Mooring Ropes Inspection & Retirement Guidelines – Timm Acera Amundsen

Table of Contents

1. Introduction

This guideline is intended for use as part of Line Management Plan (LMP) according to OCIMF MEG4 in conjunction with Installation guideline and Rope use and care manual.

1.1 Factors affecting Ropes Service Life

This document is a general guideline on ropes retirement criteria for all vessel types. Below factors will affect expected lifetime of a mooring rope:

- Vessel type
- Mooring arrangement and its design
- Position of the rope
- Trading route
- Mooring frequency
- Ports
- Cargo
- Environment

All the above mentioned is important to have in mind creating the vessels, rope inspection routines, and intervals. The retirement criteria in this document should support the Owner or Manager to create Mooring System Management Plan (MSMP).

This guideline is not intended to overrule or serve as a replacement for each individual vessel's operational practices or procedures or the experience of its crew, nor does it assume any responsibility of the manufacturer for the retirement of ropes. For the avoidance of doubt, WSS shall not be liable for any losses incurred in connection with this guideline.

1.2 Factors that can prolong rope's lifespan

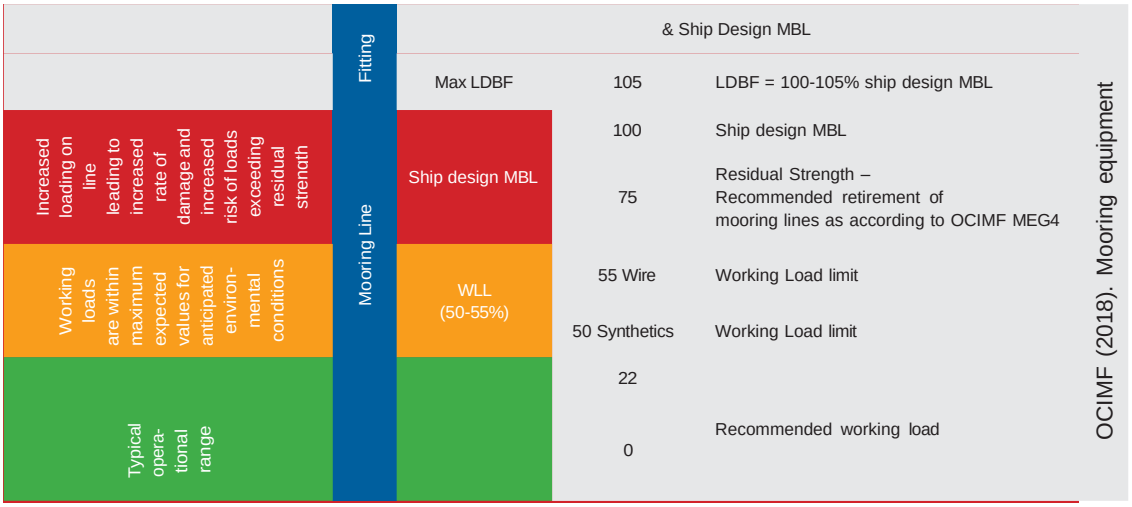
To assist in decision on the retirement of ropes, we strongly recommend actively using Timm LMP software. The LMP-application is designed to reduce the administrative workload when recording, collecting, and evaluating the data needed to make informed decisions based on these retirement guidelines. By combing records of usage and inspection results with retirement guidelines, the LMP-application becomes an important tool to ensure the retirement guidelines are followed and gives all stakeholders a platform to view and assess the current status. Actively using the application ensures high quality data that can be used to improve the rope management and replenishment routines.

The following factors should also be considered in order to prolong the lifespan of ropes:

- Installation should be done by experienced crew, according to the manufacturer's instructions
- Ensure proper and regular maintenance of the mooring winches and fittings such as mooring bits, bollards, fairleads, Panama chocks, rollers etc. to maintain smooth surface
- Crew should handle the ropes with care and follow the manufacturer's recommendations.
- Keep the ropes covered and out from the sunlight when not in use.
- Do not keep the ropes stored in contact with chemicals.
- It is recommended to use the same type of ropes on all positions where ropes are working in parallel
- Rope protection can help to prevent or limit the damage. There are several solutions, such as a braided protective jacket on the entire length or parts of the length, or a chafe protection that can be purchased separately
- Regular inspections by crew and third party
- Rotating of ropes and end-to-end changing

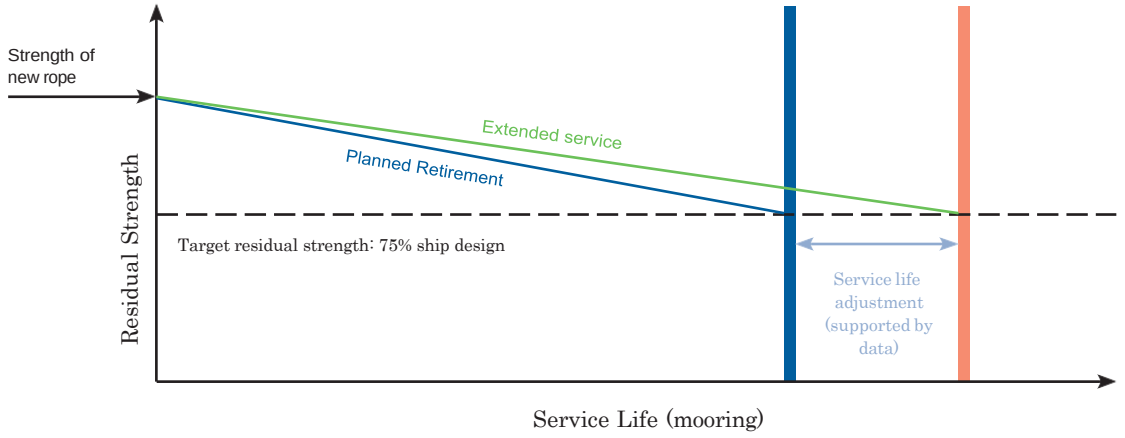
1.3 Load Limits

According to OCIMF MEG4, the typical operating range of the rope is up to 22% of the Ship design MBL. The working load limit is 50% for synthetic ropes. Loads higher than this limit will cause damage on the rope, decrease the lifespan of the rope, and cause a risk or rope's breakage by exceeding the residual strength.



OCIMF MEG4 recommends retiring mooring lines when the residual strength has reached 75% of the Ship Design MBL. Today this can only be determined by a destructive test.

For more individual retirement criteria we recommend performing a test of residual strwwength as mentioned by OCIMF MEG4. By performing a test and gradually building up historical data on different ropes and tails, the vessel will create the optimal solution. In addition to that, regular inspection with certain intervals should be performed and ropes and tails discarded if deemed necessary.



Service life adjustment according to OCIMF MEG4

2. Product Properties

HMPE Ropes

	Acera Amundsen
Construction	12-strand braided/plaited with SBA
Fiber	Acera premium HMPE/ PA core SBA
Specific gravity	0,97 (floating)
Colours	Platinum (other colours available)
UV resistance	Excellent
Abrasion resistance	Excellent
Chemicals resistance	Excellent
Water resistance	Excellent (0% absorption)
Heat resistance	Medium (145°-150° melting)
Elongation	Low (2-3% at break)
Designed lifetime	8000 mooring hours

Refer to Appendix A for more information on the elongation of Acera ropes.

Designed lifetime is contingent on, but not limited to, the following factors:

- protected port
- deck equipment in excellent condition
- split drum winch using minimum 10 turns on the tension part
- regular inspections
- not exceeding the WLL
- end-to-end at 50% of the designed lifetime
- following the manuals for Installation, Use and care and Retirement

3. Rope condition evaluation

The chapters below provide basic guidance for assessing the different types of damage. Chapters are divided similarly as in Fiber Rope Inspection and Retirement Criteria CI 2004 -4 guideline and accompanied by our best practice and knowledge.

Knowledge of the causes and appearance of damage is essential for the proper evaluation of rope damage during inspection and important when deciding if the rope should be retired or kept in service.

3.1 Colour Coding Definition

In the below sections we present main categories for damages on ropes. Following color coding is used in conjunction with detailed explanation:The following factors should also be considered in order to prolong the lifespan of ropes:

- Green – rope in excellent condition
- Yellow – signs of damage in progression
- Red – rope exceeds the retirement criteria

3.2 External Abrasion

In most cases external abrasion is localized in a limited area. Generally, damage sufficient to degrade the rope is clearly visible and easy to spot. Uniform abrasion may be visual in ropes that are used over fixed objects that bear along a large part of the rope's length. Ropes that are exposed to dragging over rough surfaces will show uniform abrasion. Signs for abrasion are better visible on new ropes than on used ropes.

Witnessed Condition	Code	Description/Recommendation
		Fibers intact, no visible external damage.
		Visible abrasion localized where rope has been in contact with uneven surface. Recommend monitoring the rope, inspect and if needed repair the hardware and protect the rope.
		Abrasion clearly visible on more than 10% of the cross section of the rope. Rope must be retired.

3.3 Internal Abrasion

If ropes are cycled for extended periods of time, even within a normal working load range, they will gradually loose strength. There are various mechanisms for the breakdown of synthetic fibers under cyclic tension, however the most common is fiber on fiber abrasion.

Witnessed Condition	Code	Description/Recommendation
		Fibers intact, no visible external damage.
		Minor visible internal abrasion. Some broken filaments. Recommend monitoring and inspecting the rope.
		Internal abrasion clearly visible. Broken and powdered filaments in the center of the rope. Rope must be retired.

3.4 Bending Fatigue

Constant bending of any type of rope will cause internal and external fiber abrasion and is frequently caused by running on pulleys. Other types of flexing, such as frequent bending over a small radius surface may also cause fatigue damage to the ropes. Flexing over fixed surfaces is often accompanied by surface wear, if sliding action is present as well. Wear will appear on the surface of the contact area. The fibers will become matted on the surface and/or glazed form heat buildup. Broken and melted filaments will be found inside the rope over the bending zone but not elsewhere.

Witnessed Condition	Code	Description/Recommendation
		Fibers intact, no visible external damage.
		Glazed appearance, it is possible to recover the original shape of the rope by flexible bending and further use under tension. Monitor and inspect the rope regularly, investigate the root cause and do corrective actions. Recommend protecting the rope.
		Glazed appearance due to heat build-up and melted fibers. Fibers damaged and non-recoverable flattening. Rope must be retired.

3.5 Cuts

Cuts in fibers and strands are usually a sign of contact between rope and any sharp edges. If one or more strands are cut, it is necessary to remove the affected area and resplice new eye if possible. The level of damage is a function of the percentage of the rope cross-section that has been permanently lost.

Witnessed Condition	Code	Description/Recommendation
		Fibers intact, no visible external damage.
		Visible cut in fibers. Less than 3% of total amount of yarns. Recommend monitoring the rope, inspect and find sharp edge in the path of the rope causing the cut and repair. Protect the rope.
		Cut yarns clearly visible on more than 3% of total amount of yarns in whole rope. Rope must be retired. Inspect and find sharp edge in the path of the rope causing the cut and repair. Protect the new rope.

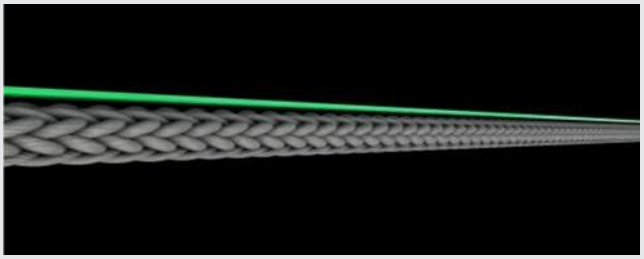
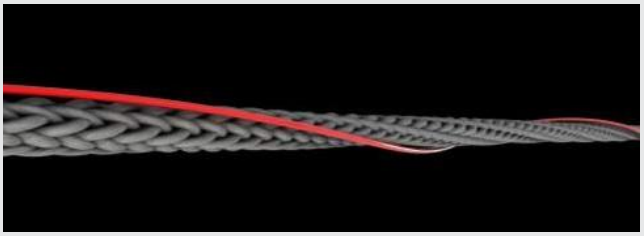
3.6 Pulled Strands and Yarns

If yarns or strands get stuck on equipment or obstacles, these yarns or strands can be pulled out. Pulled yarns or strand can easily be put back into the rope.

Witnessed Condition	Code	Description/Recommendation
		Fibers intact, no visible external damage.
		Pulled strand can be repaired by working the strand into the rope by locating the damage on the length of the rope and by pulling and settling the strand. Inspect and find the obstacle causing the pulled strand and remove or repair.
		Pulled strand caused major constructional damage on rope's length. Ropes must be retired. Inspect and find the obstacle causing the pulled strand and remove or repair.

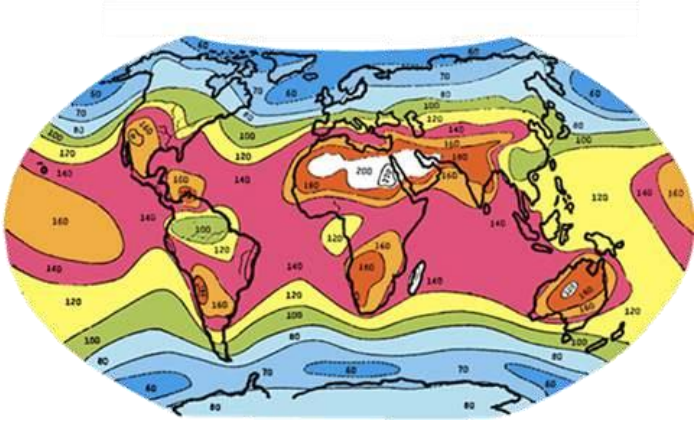
3.7 Twist

Braided and plaited ropes should display little or no twist. If there is a twist in the rope, be aware that one twist per meter will decrease the strength of the rope by approximately 6%.

Witnessed Condition	Code	Description/Recommendation
		No twist. Perfect conditions.
		Visible twist. Risk of decreasing the rope's strength. Untwist the ropein opposite direction at first possible occasion.

3.8 UV Degradation

Ultra-violet (UV) radiation from direct sunlight will cause brittle, weak outer yarns on the rope and start destruction process in inner yarns.. UV degradation is difficult to inspect visually, however brittleness and discoloration may be observed in some cases. For a definitive assessment, strength testing of a few surface fibers or in some cases the entire rope is required. In some cases, the filaments can be crushed by hand due to brittleness. Some improperly stored ropes could seem to be in good condition, but UV damage will be easily visible under tension.



Generalized Isolines of Global Radiation (Kcal./cm2/year) expressed in Kilo-Langley per year) By H.E. Landsberg

Ropes that are not in use shall always be covered to avoid damages caused by UV.

Witnessed Condition	Code	Description/Recommendation
		UV degradation on rope after tension is applied. Damaged fibers easily visible. The signs of UV degradation are not always visible before tension is applied. Attention must be paid to ropes that have been exposed to sunlight over an extensive period of time. Rope must be retired.

3.9 Chemical Degradation

Synthetic fibers generally have good resistance towards chemical attack and heat exposure under normal circumstances but may be weakened in certain situations. In many cases visual inspection may reveal discoloration and brittleness of the fibers. Melting, bonding of fibers, hard spots or stickiness may be observed, yet these indications are not always present. Any exposure to chemicals shall be logged and the inspector should research the exposure history of the rope.

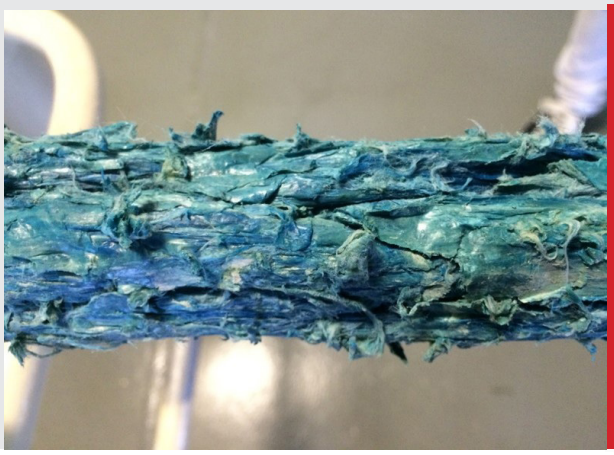
Nylon ropes can be seriously degraded by long-term contamination with rust when wet. This can be detected by a reddish or brown coloration. Fiber ropes stored at even moderately high temperatures for long periods of time can be degraded without visual indication.

High temperature will reduce the tenacity of the rope. The effect is greater at high humidity. Therefore, nylon ropes/tails used in a high temperature / high humidity environment will degrade faster.

Witnessed Condition	Code	Description/Recommendation
		Rope log shows that there has been significant exposure to chemicals. Rope must be retired.
		Rope discoloration, brittle fibers, fusion, bonding of fibers, hardness. Chemical exposure suspected. Rope must be retired.

3.10 Heat Damage

Excessive heat causes rope fibers to fuse together, and the rope may show signs of charring. If the rope has slid under high tension discoloration may appear, and the rope may appear black from extreme melting.

Witnessed Condition	Code	Description/Recommendation
		Known significant exposure to high temperature. Melted and/or discoloration.

3.11 Dirt and Particles

Contamination with dirt particles can cause internal fiber abrasion in ropes.

Witnessed Condition	Code	Description/Recommendation
		Rope and deck/floor dirty and hardware paint dried on the rope. Recommended to inspect regularly for internal and external abrasion.
		Dirt in the rope structure, broken fibers. Internal and external abrasion. Rope must be retired.

3.12 Excessive Loading/Shock Load

Overloading or shock loading a rope above the working load limit might cause significant loss of strength and/or durability, but the damage may not be detectable by visual or tactile inspection. The best method to determine whether excessive tension or shock loading has occurred is the usage history of the rope, but it can be difficult to define. The inspector must take a conservative approach when reviewing the usage history of the rope. Shock loading may cause internal melting of the fibers in the rope. All incidents with shock loads or excessive load must be registered in the rope log/LMP.

4. Conclusion/Evaluation

All mooring ropes, tails and accessories shall be regularly evaluated by responsible deck officer. The frequency shall be defined based on vessel type, trading route, port conditions etc. If any special incident occur, such as sudden swell, passing vessel or other unforeseen situations, immediate visual inspection and evaluation shall be performed and logged accordingly.

To conclude on the ropes condition, below points shall be checked:

- Evaluate the rope's log in LMP or similar for the rope's history and mooring hours evaluation
- If any of the witnessed conditions above have been evaluated with color code red, the rope shall be retired or turned end-to-end in case this is possible
- In case of yellow color code evaluations, pay special attention to these points during the next inspection
- If more than one yellow observation on the same rope has been recorded, the total degradation must be evaluatedIt Is recommended to use the same type of ropes on all positions where ropes are working in parallel
- In case of some doubt contact producer for consultation or further evaluation (record of rope history will be necessary)

Residual strength of the rope can only be determined by destructive test. Please contact producer for further information. Re-splicing of a new eye must be performed according to the manufacturer's manual by competent personnel.

- In case of shock load breakage, the whole length under tension has been affected. Cut the rope at the tension winch flange and re-splice
- In case that you detect minor damage and decide to cut off the damaged part, continue with re-splicing of the eye according to the manual

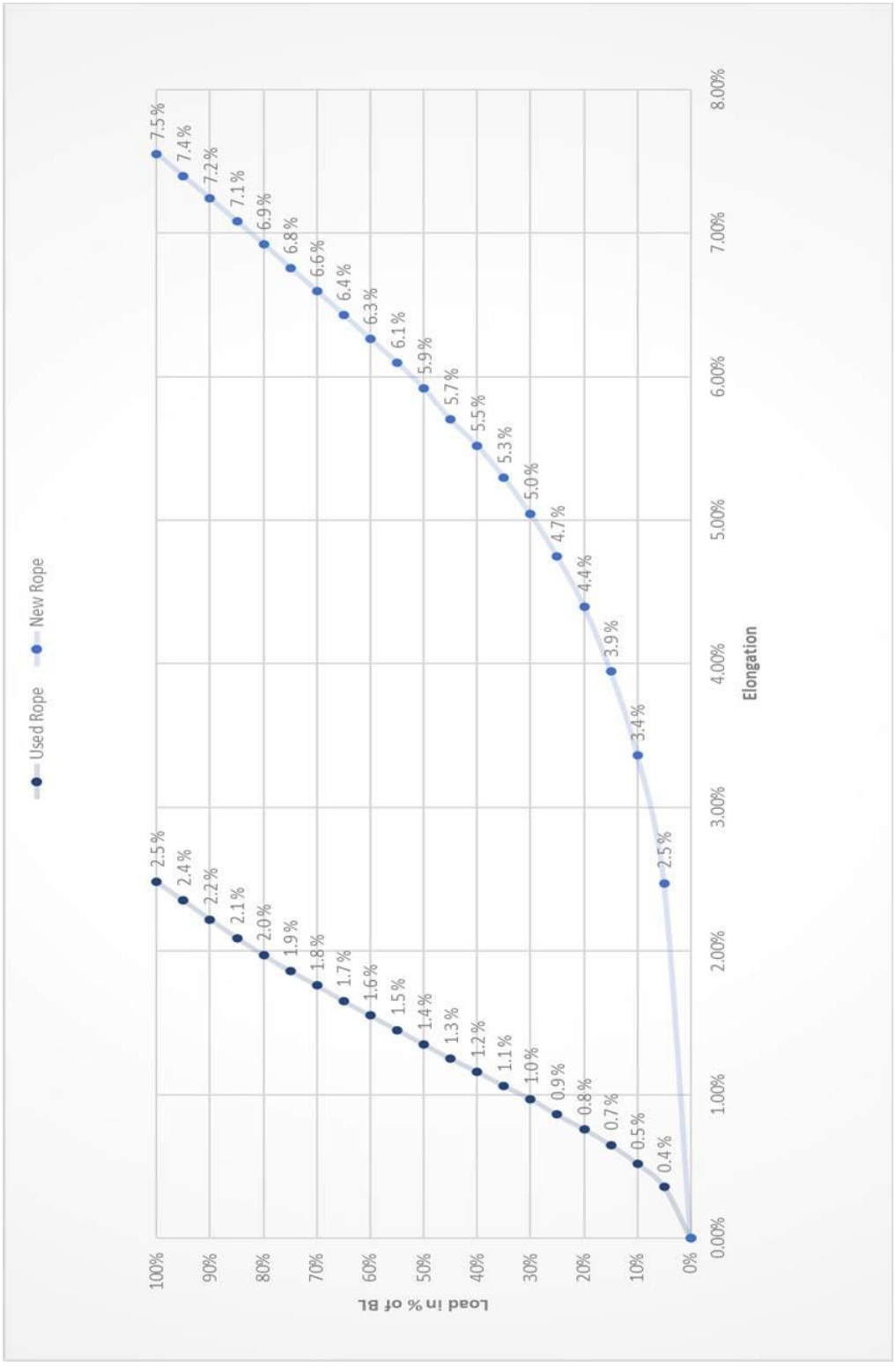
Sources

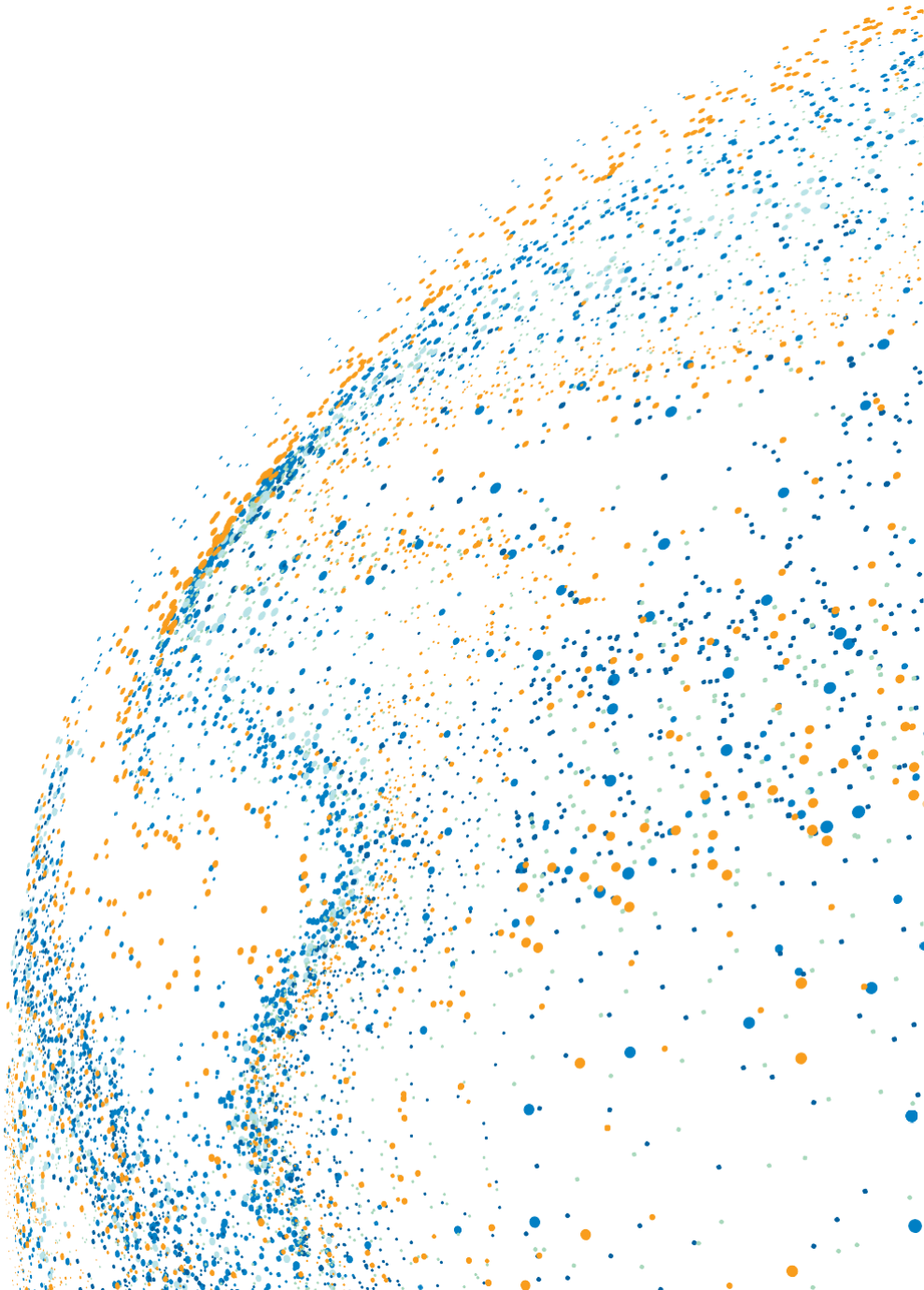
Cordage Institute CI 2001-04 Fiber Rope Inspection and Retirement Criteria. - Wayne, PA : Cordage Institute, 2004.

International Organization for Standardization ISO 9554:2019. - Geneva : International Organization for Standardization, 2019.

Oil Companies International Marine Forum Mooring Equipment Guidelines(MEG4). - Livingston : Witherby Publishing Group Ltd, 2018. - Vol. 4th Edition.

Appendix A – Elongation Graphs





Wilhelmsen Ships Service
Phone: (+47) 67 58 40 00
Fax: (+47) 67 58 40 80
Postal Address:
PO Box 33, NO-1324
Lysaker, Norway

V1.1-042024