MSC.1/Circ.1619

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GUIDELINES ON THE DESIGN OF MOORING ARRANGEMENTS AND THE SELECTION OF APPROPRIATE MOORING EQUIPMENT AND FITTINGS FOR SAFE MOORING

1 The Maritime Safety Committee, at its 102nd session (4 to 11 November 2020), having considered a proposal by the Sub-Committee on Ship Design and Construction, at its sixth session (4 to 8 February 2019), and recognizing the importance of design of mooring arrangements and the selection of appropriate mooring equipment and fittings for safe mooring operations, with a view to ensuring a uniform approach towards the application of the provisions of SOLAS regulation II-1/3-8, as amended by resolution MSC.473(102), which is expected to become effective on 1 January 2024, approved the Guidelines on the design of mooring arrangements and the selection of appropriate mooring equipment and fittings for safe mooring, as set out in the annex.

2 Member States are invited to bring the annexed Guidelines to the attention of ship designers, shipyards, shipowners, ship managers, bareboat charterers and other organizations or persons responsible for design of mooring arrangements and the selection of appropriate mooring equipment and fittings.

3 Member States are also invited to bring the annexed Guidelines to the attention of shipmasters, ships' officers and crew, and all other parties concerned.

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ANNEX

GUIDELINES ON THE DESIGN OF MOORING ARRANGEMENTS AND THE SELECTION OF APPROPRIATE MOORING EQUIPMENT AND FITTINGS FOR SAFE MOORING

1 Introduction

1.1 Historical evolution in ship designs, especially the design of large ships, has resulted in optimized performance and a greater degree of complexity; this has not been extended to the design of ships' mooring arrangements. These Guidelines support the application of the provisions of SOLAS for mooring arrangements and encourage greater consideration of the occupational safety and safe mooring of the ship when designing new ships. Improving the design of mooring arrangements should enhance usability and safety during towing and mooring operations.

1.2 Regulations II-1/3-8.7 and II-1/3-8.8 of the International Convention for the Safety of Life at Sea (SOLAS), as amended, require that for ships of 3,000 gross tonnage and above constructed on or after 1 January 2024, the mooring arrangement shall be designed, and the mooring equipment including lines shall be selected, in order to ensure occupational safety and safe mooring of the ship; and ships of less than 3,000 gross tonnage constructed on or after 1 January 2024 should comply with these requirements as far as reasonably practicable, or with applicable national standards of the Administration.

1.3 These Guidelines provide an approach to the design of mooring arrangements, and the selection of mooring equipment and fittings, which should be applied in conjunction with principles of ergonomics and usability.

2 Definitions

For the purposes of these Guidelines:

2.1 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.

2.2 Mooring area refers to the dedicated area on a ship where mooring equipment is installed and line-handling takes place. It also includes areas where there is a risk of personnel injury in event of snap-back or other failure of mooring equipment. There may be multiple mooring areas on a ship.

2.3 Mooring arrangements means the configuration of the mooring equipment and fittings and other design features of the ships related to the mooring operation, i.e. lighting and communication equipment.

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

2.5 Mooring lines means ropes, wires and combinations used for mooring operations other than messenger lines but including tails.

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

2.7 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.

2.8 Shipboard personnel means personnel assigned duties for supervising or working in mooring areas during mooring operations.

2.9 Ship Design Minimum Breaking Load (MBL_{SD}) 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.

2.10 Supervising personnel means shipboard personnel assigned duties for supervising mooring areas during mooring operations.

2.11 Towing and mooring arrangements plan means the plan as described in section 5 of the annex to the Revised guidance on shipboard towing and mooring equipment (MSC.1/Circ.1175/Rev.1). This plan presents specific information regarding the towing and mooring fittings aboard the vessel, the mooring lines, as well as the arrangement of mooring lines and the acceptable environmental conditions for mooring.

2.12 Working Load Limit (WLL) means the maximum load that a mooring line should be subjected to in operational service, calculated from the relevant environmental mooring restraint requirement.

3 Goals

The equipment selection and mooring arrangement design safety objectives should be to facilitate safe mooring operations and reduce the risk to shipboard personnel and mooring personnel caused by inappropriate selection and arrangement of equipment and fittings.

4 Functional objectives

4.1 A ship should be provided with mooring equipment and fittings appropriate for its type and size. In addition, a ship should be provided with mooring lines appropriate for the equipment and fittings installed on board. In order to achieve the goals for the correct equipment selection and mooring arrangement design safety objectives set out in section 3, the following functional objectives should be applied.

4.2 Mooring equipment and fittings should be:

.1 arranged to minimize obstructed access to and operation of the mooring equipment;

.2 arranged to minimize obstructed access to working space and minimize obstructed view of the mooring area;

.3 arranged to minimize the need for complex mooring line configurations during the normal operation of the ship;

.4 selected and arranged to minimize the need for manual handling of mooring lines under load; and .5 selected

and arranged to minimize the exposure of personnel involved in mooring operations to the dynamic loads of mooring lines.

.5 selected and arranged to minimize the exposure of personnel involved in mooring operations to the dynamic loads of mooring lines.

5 Achievement of the functional objectives

To meet the functional objectives, the following design and equipment features should be considered from the earliest stage in the design process.

Selection of equipment, fittings and mooring lines should not be undertaken independently. To facilitate safe mooring operations, it is necessary for mooring equipment, fittings and mooring lines to be considered as a complete system within which all components are compatible.

The guidance on the design of mooring arrangements and the selection of equipment and fittings should be read in conjunction with MSC.1/Circ.1175/Rev.1.

This section should be implemented to the extent permitted by the size and purpose of the ship.

5.1 Design of mooring arrangements

5.1.1 To minimize the need for complex mooring line configurations during the normal operation of the ship, mooring winches and fairleads should be positioned to allow the use of direct, unobstructed leads from the mooring winch to the fairlead for each of the mooring lines described in the towing and mooring arrangements plan. It is preferable to provide a dedicated fairlead for each mooring line.

5.1.2 Where a straight lead is not possible:

.1 the deviation from a straight lead should be by means of pedestal fairleads, rolling fairleads or similar means that will reduce friction between line/fitting and reduce bend losses. Steel fittings such as horns or bollards without chafe protection should be avoided;

.2 the line should traverse the mooring area from winch to the fairlead by the shortest route; and

.3 changes of direction of mooring line should be minimized to prevent reductions in mooring line strength due to bend loss and introduction of complex snap-back areas.

5.1.3 To provide for the oversight and supervision of the mooring operations, the mooring area should be designed to give supervising personnel an unobstructed view of the installed mooring equipment and fittings. This should include the provision for a platform, or other appropriate means, by which supervising personnel can obtain an unobstructed view of the mooring area and berth arrangements planned to be used from a position clear of hazards.

5.1.4 The mooring arrangements should be designed to provide unobstructed views between shipboard personnel, and of lines being worked, within the mooring area.

5.1.5 The winch operator should be provided with mooring winch controls that are positioned so that the winch operator has a direct view of the line in the mooring area being worked without stepping away from the winch controls. Winch controls should be positioned clear of hazards.

5.1.6 Deck illumination should provide a clear view of the mooring area and the equipment and lines being worked during hours of darkness or in conditions of limited visibility.

5.1.7 The design of mooring arrangements and mooring areas should take into account the following constraints:

.1 anticipated variations in shore-based mooring arrangements and the need to preserve flexibility in mooring line configurations to achieve an appropriate restraining capacity;

.2 ships' structural elements, including accommodation, ventilation exhausts, cargo equipment or similar

obstacles, on access; and

.3 special requirements for the location and selection of mooring equipment and fittings, for example special requirements for canal transits.

5.1.8 Unless the size and special features of the ship do not permit it, equipment and fittings in mooring areas should be positioned to provide shipboard personnel with unobstructed access to the following during mooring operations:

.1 mooring winches and winch controls;

.2 mooring fittings;

.3 mooring lines and mooring line stowage; and

.4 the space between shipside fairleads and winches to permit mooring personnel to safely apply stoppers to mooring lines when necessary.

5.1.9 The mooring arrangements should be designed to avoid the exposure of the shipboard personnel to lines under tension through snap-back or sudden movements of mooring lines. In this respect the following measures should be considered:

.1 locate winches close to shipside fairleads. The position of winches should not result in inappropriate mooring line orientations, or block or otherwise interfere with the use of shipside fairleads for additional mooring lines, connecting up of tugs for towage during mooring operations or the ability to safely moor the ship;

.2 enclosing the mooring line(s) behind barrier(s) provided that such enclosures do not adversely affect the performance of the mooring system and do not prevent effective inspection and maintenance of equipment, fittings and mooring lines;

.3 alternative design(s) where crew members do not need to work close to or have to pass mooring lines under tension or potentially under tension;

.4 use of appropriate, alternative means to moor the ship, including but not limited to automated mooring systems; or

.5 permanently fix mooring lines to a mooring winch.

5.1.10 Mooring areas should be considered as potential snap-back zones and signage should be provided to indicate that this is the case.

5.1.11 To minimize the need for manual handling of towing and mooring lines, the following measures should be considered:

.1 equipment and fitting arrangements should minimize the distance over which any mooring line may need to be handled;

.2 the use of fixed or dedicated mooring lines, taking into account the need to avoid inappropriate mooring line orientations, or block or otherwise interfere with the use of shipside fairleads for additional mooring lines, connecting up of tugs for towage during mooring operations or the ability to safely moor the ship;

.3 the layout to be designed to prevent manual intervention in transfer of the mooring line from storage drum to mooring winch drum and vice versa;

.4 use of spooling equipment;

.5 additional mooring lines should be available for immediate use, provided that their stowage does not interfere with the safe operation of the mooring equipment; and

.6 a sufficient number of mooring winches so that, during mooring operations, manual use of warping ends,

stoppers, capstans and bitts is minimized, as far as possible.

5.1.12 The mooring arrangement design should take into account the principles for effective mooring arrangements included in appropriate industry guidance on mooring equipment and fittings.

5.2 Selection of equipment, fittings and mooring lines

5.2.1 The selection of winches should take into account:

.1 the availability of winches with alternative drum arrangements, including split drum arrangements, which can reduce the need for manual handling of mooring lines during mooring operations;

.2 the positioning of winch controls, including the availability of remote controls for winches to improve the line of sight and reduce operator exposure to snap-back;

.3 the availability of constant tension winches and their appropriateness for the normal operation of the ship; and

.4 limiting noise levels to ensure proper communication during mooring operations.

5.2.2 The selection of fittings should take into account:

.1 the type of mooring line with which the fitting is designed to be used. The design or selection of the fitting and the design of its hull supporting structure should be done in accordance with MSC.1/Circ.1175/Rev.1;

.2 the diameter D of surfaces of mooring fittings that are in contact with the mooring line in relation to the mooring line diameter d (D/d ratio) to reduce or mitigate bend loss of strength; and

.3 the need for the load-bearing surfaces of fittings to minimize damage from chafing and abrasion.

5.2.3 The selection of mooring lines should take into account:

.1 the guidance on mooring restraint as per appendix A of MSC.1/Circ.1175/Rev.1;

.2 the diameter D of surfaces of mooring fittings that are in contact with the mooring line in relation to the mooring line diameter d (D/d ratio) to reduce or mitigate bend loss of strength;

.3 the compatibility of the MBL_{SD} of mooring lines and the brake capacity of the mooring winches installed on board;7

.4 the Line Design Break Force (LDBF) to be 100% to 105% of the MBL_{SD};

.5 the characteristics and limitations of mooring lines including material properties and environmental operating conditions anticipated during normal operation of the ship;

.6 the anticipated behaviour of the mooring line in the event of failure;

.7 the influence on stored energy and the potential for snap-back of high stiffness mooring lines caused by the use of tails; and

.8 as far as possible, but at least for lines in the same service (e.g. headlines, breast lines or springs), mooring lines of the same diameter and type (i.e. material) should be used.

5.2.4 To avoid overload on mooring winches, fittings and mooring lines, consideration should be given to select mooring winches with brake capacity of less than the ship design minimum breaking load of the mooring line or with adjustable brake capacity.

5.2.5 Fittings, particularly shipside fairleads, should be positioned to minimize the potential for chafing of mooring lines during the normal operation of the ship.

5.2.6 The selection of equipment and fittings including lines should take into account the principles for effective mooring arrangements included in appropriate industry guidance.

5.2.7 The mooring equipment, fittings and the mooring lines should at all times be compatible in design, diameter, strength, suitability, etc. and maintained with the original purpose and concept of the mooring arrangement.

5.2.8 Load limits

5.2.8.1 Notwithstanding the definitions in paragraph 2.1, LDBF of mooring lines made of nylon should be tested under wet and spliced conditions.

5.2.8.2 All components of a ship's mooring system, within defined tolerances, should be selected based on MBL_{SD}.

5.2.8.3 When selecting lines, the LDBF should be 100% to 105% of the MBL_{SD}.

5.2.8.4 The WLL of mooring lines should be used as user operating limiting values, not to be exceeded. The WLL is expressed as a percentage of MBL_{SD} and should be used as a limiting value in operational mooring analyses. Steel wires have a WLL of 55% of MBL_{SD} and all other cordage (synthetic) have a WLL of 50% of the MBL_{SD}.

6 Documentation on deviation

6.1 A supplement to the "Towing and mooring arrangements plan" should record the deviations if any, in relation to the following paragraphs:

.1 5.1.2 (where a straight lead is not possible);

.2 5.1.4 (unobstructed views);

.3 5.1.5 (protection of winch operators);

.4 5.1.8 (access to mooring equipment and fitting);

.5 5.1.9 (exposure of the shipboard personnel to lines under tension); and

.6 5.1.11 (minimize the need for manual handling of towing and mooring lines).

6.2 The documentation should include justification for such deviations and suitable safety measures, if any.

6.3 A reference to the supplement should be included in the towing and mooring arrangement plan so as to make the shipboard personnel aware of the safety measures which need to be considered during mooring operations.

7 References

(1) Oil Companies International Marine Forum (OCIMF), Mooring Equipment Guidelines, 4th Edition 2018, ISBN: 978-1-85609-771-0.

(2) Ian. C. Clark BSc, MSc, Master Mariner, MNI, The Nautical Institute, Mooring and Anchoring Ships Vol.1, Principle and Practice, ISBN: 9781906915934, 2009.