ARCSOPT

Association of Resource Companies, Ship Operators, Ports & Terminals

Guidelines on Safe Mooring Practices for Non-Bulk Liquid Vessels

Technical Guideline 04-23

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Technical Guideline History

Date	Version	Technical Working Group Notes	Action
01/11/23	1	Committee endorsed Technical Proposal to Guideline.	Posted to website.

Purpose

The purpose of this technical guideline is to provide bulk carrier and container ship operators and industry participants with relevant guidance on matters relating to mooring lines, mooring winches, and deck mooring fittings.

1. Concepts of this technical guideline

A key focus in the design of moorings systems is to introduce adequate safety factors that reduce the likelihood of the failure of any of the components of the mooring system (e.g., deck fittings, mooring lines) when subject to load. From a holistic perspective, this is achieved through the concept of considering the entire mooring system, the mooring winch brake rendering at a pre-set load prior to a failure point being reached being an important part of this system. The effectiveness of this concept is underpinned through effective shore based and on board understanding of related technical concepts, processes, training, and the use of appropriate equipment.

2. Determining the mooring winch brake render set point

There are multiple approaches to achieving the optimum mooring winch brake render set point value on board any specific vessel. The content within this technical guideline addresses two options (as of the date of publication of this guideline) available to a vessel operator and vessel staff that are aligned with the current regulatory framework.

- Option 1: Use the SDMBL of the vessel – either assigned to the vessel by the shipyard at the time of the vessels construction or achieved through calculations (for existing vessels).
- Option 2: Use known values of mooring ropes in use, mooring equipment and deck fittings as noted within the vessel's equipment manuals / certificates (for existing vessels).

3. Guiding principles for setting the mooring winch brake render set point

a. The ship's mooring winch brake render set point should be determined holistically with consideration being given to the classification society generated SDMBL, LDBF of mooring ropes in use, maximum BHC at the first layer of the mooring winch and the SWL of the deck mooring fittings.
b. For both conventional and split drum mooring winches, the selected maximum load for the mooring winch render set point should not exceed the maximum brake holding capacity at the first rope layer or the SWL of vessel's deck mooring fittings in use for the mooring configuration.
c. For conventional drums, mooring winch brake rendering loads should be set as per the first layer value given in the winch manual. However, the loads for three to four layers should also be considered as many rope layers typically remain on the drum.
d. In such cases when considering these loads, the load at the first layer should not exceed the BHC at the first layer as noted in the manual.
e. For split drums mooring winch render points must be set at the first layer. During mooring operations, only a single wrap must be always maintained on the drum.
f. Mooring winch brake render tests should be undertaken on an annual basis.
g. Mooring winch brake render tests should be undertaken after major maintenance of the mooring winches, changing mooring lines where the diameter of the mooring lines has significantly changed (i.e., change from polypropylene to HMPE mooring lines) or after a mooring rendering event. The mooring winch brake render set point must be prominently displayed and applied while the vessel is moored at the terminal.
h. Equipment used to undertake mooring winch brake render tests should be fit for purpose in accordance with the ship operator's safety management system.

- NOTE 1: In all cases, the mooring winch brake should be set to render at a value equal to or lower than the maximum brake holding capacity at the first layer.
- NOTE 2: For mooring operations where, mooring lines are secured on bitts, the mooring line LDBF should not exceed the SWL of the deck mooring fittings.
- NOTE 3: It is recommended that terminal operators provide ship operators with information on the SWL of the terminal mooring equipment.

4. Mooring Winch Brake Render Set Points and Testing where SDMBL is utilised.

Where a ship operator has access to the ship's SDMBL, the following should be considered when setting the mooring winch brake render set point:

a. Where the SDMBL is known, the mooring winch brake render set point should be 50% to 80% of SDMBL.

For Bulk Carriers and Container vessels, the SDMBL derived from the class approved EN calculation should be used as a guideline in the management and operations of ship's mooring systems.

For a vessel where the SDMBL or EN calculation is unavailable or unknown, the following is recommended:

a. The SDMBL can be assumed to be the same as the MBL of the original mooring lines which were placed on board as part of the vessel's compliance to class and subsequently flag state requirements.
b. The SDMBL can be calculated and assumed to be 125% of the maximum mooring winch brake holding capacity which can be found in the mooring winch certificate.
c. The SDMBL can be assumed to be the same as the minimum safe working loads (SWL) of the deck mooring fittings which are designated for mooring operations.
d. In cases where the MBL of the original mooring lines and / or 125% of the maximum brake holding capacity are greater than the safe working loads (SWL) of the mooring fittings, the SDMBL should be taken as the SWL of the mooring fittings.

- NOTE 1: In all cases, the mooring winch brake should be set to render at a value equal to or lower than the maximum brake holding capacity at the first layer.

5. Mooring Winch Brake Render Set Point where the SDMBL is not utilised.

If the SDMBL of the vessel is not being utilised, then the mooring winch brake render set point should be THE LEAST VALUE OF:
a. 50% to 80% of the Design Brake Holding Capacity (BHC) of the mooring winch.
b. 60% of the LDBF of the mooring line.
c. SWL of the deck mooring fittings used for the mooring of the vessel at the terminal.

- NOTE 1: In all cases, the mooring winch brake should be set to render at a value lower than the maximum brake holding capacity at the first layer.

6. Mooring Winch Brake Render Set Point - Vessels built after 01 January 2024

Information available at the time of publishing this technical guideline indicates that for vessels built after 01 January 2024, such vessels will need to comply with the guidelines of MSC Circular 1175 (as amended).

7. Mooring Line Design Break Force greater than SWL of deck mooring fittings

It is recommended that the mooring line LDBF should not exceed the SWL of the deck mooring fittings and/or the mooring winch brake SWL.

However, in cases where the mooring line LDBF does exceed the SWL of the deck mooring fittings, the following should be considered:

The mooring winch brake render set point should be THE LEAST VALUE OF:

a. 50% to 80% of the Design Brake Holding Capacity (BHC) of the mooring winch
b. 60% of the LDBF of the mooring line
c. SWL of the deck mooring fittings used for the mooring of the vessel at the terminal

8. Mooring System and Mooring Line Guidelines

a. Generally, the original and in-service lines design breaking force (LDBF) typically ranges between 100-105% of the SDMBL.
b. Greater strength lines (i.e., larger LDBF) can be used than what was originally installed subject to section 5 being complied with.
c. Diameter of synthetic mooring lines should not be greater than 80 mm.
d. Mooring lines should not be constructed of wire.
e. Mooring lines constructed of high modulus synthetic fibre (HMSF / HMPE) material must be fitted with mooring tails.
f. Mooring tail design breaking force (TDBF) should be 125 % to 130% of the LDBF of the mooring rope and constructed of less stiff material. Nylon tails should be certified “Tested wet”.
g. Mooring tails are to be connected to the primary mooring line by cow hitch, unless otherwise recommended by the mooring rope manufacturers.
h. All mooring lines must be a minimum of 200 meters in length.
i. All mooring line tails to be between 11 and 22 metres.
j. Mooring lines and tails should be inspected in accordance with the vessel operator’s safety management system.
k. Mooring lines should be fresh water rinsed after use.
l. All tails in the same lead should be of similar type, strength, length, and material.
m. Each fitting should be clearly marked to indicate the SWL of the fitting. The units (Mt, Kn etc) should also be clearly indicated to avoid overloading the fitting.

9. Mooring System and Mooring Line Management Plans

It is recommended that vessel operators develop Mooring System and Line Management Plans whose primary function is to provide clear and concise guidance on the management of the onboard mooring system and mooring lines.

It is recommended that the Mooring System and Line Management Plans should contain as a minimum the following information:

a. The SDMBL and the methodology used to determine the SDMBL (if applicable).
b. Mooring equipment and deck fittings in service on board the vessel and their safe working loads (SWL).
c. The optimum mooring configurations for the vessel.
d. The Mooring winch brake test records in a clear concise format. The format must articulate and include the SDMBL, the type of mooring winch in service, the date of the test, the mooring winch maximum (design) brake holding capacity (BHC), the dimensions that were utilised for undertaking the calculations for determining hydraulic pressure settings, the brake rendering set value and reason for chosen set point value.
e. The mooring line and tail in service life cycle records.
f. The number, type and size of mooring lines and tails in service.
g. The number and type of mooring line and tails held as spares. Vessels shall maintain at least two new spare mooring ropes of each type of mooring rope in use.
h. Certificates for all in-service and spare mooring lines and tails.
i. Guidelines for safe storage of all mooring lines

j. Mooring equipment, mooring line and deck fittings maintenance and inspection regime.
k. Mooring winch render test procedures including an understanding of the loads generated by the hydraulic jack and transmitted to the deck during the render load setting process.
l. Detailed and unambiguous guidance and training to be provided to ship's crew to conduct mooring rope inspection to verify each ropes continued suitability for use.

10. Mooring Line Stowage and Service Life

The mooring and line management plans should also include the life cycle plan for mooring lines. The process should commence with the selection of the mooring lines for specific environments and include the monitoring of the physical condition via inspections and the determination of residual strength of the mooring line throughout its service life.

The below guidelines should be followed:

a. Stowage in a well-ventilated, cool location away from direct / indirect sunlight (ropes should be covered when not in use).
b. Stowed without bends or kinks in the storage position.
c. Stowed not in direct contact with the deck.
d. Stowed not in contact with oil, grease, paints, thinners etc.
e. Service life should be pre-determined, and rope should be retired based on rope type.

11. Mooring Line Deployment Practice

The following guidelines should be considered by vessel operators and vessel staff in the deployment and management of mooring lines when alongside a terminal:

a. In terminals where minimum mooring equipment requirements have been set, terminals shall convey this to the vessels to confirm compatibility.
b. Vessels must be equipped with the same type of lines on the same leads to ensure that powered drums tending to the same lead share an equal environmental load and to avoid overloading the ropes.
c. Vessels may deploy mooring lines using powered drums as far as practically possible.
d. The mooring winch brakes should not be over-tightened. Mooring winches should be set to render at a pre-determined value.
e. More than one mooring line should not be run through one (1) fairlead.
f. Ship operators should ensure there are sufficient staff on board to monitor and tend to mooring line tension all through the period of berth occupancy always taking into account the local environmental conditions.

Addendum 1 - Glossary

1. **Line Design Breaking Force (LBDF) of Mooring Rope**: It is the minimum force at which a new dry, “spliced mooring line” or ‘tail” will break when tested. This is for all mooring lines and tails except for those manufactured by nylon, which is tested wet and spliced.
2. **EN assigned SDMBL:** Each vessel at the design stage is assigned an “EN” (Equipment Number / Numeral) by Class. The EN corresponds to a Ship Design Minimum Breaking Load (SDMBL), which is the EN assigned SDMBL. This SDMBL is for reference purpose only.
3. **Brake Holding Capacity (BHC):** As provided in the mooring winch manual. This value may already include a factor of safety ranging from 60% to 80%. Some manuals may provide a 100 % value. It is recommended that this is confirmed from the manufacturer and a value up to 80% is used (20% safety margin) for brake rendering calculations. The value given in the manual is applicable for the first layer only. For subsequent layers the value should be reduced.
4. **SWL of fittings:** A load less than the breaking load by a safety factor as determined by a standard, code, or practice. Can be obtained from the ships mooring plan/manual and SWL already has a safety factor embedded.

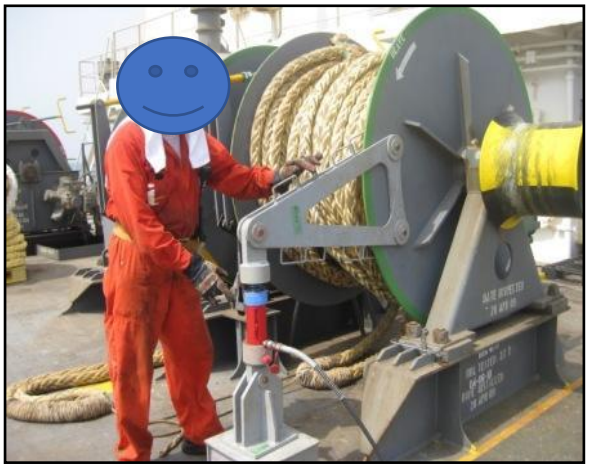
Addendum 2 - Mooring line and mooring tail service life guidelines

Type	Inspection Retirement/End for End	Condition for Extension in Service
Synthetic (except HMSF ropes) Mooring Ropes / Nylon Ropes	Regular Inspections by Ships Staff and qualified individuals. Retirement 5 years from date in use End for End 2.5 years from date in use. Damaged and/or overloaded mooring lines should be retired.	Extension on case-to-case basis after thorough evaluation of condition and inspection by line manufacturer or third party (using the manufacturers guidelines or cordage institute guidelines fiber rope inspection and retirement criteria). **Service life cannot be extended to more than 8 years.**
HMSF ropes	Regular Inspections by Ships Staff and qualified individuals. End for End each 2.5 years from in service date. HMSF lines at (5) years in service require examination/recertification. Damaged and/or overloaded mooring lines should be retired.	Case-to-case basis after thorough evaluation of condition and inspection by line manufacturer or qualified third party to recertify the line whose service life exceeds five (5) years. **Service life cannot be extended to more than 10 years**
Mooring Wires	Not permitted at terminal.	No extension permitted
Mooring tails	Regular Inspections by Ships Staff 18 months from date in use. Damaged and/or overloaded mooring lines should be retired. Tails shall be between 11 to 22 meters in length. Tails LDBF shall be 125% to 130% of the LDBF of the mooring rope it is connected to	Case-to-case basis may be extended to 24months basis evaluation of the service life and condition by qualified 3rd Party. No extension permitted beyond 24months.

Addendum 3 – Procedure to carry out brake rendering test.

1. Prepare the brake rendering calculations and submit to office for review.
2. Brake render testing has inherent risks, involving use of high pressure, potential damage to the testing equipment, mooring equipment and the deck itself. Therefore, it is important that due risk assessment should be carried out, fit for purpose equipment is used, crew are trained and briefed of the risks involved prior undertaking this job.
3. Set up the brake testing kit to the winch drum as per below procedure.
   a. Switch OFF the power of mooring winch, Lock Out - Tag Out the power switch.
   b. Disengage the gear. Secure the mooring winch control lever by locking pin.
   c. Rotate the mooring winch drum manually by hand - to align the installation brake testing kit.
   d. Connect the brake testing kit to the mooring winch. Rotate mooring winch drum manually by hand for final adjustment. Fully tighten the brakes.
4. Ensure the following:
   a. A 10/12 mm steel plate of 1mtr x 1mtr is placed on deck under the jack to spread the load to prevent deformation of deck plating Ensure kit is positioned in the correct direction (considering the direction of load when the rope is passed, and brake is applied).
   b. Ensure the kit is correctly aligned to prevent accidental slippage of the jack under pressure.
   c. Lash the kit to ensure it does not injure someone if it slips under pressure.
   d. Mooring winch is NOT turned under power as it may cause serious injuries and damage the brake testing equipment.

5. Sample Photos



6. Fully tighten the brake.
7. Apply hydraulic pressure as calculated for first layer and confirm if brake slips or not (If slippage of brake occurs at less than calculated pressure brake should be inspected for defects, ~~or~~ wear down of brake band, frozen blocks, or couplings).
8. Once the calculated jack pressure is reached, monitor for a short while that the pressure is not reducing, then very slowly start releasing the brake till the brake slips. Make a marking of the point at which the brake slipped. Brake is considered to slip when a visual, audible slip occurs, or the pressure suddenly reduces.
9. Notes: Every time the brake slips the pressure on the jack shall be released and pressurized again. Do not continue tightening after the previous test as this will give incorrect markings. Non marking of the brake rendering set points may render the test invalid.
10. Repeat the above procedure for all winches on board.
11. Carry out training of crew and officers on how to use the markings when tightening the brakes depending on the number of layers on the winch before arrival in port.

12. Photographic Evidence required for each winch brake testing:
    a. The brake testing kit and arrangement on the winch.
    b. Photo of the pressure at which the brake slipped.
    c. Brake tightening mark on the brake spindle.
13. Sample Photo – Marking can be made on the other side, but not on the threads directly.

Addendum 4 - Contents of Line Management Plan (LMP) and Mooring Safety Management Plan (MSMP)

Line Management Plan (LMP)	Mooring Safety Management Plan (MSMP)
i) Record of Revisions ii) Introduction *-Objectives, Relevant definitions* iii) General Ship Particulars iv) Mooring Ropes/ Mooring Tails/ HMSF Lines (as applicable) *-Line installation* *-Storage* *- Repair* *- Maintenance* *- Inspection (Routine/detailed)* *-Wear zone management* *-Service life and retirement criteria* v) General *-Hazards & precautions* *-Operators SMS procedures,* *-Training & competence requirements,* *-Roles and responsibilities* vi) Appendix *-Mooring arrangement plan* *-Line manufacturer guidelines* *-Inspection records* *-Usage records* *- Certificates of Mooring Ropes/ Mooring Tails/ HMSF Lines* *- Sample Mooring Diagram*	i) Record of Revisions ii) Introduction *-Objectives, Relevant definitions* iii) General Ship Particulars iv) Detailed List of Mooring Equipment *- Permanent fittings & mooring machinery* *-Loose equipment's (mooring lines, tails etc.)* *-Critical & specialist equipment (e.g., winch brake testing equipment)* v) Inspection, Maintenance and retirement principle *-Inspection and planned maintenance schedules* *-Identification of critical and specialist equipment* *- Certificates and documents detailing onboard equipment and spares maintenance, e.g., winch brake test records* vi) Risk and Change management, Safety of personnel *-Identification and management of risks arising from the mooring system* *-Manning & training (Safe manning levels, Competency requirements, Familiarization and training requirements necessary before personnel undertake mooring operations, Mooring operations supervision, Communications methods)* *-Change management process and lines of authority* vii) Records and Documentation *-Mooring equipment-related Class Survey certificates & test certificates* viii) Mooring System Management Plan Register *Records, Operating instructions and documentation relating to the mooring equipment.* ix) Appendix *-Documents detailing safe operation of critical equipment* *- Training documentation* *- Equipment manufacturer books, operating and maintenance guidance* *- Change Management documentation*