequently, severe cuts are sufficient cause to remove the rope from service. As with specific patterns of abrasion, cuts also indicate that there is a problem somewhere within the rope system and the cause should be immediately identified and corrected.

If cuts are noticed when performing either visual or periodic inspections the line should be retired and removed from service or alternatively repaired by trained and qualified personnel.

Look for signs of chaffing or Cuts that may indicate damage.

**Cuts**

**c) Discoloration or Glossy or Glazed sections**

When fibers, or coatings applied to the ropes are exposed to UV light, these tend to discolour. Synthetics have moderate to excellent UV light resistance. However, long periods of exposure will decrease the overall strength. Chemicals will also damage the colour, which is the first indicator of damage in the rope.

Look for any Discoloration or Glossy or Glazed sections that may indicate damage.

**Discoloration**

**d) Twists and Kinks**

Sight the rope down its length as you would a plank or mast. Look for twist in braided and plaited ropes, and corkscrewing in stranded ropes. Also look for kinks or knots, as these can weaken the rope and make it more prone to damage

**Twist**

**e) Inconsistent Diameter**

Any diameter disruption must be taken into consideration for retirement. Distortion, significant diameter change, inconsistency in overall measurements will decrease the performance of the rope. When dealing with small diameter cordage diameter changes will be noticeable by tactile and visual inspections.

Determine the circumference in a number of places, in particular in any damaged areas. This is most easily done with a thin whipping twine, thin metal or fabric tape measure or a pi-tape, wrapped around the rope with slight hand tension. Make note of nominal circumference, and any point on the rope where the circumference varies more than 10% from what is found on most of the rope. Ropes may decrease in circumference if well used and may be less than specified for the ropes.

**Inconsistent Diameter**

**f) Compression**

Open the rope and examine the interior. Turn twisted rope slightly to open the interior for observation. Push on single braided or plaited ropes or use a fid to open the interior to view. Check for any signs of damage, such as flattening or compression, which may indicate that the core has been compromised.

On double braided ropes, push on the rope and use a fid to open a small hole to view the core. Be careful not to pull strands excessively. Look for broken filaments, fuzzy areas, kink bands.

**Compression**

**g) Strands/Yarns Breakages**

A pull occurs when a sharp object or edge snags a yarn or strand and pulls it away from the rope's surface, forming a loop. The loop can create a dangerous situation if it should catch on a projection while the rope is under load. Pulls generally occur only when the rope is under little or no load, as even a moderate load will cause the rope to become very hard and compact.

In most cases the pulled yarn or strand can be easily worked back into the body of the rope. If a pulled yarn cannot be worked back in, then the line should be retired and removed from service or alternatively repaired by trained and qualified personnel.

A meaningful inspection must include both ends of a broken or pulled strand. Note location and nature of break. If possible, identify the conditions that caused the damage, such as rough hardware surfaces, points of contact, excessively sharp bends or introduction of twist from winching practises.

**Pulled Yarns**

**h) Damage to splices**

Check the ends of the rope for signs of unravelling or damage. Make sure that the rope is properly spliced or has the appropriate fittings for your mooring setup.

**Damage to Spices**

### i) Deformation Caused By Heat

Virtually all synthetic fibres can be melted due to frictional heating. Burns can be identified by a glassy fused area on the rope's surface. Although burned fibre has lost all of its strength, the extent of the damage can vary. A light glazing of the rope surface indicates marginal fusing and only a slight strength loss. Darker, brittle areas have probably been more severely damaged. If any form of fibre glazing due to frictional heat are noticed, the line should be immediately retired. A more thorough inspection should be performed on the interfacing hardware to determine and mediate the cause of the friction.

Check for any signs of rot or decay, which can weaken the rope and make it more prone to damage. Pay special attention to areas where the rope may have been exposed to moisture or sunlight.

**Deformation caused by Heat**

### j) Condition of ancillary equipment

Check Deck fittings are smooth to ensure mechanical damage is avoided


**Rust can cause Abrasion, Cuts or Pull Strands**

### k) Tag (ID)

Illegible or missing tagging is a major criteria for retirement. Information to be included on tag: rope type, rope, diameter, rope length, published LDBF, date of manufacture.


### 4.4.5 ASSESSMENT AND EVALUATION OF LINE INSPECTION

Careful and frequent inspection of mooring rope, using procedures contained in this document, reflects prudent safety management required to protect personnel and property.

This guideline provides information and procedures to inspect the mooring rope and to establish documentation of the inspection.

The assessment of the inspection provides inspectors with help to make reasonable decisions regarding retirement or continued use, including repairing or downgrading

The inspector should always act conservatively when evaluating a rope and making recommendations for further use.

Residual strength in a used rope can be estimated and destructive test methods are required to be definitive.

The visual inspection method can only provide an estimate of the rope condition.

| Condition | Area of Potential Damage | Evaluation | Assessment |
|---|---|---|---|
| Cut (severe) |  | 10% loss of fibre cross-section in whole rope or in an individual strand | Retire |
| Cut (caution) |  | Between 5% and 10% loss of fibre cross-section in whole rope or in and individual strand | Downgrade or Repair |
| Cut (monitor) |  | Less than 5% loss of fibre cross-section in whole rope or in and individual strand | Protect and use |

**b) The Retirement Criteria - Abrasion**

| Condition | Area of Potential Damage | Evaluation | Assessment |
|---|---|---|---|
| External abrasion (deflective wear) |  | Localized 80% loss of damaged (deflective wear) on strand. Found more than 10% diameter reduction comparing non-damaged line. | Repair Retire |

| | | | |
|---|---|---|---|
| External abrasion (severe) |  | More than 10% loss of fibre cross-section in whole rope or in and individual strand cross section | Retire |
| External abrasion (caution) |  | 10% loss of fiber cross-section in whole rope or in and individual strand cross section | Dowgrade |

# APPENDIXES

## MOORING LINE

# Inspection Record

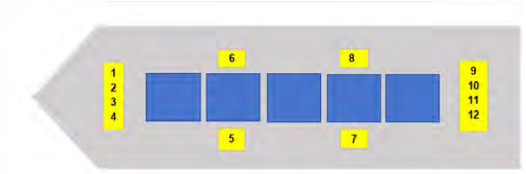
APPENDIX I

Company: _____ CERT No.: _____

Vessel Name: _____ VesselType: _____

**SAMPLE**

| S/N | LOCATION | TAG NO. | MAKER | MATERIAL / MODEL | CERT NO | DIA (mm) | LENGTH (M) | LDBF (TON) | IN SERVICE (DD/MM/YY) | END | Usage Records | Last Inspection | CONDITION | EVALUATION | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Headline | MR22001-1 | DSR | Mixed | RPN1123445 | 64 | 220 | 52.5 | 20/7/2022 | End-1 (Blue) | 20/07/22 to 19/01/23 | 15-Jan | 1 | Safe | |
| | | MR22001-2 | | | | | | | | End-2 (Red) | 20/01/22 to 19/07/23 | 15-Jul | 1 | Safe | |
| | | MR22001-1 | | | | | | | | End-1 (Blue) | 20/07/23 to Present | 30-Sep | 3 | Frequent Inspection | |
| 2 | Headline | MR22002 | DSR | Mixed | RPN1123445 | 64 | 220 | 52.5 | 20/7/2022 | | | 30-Sep | 1 | Safe | |
| 3 | Headline | MR22003 | DSR | Mixed | AB12345-1 | 64 | 220 | 52.5 | 18/2/2022 | | | 30-Sep | 2 | Safe | |
| 4 | Headline | MR22004 | DSR | Mixed | AB12345-1 | 64 | 220 | 52.5 | 18/2/2022 | | | 30-Sep | 4 | Repair or Discard | |
| 5 | FWD Spring | MR23001 | Ropenet | Mixed | LR345678/3 | 64 | 220 | 52.5 | 25/4/2023 | | | 30-Sep | 1 | Safe | |
| 6 | FWD Spring | MR23002 | Ropenet | Mixed | LR345678/3 | 64 | 220 | 52.5 | 25/4/2023 | | | 30-Sep | 1 | Safe | |
| 7 | AFT Spring | MR23003 | Ropenet | Mixed | LR345678/3 | 64 | 220 | 52.5 | 25/4/2023 | | | 30-Sep | 1 | Safe | |
| 8 | AFT Spring | MR23004 | Ropenet | Mixed | LR345678/3 | 64 | 220 | 52.5 | 25/4/2023 | | | 30-Sep | 1 | Safe | |
| 9 | Sternline | MR22005 | DSR | Mixed | RPN1123445 | 64 | 220 | 52.5 | 20/7/2022 | | | 30-Sep | 1 | Safe | |
| 10 | Sternline | MR22006 | DSR | Mixed | RPN1123445 | 64 | 220 | 52.5 | 20/7/2022 | | | 30-Sep | 1 | Safe | |
| 11 | Sternline | MR22007 | DSR | Mixed | AB12345-1 | 64 | 220 | 52.5 | 18/2/2022 | | | 30-Sep | 2 | Regular Inspection | |
| 12 | Sternline | MR22008-1 | DSR | Mixed | AB12345-1 | 64 | 220 | 52.5 | 18/2/2022 | End-1 (Blue) | 18/02/22 to 17/08/22 | 15-Aug | 1 | Safe | |
| | | MR22008-2 | | | | | | | | End-2 (Red) | 18/08/22 to Present | 30-Sep | 5 | Discard | |



**MOORING LINE**

# INSPECTION CHECKLIST

**APPENDIX II**

**SAMPLE**

Company: _____

Vessel Name: _____

Vessel Type: _____

Date of Inspection: _____

S/N _____
LOCATION _____
TAG NO. _____
MAKER _____
MATERIAL / MODEL _____
CERT NO _____
DIA (mm) _____
LENGTH (M) _____
LDBF (Ton) _____
IN SERVICE (dd/mm/yy) _____
END _____

---

Layout the rope in a straight line, on a smooth surface, underhand tension. Start by visually inspecting the entire length of the rope.
Look for signs that may weaken the rope due to damage or deterioration

If there are signs, record all findings

- Photograph the rope and attach the photo on the spaces provided
- Identify end-to-end location of detectable damage areas.
- Record the distance of the sign from the soft eye

1 **Check the Entire Length**

- Look for signs of fraying, chafing, **Cuts or Abrasions**.
- Look for any **Discoloration** or **Glossy or Glazed sections** that may indicate damage.

| Attach Photo | Attach Photo | Attach Photo |
|---|---|---|
| Distance from the soft eye _____ Mtr | Distance from the soft eye _____ Mtr | Distance from the soft eye _____ Mtr |

2 **Check for Twists and Kinks**

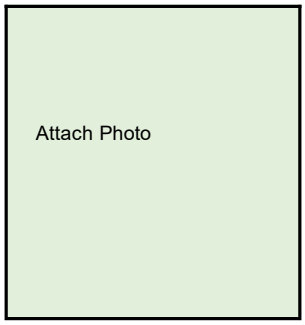
- Check the rope for any **Twists**, kinks, or knots

| Attach Photo | Attach Photo | Attach Photo |
|---|---|---|
| Distance from the soft eye _____ Mtr | Distance from the soft eye _____ Mtr | Distance from the soft eye _____ Mtr |

SAMPLE

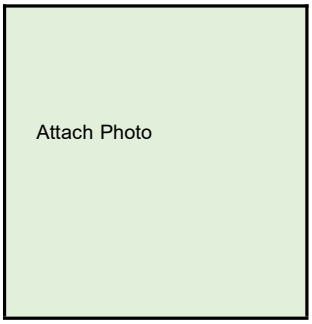
3 **Measure the Circumference.**

- Determine the circumference in a number of places, in particular in any damaged areas




Distance from the soft eye
_____ Mtr

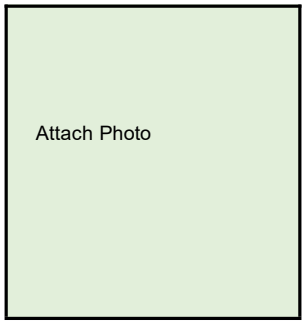

Distance from the soft eye
_____ Mtr



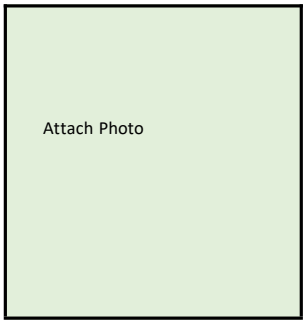

Distance from the soft eye
_____ Mtr

4 **Check the Core:**

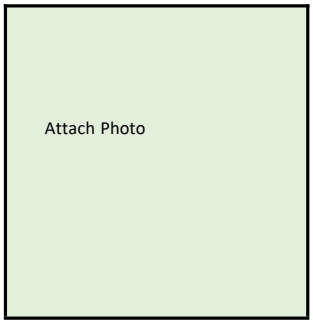
- If your rope has a core, check for any signs of damage, such as flattening or **Compression**




Distance from the soft eye
_____ Mtr




Distance from the soft eye
_____ Mtr



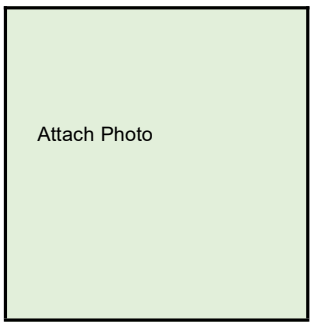

Distance from the soft eye
_____ Mtr

5 **Check for Strand/ Yarn Breakages**

- A meaningful inspection must include both ends of a broken rope.
- Note location and nature of break.


Distance from the soft eye
_____ Mtr


Distance from the soft eye
_____ Mtr




Distance from the soft eye
_____ Mtr

SAMPLE

6 **Check for signs of Rot:**

- Check for any signs of rotor decay
- Pay special attention to areas where the rope may have been exposed to moisture or Heat.

Attach Photo

Distance from the soft eye
_____ Mtr

Attach Photo

Distance from the soft eye
_____ Mtr

7 **Check the end Spicing:**

Attach Photo

Distance from the soft eye
_____ Mtr

- Check for signs of unravelling or damage.
- Make sure that the rope is properly spliced or has the appropriate fittings for your mooring setup

Attach Photo

Distance from the soft eye
_____ Mtr

Inspection Conducted by / Date

Attach Photo

Distance from the soft eye
_____ Mtr

Attach Photo

Distance from the soft eye
_____ Mtr

_____

_____
Final Checked by

APPENDIX III

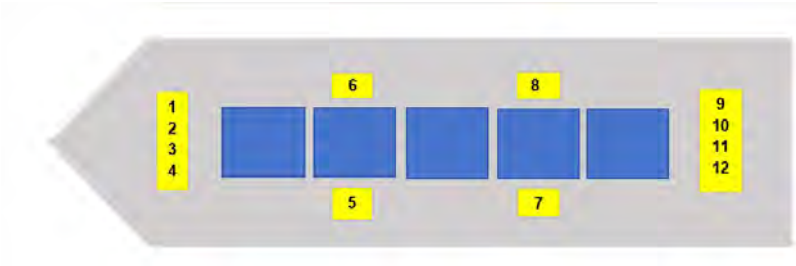
## MOORING LINE

# Inspection Test Summary

**SAMPLE**

Company: _____ Date of Inspection: _____

Vessel Name: _____ Vessel Type: _____




| S/N | Location | Ends | Abrasion/ cuts | Discoloration | Glossy or g lazed sections | Kinks/twisting/deformation | Inconsistent diameter | Compression | Strand/ Yarn Breakages | Deformation caused by Heat | Damage to Splices | Condition | Evaluation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Headline | End-1 | 1 | 1 | 2 | 3 | 1 | 1 | 2 | 1 | 1 | 3 | Frequent Inspection |
| 2 | Headline | End-1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | Safe for Use |
| 3 | Headline | End-1 | 1 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | Frequent Inspection |
| 4 | Headline | End-1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 4 | 4 | Repair or Discard |
| 5 | FWD Spring | End-1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | Safe for Use |
| 6 | FWD Spring | End-1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | Safe for Use |
| 7 | AFT Spring | End-1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | Safe for Use |
| 8 | AFT Spring | End-1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | Safe for Use |
| 9 | Sternline | End-1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | Safe for Use |
| 10 | Sternline | End-1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | Safe for Use |
| 11 | Sternline | End-1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 2 | Regular Inspection |
| 12 | Sternline | End-2 | 5 | 1 | 1 | 1 | 1 | 1 | 3 | 1 | 1 | 5 | Discard |

| Condition | | Evaluation |
|---|---|---|
| 1 | Excellent Condition | Safe for Use |
| 2 | Good Condition | Regular Inspection |
| 3 | Mediocre Condition | Frequent Inspection |
| 4 | Poor Condition | Repair or Discard |
| 5 | Extremely Poor Condition | Discard |

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*STRENGTH BEYOND*

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