GUIDANCE FOR MAINTENANCE AND INSPECTION OF MOORING EQUIPMENT.

How to get your vessel in compliance with MSC.1/Circ. 1620, GUIDELINES FOR INSPECTION AND MAINTENANCE OF MOORING EQUIPMENT INCLUDING LINES.

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Contents

1 GENERAL

1.1 Introduction

As part of Resolutions from the hundred and second session of the Maritime Safety Committee in November 2020 (Res. MSC.474(102),) **SOLAS II-I Reg.3-8 "Towing and mooring equipment"** was amended. This amendment is aimed to introduce a more holistic approach to all aspects of safe mooring, by introducing three new guidelines affecting new buildings and existing vessels.

- MSC.1/Circ.1175/Rev.1 Revised guidance on shipboard towing and mooring equipment
- MSC.1/Circ.1619 Guidelines on the design of mooring arrangements and the selection of appropriate mooring equipment and fittings for safe mooring
- MSC.1/Circ.1620 Guidelines for inspection and maintenance of mooring equipment including lines

The amended regulation will enter into force (EIT) 2024-01-01.

MSC.1/Circ.1620 "Guidelines for inspection and maintenance of mooring equipment including lines" has retroactive requirements that will have effect on existing vessels. The purpose of the MSC.1/Circ.1620 is to provide 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.

1.2 Objective

The purpose of this guidance is to provide recommendations and guidance related to how existing vessels can document compliance with **MSC.1/Circ.1620 "Guidelines for inspection and maintenance of mooring equipment including lines."** It is recommended that MSC.1/Circ.1620 is read in conjunction with this guidance.

1.3 Scope

This guidance includes a description of the documentation needed to verify early compliance with **MSC.1/Circ.1620.**

1.4 Application

The retroactive requirements given in **MSC.1/Circ.1620 Guidelines for inspection and maintenance of mooring equipment including lines** is applicable for to all vessels required to comply with SOLAS II-I Reg.3-8.

1.5 Definitions

Equipment number (EN)	a dimensionless parameter used to determine the size and number of anchors, chain cables and mooring & towing lines for a new ship. However, it is important to remember that the anchoring equipment determined in accordance with the "Equipment Number" is intended for temporary mooring of a vessel within a harbor or sheltered area, when the vessel is awaiting berth, tide, etc..

Ship Design Minimum Breaking Load (MBL**SD**) / Minimum breaking strength (MBL)	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.
Line Design Break Force (LDBF)	the minimum force at which a new, dry, spliced, mooring line will break. This is for all synthetic cordage materials.
Mooring arrangement	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.
Towing and mooring arrangements plan	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.
Mooring equipment and fittings	items such as winches, capstans, bollards, bitts, fairleads, rollers, chocks, etc. and also includes mooring lines.
Mooring line configuration	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	normal mooring and unmooring of the ship, including associated in-harbor towing movements.
Mooring personnel	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	periodical change of mooring lines between mooring drums to equalize the wear of mooring lines.
Bend radius (D/d ratio)	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.
Mooring boat	the boat handling mooring lines between the ship and ashore mooring facilities during mooring and unmooring operations and does not include harbor ship assist tugs (see the *Guidelines on minimum training and education of mooring personnel* (FAL.6/Circ.11/Rev.1)).

2 VOLUNTARY STATEMENT OF COMPLIANCE

2.1 Introduction

The retroactive requirements given in MSC.1/Circ.1620 will be applicable for all newbuilding and all vessels in operation after 2024-01-01. DNV may provide a Statement of Compliance for a vessel prior to the requirements entering into force.

For vessels built before 2007, compliance with SOLAS mooring requirements was not required. For these vessels some information such as SWL and MBL may not be readily available. MBL may not correspond to the approved EN, or SWL on fittings may not correspond to MBL. In some cases, new calculations may have to be carried out. Such calculations can either be carried out by the company themselves, or a third party such as DNV Advisory or others. The calculations might show that strengthening of support foundation for mooring fittings are necessary to attain an acceptable MBL and SWL.

To comply with the retroactive requirements the mooring arrangement and mooring fittings may have to be updated (strengthened) before 2024-01-01. Any hull structural modification will be subject to class approval.

2.2 Documentation

To comply with the requirements, procedures for mooring operations, and inspection and maintenance of mooring equipment shall be established. The following information shall be submitted for the verification of compliance:

- Example of mooring operational procedure
- General vessel information - section 3.1 and Appendix A Table 1.
- Mooring arrangement drawing/plan - section 3.2, and Appendix A Figure 1, Table 2 and Table 3
- Design drawing of associated hull support foundation of mooring fittings and winches, and detail information of mooring fittings - section 3.2.4 and Appendix A Table 4
- Examples of inspection and maintenance plan for mooring winches and hull fittings - section 3.3. and Appendix A Table 5
- Examples of Identification and control of mooring line details - section 3.4 and Appendix A Table 6
- Examples of Inspection and maintenance plan for mooring lines - section 3.4 and Appendix A Table 7
- Procedure for replacement of mooring lines, see section 3.4.4
- Procedure for general record keeping, see section 3.5

3 GUIDANCE FOR COMPLIANCE

Throughout its operational life, mooring equipment should be maintained and operated in accordance with the original design concept, if available, including when replacing parts and lines. To ensure that all mooring equipment functions as designed, procedures for mooring operations, inspection and maintenance of mooring equipment, including mooring lines, should be established.

This section describes the content of the documentation that shall be submitted to verify compliance with the requirements given in MSC.1/Circ.1620.

3.1 General vessel information

The documentation submitted for verification of compliance shall contain the following general vessel information: Ship name, IMO no, Flag, Port of registry, Date of build, Principal dimension Loa x B x D and Equipment Number. See example given in **Appendix A Table 1 "General vessel information".**

3.2 Mooring arrangement drawing/plan

The towing and mooring arrangement plan is a document with index and characteristics of mooring winches shipboard fittings and ropes available for mooring and towing. The document should include a number of pre-planned layouts such as: basic mooring pattern; mooring pattern for excessive winds; emergency towing, etc. It shall be available on board for the guidance of the Master.

The mooring arrangement should include geometric arrangement of mooring lines, patten and layout between the ship and the berth. The following should be clarified in the mooring arrangement drawing/plan:

- All deck mooring fittings (winches, bollards, chocks, rollers, ropes and wires),
- the mooring patterns (line passing through winch, roller and chock/fairlead),
- safe working load (SWL) of each fitting,
- the minimum breaking strength (MBL/ MBLSD) of mooring ropes and wires

An example of a mooring arrangement drawing is given in appendix A Figure 1.

3.2.1 Safe Working Load (SWL)

The Safe Working Load (SWL (t)) is the load limit for mooring purpose. The SWL of mooring fittings shall not exceed the minimum breaking strength of the mooring line. The SWL of each shipboard mooring fitting shall be marked on the fittings. For fittings intended to be used for both mooring and towing, TOW (t) is to be marked in addition to SWL.

3.2.2 Safe Mooring principal parameters: Equipment Number, Minimum breaking strength, length & number of mooring lines

Safe Mooring principal parameters are the basis for dimensioning the mooring equipment and the mooring lines.

Each ship has an approved equipment number EN in accordance with requirements in IACS UR A1. The recommended minimum breaking strength and number of mooring lines can be found in IACS Rec. 10 Table 5 "Mooring lines and tow line".

For vessels delivered after 2016 having an equipment number EN >2000, the design minimum breaking load (minimum breaking strength) of mooring lines and the number of mooring lines should be calculated based on the vessel's side projected area. The side projected area can be calculated as per IACS Rec. 10, "Chain Anchoring, Mooring and Towing Equipment"

3.2.3 Mooring winches.

Mooring winches secure the shipboard end of mooring lines, provide for adjustment of the mooring line length and compensate for changes in draft and tide. General requirements for shipboard mooring winches are given in ISO Standards 3730 and 7825.

Winch brake holding capacity is normally designed to hold 80% of the new mooring rope or wire MBL and is set in service to hold 60% of the mooring line MBL. Brake holding capacity may be expressed either in tones or as a percentage of the line MBL. The rated brake holding capacity is only achieved with one layer of wire on the tension drum. Operation with additional layers will decrease the brake holding capacity.

For powered winches the maximum hauling tension which can be applied to the mooring line (the reeled first layer) should not be less than 1/4.5 times, nor be more than 1/3 times the rope's ship design minimum breaking load. For automatic winches these figures apply when the winch is set to the maximum power with automatic control.

For powered winches on automatic control, the rendering tension which the winch can exert on the mooring line (the reeled first layer) should not exceed 1.5 times, nor be less than 1.05 times the hauling tension for that particular power setting of the winch. The winch should be marked with the range of rope strength for which it is designed.

The documentation onboard the vessel shall contain a list of mooring winches with information like Line Number, Mooring winch, Drums, Brake Capacity, Output power, Certificate etc. See example given in **Appendix A Table 3**

3.2.4 Mooring fittings and associated hull support foundation

Shipboard mooring fittings (bollards, chocks, fairleads and rollers) shall be manufactured in accordance to an Industry Standard or International / National Standard. Shipboard fittings for mooring are located on longitudinal, beams and/or girders, which are part of the deck construction to facilitate efficient distribution of the mooring load. The minimum design load applied to supporting hull structures for shipboard fittings calculated to be 1.15 times the minimum breaking strength (MBL / MBLSD) of the mooring line. The minimum design load applied to supporting hull structures for winches is to be 1.25 times the intended maximum brake holding load, where the maximum brake holding load is to be assumed not less than 80% of the minimum breaking strength of the mooring line. Information about the deck mooring fittings shall be submitted with information given in **Appendix A Table 4.**

Hull support foundation of mooring fittings construction drawings should be included for:

- Fore, Midship and Aft deck constructions
- Winch / Windlass foundations
- Fore, cargo area and Aft mooring winch foundations
- Deck equipment reinforcement

3.3 Inspection and maintenance plan - mooring winches and hull fittings

Equipment and fittings should be properly inspected and maintained, based on the manufacturer's recommendations. Mooring equipment and fittings should be included in the onboard maintenance plan or equivalent maintenance management system. The maintenance plan may be computer based.

Records of inspection and maintenance should be available on board. Records of the original design concept, equipment, arrangement and specifications should be retained on board through the life cycle of the ship.

Equipment used in mooring operations should be regularly inspected and defects shall be corrected. Particular attention should be paid to oil leaks from winches. The surfaces of fairleads, bollards, bitts and drum ends should be clean and in good condition, and drum ends should not be painted. Rollers and fairleads should turn smoothly, and a visual check be made that corrosion has not weakened them.

Maintenance should include the preservation of the clear marking of information on equipment and fittings, including Safe Working Load (SWL) and winch control instructions.

An example of information to be included in an inspection and maintenance plan is given in **Appendix A Table 5.**

3.4 Mooring lines

As the most serious mooring accidents were "snapback" of loaded synthetic mooring rope when it breaks, extreme caution shall be given to loaded synthetic mooring ropes. Synthetic lines normally break suddenly and without warning. Stand well clear of the potential path of snapback whenever possible. Regular inspection of mooring lines is very important to eliminate possible failure during mooring operations.

Towlines and mooring lines may be of steel, natural fibre or synthetic fibre construction. Normally, the tensile strength of the wires shall be 1570 N/mm^2 or 1770 N/mm^2 in accordance with ISO Standard 2408. The wire shall be galvanized or bright (uncoated). Galvanized wire shall comply with the specifications in ISO Standard 2232.

3.4.1 Protection and storage of mooring lines

To preserve the design life of mooring lines, the following practices should be followed during mooring operations:

- smooth contacts at turn-off points with large angles and/or eye splices; and
- using covers/mats at ship side to protect against any friction damage.

Chocks / fairleads and other contact surfaces shall be maintained clean, smooth and rust-free in order to prevent abrasion damage of mooring lines. Consideration should be given to fitting chafe protection to the section of line passing through the fairlead.

For Panama leads, the steel should be highly polished. If this is difficult to achieve consideration should be given to fitting stainless steel or polymer liners. Roller fairleads or other rotating deck equipment should be well maintained and kept free to rotate as originally designed.

In all cases steel wire ropes or towing pennants should never be used on the same deck equipment, fairleads and rollers that HMSF or other synthetic mooring lines are to be used on.

To preserve the design life of mooring lines and reduce the potential for failure during mooring operations any storage provided for additional (loose) mooring lines should minimize the exposure to harmful environments (e.g. UV light, water, chemicals, cargo, extreme temperature).

Indoor storage in a clean, well-ventilated, dry location such as a rope locker is preferred. If outdoor storage is unavoidable, the rope should be covered with waterproof material to protect it from the sun and weather.

3.4.2 Identification and control of mooring lines

To facilitate inspection and maintenance, a record with details of mooring lines shall be established to allow the identification and control of mooring lines, tails and associated attachments. Such records may be included in either the towing and mooring arrangements plan or with records of inspection and maintenance. Such record should include:

- the number, type and location of mooring lines, tails and associated attachments.
- means of linking specific mooring lines, tails and associated attachments to the relevant records and a manufacturer's certificate, if available.

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An example is given in **Appendix A Table 6 "Details of mooring lines"**

Any defect discovered to the mooring lines during mooring operations should be immediately reported to the Master by all parties concerned including shore-based mooring personnel.

3.4.3 Inspection and maintenance plan - mooring lines

To prevent the deterioration of mooring lines to a condition which may result in the failure of the line during mooring operations, the periodic inspection of mooring lines, mooring line tails and associated attachments should be included in the onboard maintenance plan or equivalent maintenance management system. The maintenance plan may be computer based.

The requirements for inspection of individual mooring lines will be specific to the type of mooring line used on board. In general, onboard inspection of mooring lines will be based on manufacturer recommendations and by visual inspection of the outside of the mooring line to identify excessive wear or damage, e.g. external abrasion, external cut, kink, heat damage such as fusion and slackening or fraying of eye splices. Such visual inspections should be based on:

- the recommendations of the mooring line and/or tail manufacturer, particularly the criteria provided for the assessment of mooring line condition.
- operational experience regarding the performance of the mooring line and/or mooring line tail during previous mooring operations; and
- the environmental conditions to which the mooring lines and/or mooring line tails are routinely exposed.

In the case of jacketed synthetic fibre mooring lines, detailed visual inspection of the condition of the synthetic fibre line may not be possible. The condition of the external jacket is not an accurate indicator of the condition of the load-bearing synthetic fibre material within the mooring line.

All lines/wires used for mooring to be regularly inspected for defects. Attention should be paid to those sections of line that are proven by experience to be the main areas of deterioration such us spliced eyes and interface areas with winches, capstans bollards, fairleads and rollers. Inspection should also be conducted prior to use. Mooring lines installed on winches should be covered with a suitable water-proof tarpaulin or other similar covering when not in use.

Inspections should be carried out by visual assessment. The main areas of deterioration are external and internal abrasion, cut yarns/mechanical damage and inducted twist.

The following areas should be inspected:

- sections of line in wear zones, particularly those that run regularly through deck fairleads and around pedestal rollers,
- section of line at the crossover point on slip drum winches,
- eye splice, crown of the eye and sections of line close to the eye that may have been damaged through abrasion or contamination.
- mooring tails and integrity of the connection with the mooring line.
- wire lines at terminations (particularly Talurit type) to identify any looseness, cracks, distortion or corrosion.
- Wire ropes for any diameter reduction. Any marked reduction in rope diameter indicates degradation.

See **Appendix A table 7** for example of items covered "in the inspections and maintenance plan".

3.4.4 Selection of replacement mooring lines

All vessels shall have procedures for replacement of mooring lines and tails. When replacing mooring lines, compatibility with the mooring equipment and fittings on board, as specified in the mooring arrangement plan, should be taken into account. This should be achieved by selecting a replacement mooring line which meets the designed specifications. In cases where this is not possible, the following properties should be taken into consideration and the towing and mooring arrangement plan updated accordingly:

- breaking strength;
- environmental conditions to be used (e.g. temperature);
- linear density;
- tenacity;
- D/d ratios;
- compression fatigue; and
- stiffness.

Any increase in LDBF for the mooring lines above the limits specified, i.e. 100% to 105% of the MBLSD, require a review of the operating parameters and load limits of mooring equipment and fitting as well as of their hull supporting structures.

It should be noted that, when selecting replacement mooring lines, over time in service their strength will decay due to varying environmental conditions and thus the original service life expectancy may not be achieved. Therefore, the Company should ensure that the condition of mooring lines is tracked throughout their service with the objective to replace the line before failure.

For wire ropes, corrosion protection should be considered. For both wire and fibre mooring lines, the acceptable minimum bend radius (D/d ratio) recommended by the manufacturer should be taken into consideration as strength and life expectancy of these lines are directly related to the bend radius they are exposed to in service. Where the acceptable minimum bend radius recommendations for a particular mooring line are not achievable, the service life of the line may be less than that stated by the manufacturer and therefore the line may need to be replaced before the end of the service life recommended by the manufacturer. The condition of lines regularly exposed to below the acceptable minimum bend radius should be subject to particular attention during inspections. When selecting replacement mooring lines with high stiffness, including wire and high modulus synthetic lines, consideration should be given to the use of synthetic tails in order to reduce peak loading when the ship is secured alongside.

Consideration of the use of synthetic tails on high stiffness mooring lines should take into account industry and manufacturer guidance and the potential effects of synthetic tails on the stored energy of mooring lines under tension. The use of tails can change the characteristics of a mooring line and its behaviour in the event of failure. High stiffness mooring lines may exert significant dynamic force and have significant snap-back zones when used with synthetic tails that have a low stiffness.

3.5 Updating of ship documents and record-keeping

Records of inspection and maintenance of mooring equipment and inspection and replacement of mooring lines should be retained on board. Manufacturers' test certificates for mooring lines, joining shackles and synthetic tails should be kept on board and properly linked back to the equipment.

The items to be recorded during inspection and maintenance should be determined, taking into account the recommendations of the manufacturers of the mooring lines. Any change of mooring line configuration requires updating of the towing and mooring arrangements plan.

3.6 References

-GUIDELINES FOR INSPECTION AND MAINTENANCE OF MOORING EQUIPMENT INCLUDING LINES, MSC.1 /Circ 1620

-Anchoring Equipment, IACS UR A1

-Shipboard fittings and supporting hull structures associated with towing and mooring on conventional vessels, IACS UR A2

-Anchoring, Mooring and Towing Equipment, IACS Rec. 10

-Round drawn wire for general purpose non-alloy steel wire ropes and for large diameter steel wire ropes – Specifications, ISO 2232

-Shipbuilding and marine structures — Mooring winches ISO 3730

-Fibre ropes General specifications, ISO 955

APPENDIX A, EXAMPLES

- General vessel information - Table 1.
- Mooring arrangement drawing/plan - Figure 1, Table 2 and Table 3
- Design drawing of associated hull support foundation of mooring fittings and winches, and detail information of mooring fittings - Table 4
- Examples of inspection and maintenance plan for mooring winches and hull fittings - Table 5
- Examples of Identification and control of mooring lines details - Table 6
- Examples of Inspection and maintenance plan for mooring lines - Table 7

Table 1 General vessel information

Ship Name	
Ship Type	
IMO No	
Flag	
Port of Registry	
Class	
Class Notation	
Date of Build	
Build Yard	
Principal dimension Loa x B x D	
Equipment Number	

Figure 1, Mooring Arrangement (example)

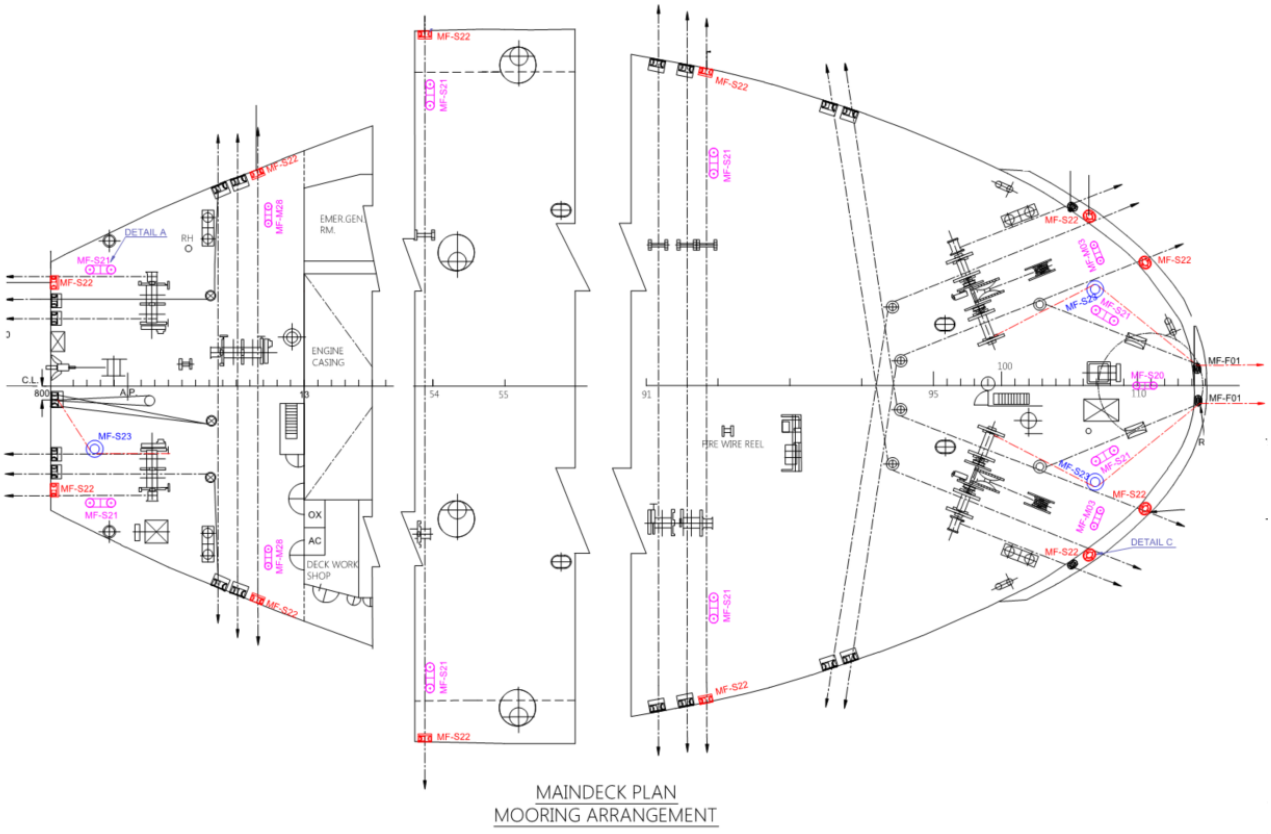

Table 2 Safe Mooring principal parameters (Example)

Equipment number	MBL / MBL SD	Total number of mooring lines	Length of mooring lines

Table 3 List of mooring winches (Example)

Line Number	Mooring winch	SWL(t)	Brake Capacity	Output power	Certificate
1	Forecastle – Port Winch				
2	Forecastle – Stbd Winch				
3	Forecastle – Port Storage Reel				
4	Forecastle – Stbd Storage Reel				
5	Main Deck – Forward Winch				
6	Main Deck – Aft Winch				
7	Bridge Deck Aft – Port Outer Storage Reel				

8	Bridge Deck Aft – Stbd Storage Reel				
9	Poop Deck – Port Winch				
10	Poop Deck – Stbd Winch				
11	Bridge Deck Aft – Port Inboard Storage Reel				

Table 4 List of mooring fittings (example)

Mooring Fitting						
SER. No.	Description	Dimensions	Q'TY	Ref. DWG	SWL (t)	Remark
FORE deck						
M-F01	Bow chock	600x400	1			ET:204T SPM:200T
M-F02	Bow stopper				200	
M-F03	Double bollard	500A			60	
M-F04	Roller	DIA400				
Mid deck						
M-M01						
M-M02						
M-M03						
AFT deck						
M-A01						
M-A02						
M-A03						

Table 5 Information to be included in a maintenance and inspection plan (Example)

Mooring equipment	Position/ location	Planned Maintenance (Ref. Maker recommendations and/ or minimum maintenance as per experience)	Inspection	Check of marking
Mooring winch no.1	Aft Stb.	E.g. Lub oil analysis, check of brake, overhaul etc. (Not an exhaustive list)	E.g. visual inspection and test prior to use	Maintenance should include the preservation, by appropriate means, of the clear marking of information on equipment and fittings, including SWL and winch control instructions
Bollard no.1	Forecastle Port	E.g. Check for corrosion, sharp edges, smooth contact surface etc (Not an exhaustive list)	E.g. visual inspection and test prior to use	Maintenance should include the preservation, by appropriate means, of the clear marking of information on equipment and fittings, including SWL

Table 6 Details of mooring lines (Example)

No.	Mooring rope	Diameter (mm)	Material	Length (m)	MBL(t)	Certificate
	Head lines					
	Head lines					
	Breast lines					
	Breast lines					
	Spring lines					
	Spring lines					
	Stern lines					
	Stern lines					
	Wire tails					
	Fore deck					
	Mid deck					
	AFT deck					
	Other mooring lines (STS)					
	Towlines					
	Fore deck					
	AFT deck					

Table 7 Record of inspections and maintenance (example)

Mooring line No	Inspection/ maintenance date	Inspection/ maintenance intervals	Maintenance instructions according to maker/ industry guidance	Visual inspections prior to use	Accumulated hours in use	Notes/ comments