

SUB-COMMITTEE ON SHIP DESIGN AND
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Agenda item 11

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**REVISED SOLAS REGULATION II-1/3-8 AND ASSOCIATED
GUIDELINES (MSC.1/CIRC.1175) AND NEW GUIDELINES
FOR SAFE MOORING OPERATIONS FOR ALL SHIPS**

Report of the correspondence group

Submitted by Denmark and Japan

SUMMARY

Executive summary: This document provides the report of the Correspondence Group on Safe Mooring Operations regarding the development of draft revised SOLAS regulation II-1/3-8 and the associated draft guidelines on the design of safe mooring arrangements, and consideration of the need for the IMO guidance on selection, identification, use, inspection and/or maintenance of mooring lines

Strategic direction: 5.2

High-level action: 5.2.1

Output: 5.2.1.1

Action to be taken: Paragraph 40

Related documents: MSC 95/19/2, MSC 95/19/13, MSC 95/INF.3, MSC 95/22; SDC 3/15, SDC 3/15/1, SDC 3/15/2 and SDC 3/INF.5

Introduction

1 The Sub-Committee, at its third session (18 to 22 January 2016), established the Correspondence Group on Safe Mooring Operations under the coordination of Denmark and Japan.

List of participants

2 Representatives from the following Member States participated in the group:

ANTIGUA & BARBUDA
AUSTRALIA
CHINA

DENMARK
FINLAND
INDIA

ITALY
JAPAN
MARSHALL ISLANDS
NETHERLANDS
NORWAY

REPUBLIC OF KOREA
SWEDEN
UNITED KINGDOM
UNITED STATES

from the following Associate Member of IMO:

HONG KONG, CHINA

from the following intergovernmental organization:

EUROPEAN COMMISSION (EC)

and from the following non-governmental organizations in consultative status:

INTERNATIONAL CHAMBER OF SHIPPING (ICS)
BIMCO
INTERNATIONAL ASSOCIATION OF CLASSIFICATION SOCIETIES (IACS)
ICHCA INTERNATIONAL LTD. (ICHCA)
OIL COMPANIES INTERNATIONAL MARINE FORUM (OCIMF)
INTERTANKO
SOCIETY OF INTERNATIONAL GAS TANKER AND TERMINAL OPERATORS LTD.
(SIGTTO)
INTERNATIONAL ASSOCIATION OF DRY CARGO SHIPOWNERS (INTERCARGO)
INTERNATIONAL HARBOUR MASTERS' ASSOCIATION (IHMA)
THE NAUTICAL INSTITUTE (NI)

Terms of reference

3 The group was instructed, taking into account documents MSC 95/19/2, MSC 95/19/13, MSC 95/INF.3, MSC 95/22, paragraph 19.2, SDC 3/15, SDC 3/15/1, SDC 3/15/2 and SDC 3/INF.5 and the discussion at SDC 3, to:

- .1 prepare draft SOLAS amendments regarding safe mooring operations, using annex 1 to document SDC 3/15 as a base document;
- .2 develop draft Guidelines on the design of safe mooring arrangements, using annex 2 to document SDC 3/15 as a base document;
- .3 when developing SOLAS amendments and guidelines on the design of the mooring arrangements consider information concerning selection, identification and use of mooring lines;
- .4 based on information made available, consider the need for guidelines on the inspection and/or maintenance of mooring lines; and
- .5 submit a report to SDC 4.

4 It was agreed to work on the terms of reference set out in paragraphs 3.1 and 3.2 under the coordination of Denmark, and on the terms of reference set out in paragraphs 3.3 and 3.4 under the coordination of Japan.

Working procedure

5 By using annexes 1 and 2 to document SDC 3/15 as the base texts for a draft revised SOLAS regulation II-1/3-8 and the associated draft guidelines, respectively, the participants were invited to provide their comments. In addition, participants were also invited to provide their comments on work items prepared by the coordinator regarding the terms of reference outlined in paragraphs 3.3 and 3.4 above. The work was then carried out through the circulation of three sequential rounds where proposals were considered, positions identified and, where possible, common grounds agreed upon. This report summarizes and provides the results of the considerable number of comments and proposals received.

Development of the draft revised SOLAS regulation II-1/3-8

6 Based on the majority view of the group, a draft revised SOLAS regulation II-1/3-8 has been prepared. As the draft revised regulation includes requirements for existing ships and new ships, the definition of new ships has been included. Further, the whole regulation has been restructured in order to ensure clarity and coherence.

7 The group decided to remove the specific risk control option recommendations, outlined in paragraph 3.1 of annex 1 to document SDC 3/15, from the draft revised regulation. It was agreed that these recommendations should be included in the draft guidelines rather than the regulation text.

8 During consideration of the draft revised regulation, two members of the group preferred to leave it to the Administration to establish the specific framework for safe mooring on ships below 3,000 gross tonnage. Further, one member expressed concern about the inclusion of "health" in the design requirements of the draft amendments to the SOLAS regulation.

9 One member was of the opinion that the threshold of 3,000 gross tonnage should be reconsidered. This comment, however, seemed to be in conflict with the instruction from MSC 95 (MSC 95/22, paragraph 19.23.1) and, therefore, it was not further considered by the group.

10 The draft revised SOLAS regulation II-1/3-8 is set out in annex 1. It should be noted that no track changes compared to existing SOLAS text have been included as the use of track changes would not be helpful to get an overview, and the new text involves a completely new structure.

Development of the draft Guidelines on the design of safe mooring arrangements

11 The group could not finalize the draft guidelines within the available time slot. The group was, therefore, of the view that further consideration of the Guidelines would be necessary and recommended that the Sub-Committee should further consider the draft Guidelines at SDC 4.

12 The group agreed not to reproduce the definitions, set out in the draft SOLAS regulation, in the draft Guidelines as they were considered established and well understood.

13 Several members questioned the feasibility of using a ship specific risk assessment in the design phase, including a definition of the ALARP (As Low As Reasonably Practicable) area, as an appropriate tool to ensure safe mooring operations. They would rather see guidance on what constitutes a safe mooring arrangement. The Sub-Committee is invited to further consider this issue.

14 The group noted that sections 1 (Introduction) and 3 (Scope of applicability) (SDC 3/15, annex 2) had a number of similarities in content and agreed to merge them in the introduction section of the draft Guidelines. The remaining sections of the draft Guidelines, set out in annex 2 to this report, had been renumbered accordingly.

15 In section 2 of the draft Guidelines, a number of additional definitions have been included with a view to providing the definitions of related terms found in other IMO instruments, including the *Revised guidelines for Formal Safety Assessment (FSA) for use in the IMO rule making process* (MSC-MEPC.2/Circ.12/Rev.1) and the *Guidelines for the approval of alternatives and equivalents as provided for in various IMO instruments* (MSC.1/Circ.1455). As several of these definitions are only used sparsely or not at all, they have been placed in square brackets for further consideration by the Sub-Committee.

16 Some members of the group were of the view that "efficiency" is not an issue to be dealt with by IMO, while the majority of the group seemed to accept the inclusion of this issue. The Sub-Committee is invited to further consider this issue.

17 Some members of the group found that the revised section 3 could be merged with section 1 as this section, to a certain extent, contains the same objectives. These potential amendments need to be further elaborated.

18 It was also noted that there may be a number of duplicating requirements in revised sections 4 and 5 just as the text could be simplified. These potential amendments need to be further considered.

19 The group noted that clearer distinction is necessary between the requirements of revised sections 4 and 5. The group was of the view that further consideration was necessary on grouping of requirements. In this respect, it seems appropriate that the revised section 4 provides top-level considerations and the revised section 5 provides specific details and guidance. A view was expressed that the guidance may need to be aligned with the approach to describing goals and functional requirements detailed in the *Generic guidelines for developing IMO goal-based standards* (MSC.1/Circ.1394/Rev.1). This, however, seems to call for a more thorough consideration by the Sub-Committee.

20 One member of the group pointed out that a use of non-slip-paint would cause additional wear on mooring lines. As this comment seemed to fall outside the scope of the Guidelines, this aspect had not been further considered.

21 The group discussed the inclusion of a requirement stipulating that "mooring equipment and lines should be properly maintained in good conditions for its intended use". Some members of the group were of the opinion that the requirement is superfluous, considering the existing scope of the ISM Code.

22 One member of the group expressed concern about the feasibility of the revised section 5 which seems to be quite prescriptive and has not been prepared on the basis of an FSA.

23 Several members expressed concern that, at the design stage of a ship, it was difficult to predict quay side configurations of ports of call, especially for ships without a fixed schedule (trampers).

24 It was noted that completely removing the exposure to the dynamic forces of mooring lines might be practically impossible. The ALARP principle would be a helpful tool to find appropriate designs in this respect.

25 Three members of the group were of the view that appropriate spooling devices to avoid physical involvement by crew members are not available on the market. Further, they pointed out that placing of mooring equipment close to the ship's side might involve new negative effects for the mooring personnel just as it might influence the flexibility of towing and mooring operations.

26 One member of the group noted that, taking account of the ISM Code, the operational contents of the Guidelines should be regarded as guidance only.

27 Three members of the group were of the view that a requirement "that mooring lines should as far as possible be arranged so that all lines in the same service are about the same length between the ship and the shore bollard" should not be included in the Guidelines.

28 Regarding section 6, several members of the group pointed out that this section of the Guidelines needs to be reviewed. In this respect, the following views were expressed:

- .1 combining operational and design risk assessments in the same Guidelines seemed inappropriate;
- .2 recommending risk assessments for all new ships of 3,000 gross tonnage and above could be demanding and impractical;
- .3 recommending an approval process by an "independent competent person" could be inappropriate;
- .4 the Guidelines should apply appropriate and state-of-the-art risk assessment methods that are, as far as reasonable, consistent with methods given by other IMO documents (e.g. MSC-MEPC.2/Circ.12/Rev.1); and
- .5 establishing and referencing to acceptable risk acceptance criteria seemed appropriate.

Unfortunately, no specific proposals have been provided during the three consultative rounds of the group.

29 Additionally, some members of the group were of the view that a clear decision should be made whether risk assessments associated with safe mooring should be included in the Guidelines or not.

30 The opinion of the group was divided on the issue of involving the port/terminal side of mooring operations and reviews upon change in circumstances and equipment or operations.

31 Regarding section 7 and the appendix, the majority of the group had expressed concerns about the inclusion of specific figures on acceptable mooring assessments from the view point of feasibility. Accordingly, it was preferred that this section should be reconsidered.

32 The draft Guidelines on the design of safe mooring arrangements is set out in annex 2.

Selection, identification and use of mooring lines

33 In order to clarify the work of the group, the coordinator prepared work items, which include reconfirmation of the discussion at SDC 3 and each item's advantage and disadvantage. The members of the group have been invited to submit comments on these items.

34 The comments submitted by the members of the group are summarized as follows:

- .1 the majority of the group was of the view that selection, identification and use of the lines should be included in instruments developed by IMO and that the Safety Management System (SMS) could be a suitable instrument in this regard, while a different comment was made from the view of an administrative burden;
- .2 concerns were expressed regarding the administrative burden of including the selection, identification and use of mooring lines in the SMS, given existing guidance provided by Administrations and industry;
- .3 existing guidance from Administrations, including the "Code of safe working practices for merchant seafarers (CoSWP)" developed by the Maritime and Coastguard Agency of the United Kingdom, is relevant and should be taken into account;
- .4 existing industry publications which provide detailed information on selection, identification and use of mooring lines are available and should be taken into account; and
- .5 any guidelines on selection, identification and use of mooring lines should take into account the compatibility with other parts of a mooring system.

35 A survey report on mooring rope accidents prepared by ICHCA was provided at the end of round 3 but was not subject to a detailed review or assessment by the group.

36 Taking into account the summary presented in paragraph 34 above, it would be appropriate to develop guidelines on the selection, identification and use of mooring lines for inclusion in the SMS.

Guidelines on inspection and/or maintenance of mooring lines

37 In order to clarify the work of the group, the coordinator prepared work items, which included reconfirmation of the discussion at SDC 3 and each item's advantage and disadvantage. The members of the group had been invited to submit comments on the items.

38 The comments submitted by the members of the group are summarized as follows:

- .1 the majority of the group was of the view that information on mooring lines failure is beneficial and should be available;
- .2 guidelines on inspection and/or maintenance of mooring lines may be necessary and consideration should be given to generic guidelines which take into account manufacturers' recommendations and materials used, and mooring line materials and construction;

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- .3 a view was expressed that generic guidelines on inspection and maintenance of mooring lines may not be effective, i.e. due to the variety and characteristics of different mooring equipment and mooring lines, the effective maintenance of mooring lines can only be assured if based on the recommendations of the manufacturer, not on generic guidelines;
 - .4 maintenance of mooring lines is already covered by the requirements of the ISM Code;
 - .5 procedures for maintenance of mooring lines could be included in the SMS;
 - .6 best practices for maintenance of mooring lines may be beneficial and should be generic; and
 - .7 an awareness campaign may be beneficial.

39 Taking into account the summary shown in paragraph 38 above, the majority of the group was of the view that:

- .1 the generic guidelines on inspection and/or maintenance of mooring lines would be necessary and they could be referred to in the SMS;
- .2 information on break accidents and best practices for maintenance of mooring lines would be beneficial; and
- .3 an awareness campaign would also be beneficial.

Action requested of the Sub-Committee

40 The Sub-Committee is invited to note the above information on the outcome of the group's work, in general, and take action as appropriate and, in particular, to:

- .1 agree, in principle, to the draft revised SOLAS regulation II-1/3-8 for new and existing ships (paragraph 10 and annex 1);
- .2 endorse the group's view that further discussion is necessary in order to finalize the draft Guidelines on the design of safe mooring arrangements (paragraphs 11 and 32, and annex 2);
- .3 consider if the draft Guidelines on the design of safe mooring arrangements should be based on the conduct of a risk assessment, including a definition of the ALARP area, or whether they should only give guidance on how to design the mooring arrangement (paragraphs 13 and 29);
- .4 consider if the definitions in square brackets should be maintained in the Guidelines (paragraph 15);
- .5 consider if efficiency should be part of the scope of the Guidelines (paragraph 16);
- .6 consider if section 7 on acceptable mooring arrangements and the appendix should be maintained within the Guidelines (paragraph 31);

- .7 endorse the group's view that relevant description such as selection, identification and use of mooring lines should be included in the SMS when developing draft SOLAS amendments and the draft Guidelines on the design of the mooring arrangements (paragraphs 34 and 36);
- .8 endorse the group's view that the generic guidelines on the inspection and/or maintenance of mooring lines would be necessary and could be referred to in the SMS, that information on break accidents and best practices of maintenance of mooring lines would be beneficial and that an awareness campaign would also be beneficial (paragraph 39); and,
- .9 agree to establish a working group to further consider the present report and finalize draft SOLAS amendments and the associated draft guidelines.

ANNEX 1

DRAFT REVISED SOLAS REGULATION II-1/3-8

The text of existing regulation II-1/3-8 is replaced with the following:

"1 For ships constructed on or after 1 January 2007, the following apply:

- .1 ships shall be provided with arrangements, equipment and fittings of sufficient safe working load to enable the safe conduct of all towing and mooring operations associated with the normal operation of the ship;
- .2 arrangements, equipment and fittings provided in accordance with paragraph 1.1 above shall meet the appropriate requirements of the Administration or an organization recognized by the Administration under regulation I/6;¹ and
- .3 each fitting or item of equipment provided under this regulation shall be clearly marked with any restrictions associated with its safe operation, taking into account the strength of its attachment to the ship's structure.

2 For ships with a gross tonnage of 3,000 and above constructed on or after [date of entry into force] the mooring arrangement shall be designed to ensure safe and healthy work conditions during mooring operations and to allow appropriate line of sight, supervision and efficiency, based on guidelines developed by the Organization.²

3 Ships less than 3,000 gross tonnage constructed on or after [date of entry into force] should comply, as far as reasonable and practicable, with the requirement in paragraph 2 above or with applicable national standards of the Administration which provide an equivalent level of safety.

4 For the purpose of paragraphs 2 and 3, the expression ship constructed on or after [date of entry into force] means:

- .1 for which the building contract is placed on or after [date of entry into force];
or
- .2 in the absence of a building contract, the keel of which is laid or which is at a similar stage of construction on or after [date of entry into force plus 6 months];
or
- .3 the delivery of which is on or after [date of entry into force plus [three years][48 months]].

5 This regulation does not apply to emergency towing arrangements provided in accordance with regulation 3-4.

1 Refer to the Guidance on shipboard towing and mooring equipment (MSC.1/Circ.1175).

2 Refer to the Guidelines on the design of safe mooring arrangements (MSC.1/Circ.[...])."

ANNEX 2

DRAFT GUIDELINES ON THE DESIGN OF SAFE MOORING ARRANGEMENTS

1 Introduction

1.1 Historical evolution in ship designs and especially the design of large ships have resulted in optimized performance and a greater degree of complexity; this has not been extended into consideration of design of ships mooring arrangements. In order to improve safety and occupational health during mooring operations on new ships, new design methods for mooring operations should be introduced which additionally take into account an assessment of the ship shore integrity for likely mooring configurations.

1.2 The International Convention for the Safety of Life at Sea (SOLAS), as amended, requires in chapter [II-1, part A, regulation 3-8] that the mooring arrangement in ships with a gross tonnage of 3,000 or above constructed on or after [1 January 2020] shall be designed to ensure safe and healthy working conditions during mooring operations and to allow appropriate line of sight, supervision and efficiency. Ships less than 3,000 gross tonnage constructed on or after [1 January 2020] should comply with the above requirement, as far as reasonable and practicable.

1.3 These guidelines are intended for use by Administrations, owners, operators, designers and classification societies when applying the requirement for the arrangement of mooring equipment to be designed to minimize the risk of harm to personnel engaged in mooring operations. They seek to provide a non-prescriptive design method in the form of a tool controlled by defined goals. The setting of goals is introduced to achieve appropriate designs having been validated or updated in respect of safety and efficiency.

1.4 References to mooring in these guidelines include unmooring and all harbour towing operations relating to mooring operations.

2 Definitions

For the purposes of these guidelines:

2.1 *Administration* means the Government of the State whose flag the ship is entitled to fly.

[2.2 *ALARP (As Low As Reasonably Practicable)* refers to a level of risk for which further investment of resources for risk reduction is not justifiable. When risk is reduced to ALARP, it is acceptable.]

[2.3 *Mooring crew* refers to the team of shipboard personnel involved in a mooring operation (line handlers, winch operators, lookouts, supervisors, etc).]

2.4 *Mooring deck* refers to the local deck area where mooring equipment is installed and line-handling takes place. It also includes deck 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 decks on a vessel.

2.5 *Efficiency* in this context means the time taken to complete a mooring operation and secure a ship at a berth safely using a particular mooring line configuration and with a given number of shipboard and shore-based mooring personnel.

2.6 *Occupational health* in the context of these guidelines means that the mooring operation can be carried out in such a manner that those involved are not exposed to adverse effects, e.g. due to heavy lifting, poor posture, noise, vibrations, high demands of work, stress, fatigue.

2.7 *Hazard identification* means a process to find, list, characterize, and rank hazards.

2.8 *Risk* is a measure of the likelihood that an undesirable event will occur together with a measure of the resulting consequence within a specified time, i.e. a combination of the frequency and the severity of the consequence (this can be either a quantitative or qualitative measure).

2.9 *Risk assessment* is an integrated array of analytical techniques, e.g. reliability, availability and maintainability engineering, statistics, decision theory, systems engineering, human behaviour, that can successfully integrate diverse aspects of design and operation in order to assess risk.

2.10 *Risk-based design* is a design where the design process has been supported by a risk assessment or the design basis has resulted from a risk assessment. That is, it is a structured and systematic methodology aimed at ensuring safety performance and cost-effectiveness by using risk analysis and cost-benefit assessment.

[2.11 *Risk control measure* is a means of controlling a single element or risk; typically, risk control is achieved by reducing either the consequences or the frequencies; sometimes it could be a combination of the two.]

[2.13 *Risk control option (RCO)* is a combination of risk control measures.]

[2.14 *Risk evaluation criteria* are formally recognized objective criteria defining the acceptable risk.]

2.15 *Safety* is the absence of unacceptable levels of risk to life, limb and occupational health (from non-willful acts).

3 Goals

3.1 The goal of these guidelines is to establish a common approach to the implementation and enforcement of the SOLAS requirements on the design and operation of mooring arrangements which ensures the safety and occupational health of those involved.

3.2 The guidelines provide recommendations on how to interpret and apply the provisions of the SOLAS requirements.

3.3 Adherence to these guidelines will facilitate compliance with the SOLAS requirements by ship designers, equipment suppliers, shipyards, shipping companies and port terminal facilities and their employees, in understanding their respective roles in the development of better designs ensuring safety and occupational health of those participating in mooring operations.

4 Functional objectives

4.1 The overall goal is, to guide designers, classification societies, flag States and owners to think in terms of innovative, safe and occupational health preserving solutions for mooring systems. The outcome of the design shall be the creation of a corresponding mooring arrangement, enabling the crew to efficiently maintain the ship shore interface throughout the port call.

4.2 In order to achieve the appropriate goal, the mooring arrangement should be designed and arranged in order to ensure that:

- .1 the mooring arrangement is designed to provide unobstructed access to and operation of mooring equipment;
- .2 the mooring equipment is arranged to minimize the need for complex mooring line configurations during the normal operation of the ship;
- .3 in normal mooring operations only mooring lines that are permanently fixed to a winch are used;
- .4 each mooring line has a straight lead and its own dedicated fairlead(s);
- .5 manual handling of mooring lines is reduced to an absolute minimum during mooring operations and never involves manual handling during load, heaving or ease situations; and
- .6 the mooring arrangement is appropriate for the specific ship type and its usual mooring configuration;
- .7 there is an unobstructed view of the mooring deck for those taking part in the mooring operation.
- .8 mooring arrangements minimize the exposure of mooring personnel, including personnel monitoring lines and supervising the mooring deck, to the hazards associated with mooring lines under tension or dynamic load;
- .9 mooring lines are appropriate for the mooring equipment installed on board.
- .10 the working areas are adequately lit to minimize the areas of shadow, as far as reasonably practicable;
- .11 sufficient working space is present at the mooring decks;
- .12 personnel involved in mooring operations are not exposed to the dynamic loads of mooring lines;
- .13 those involved in mooring operations are not at risk of tripping over, or being trapped or impacted by free lying mooring lines;
- .14 manual handling of mooring lines that may have detrimental impact on the health of the involved personnel are avoided;
- .15 noise in way of mooring decks does not impair effective communication;

- .16 effective means of communication is available;
- [.17 the ship is provided with appropriate information about the mooring arrangement and its intended use included in the Towing and arrangements plan;]
- .18 a mooring deck surface, which minimizes tripping and slipping hazards, is provided;
- .19 additional stresses on mooring lines are avoided through careful deck layout; and
- .20 mooring equipment and lines can be properly maintained in good condition for its intended purpose.

5 Achievement of the objectives

In order to meet the functional objectives, the following construction, equipment and operational features should be considered.

5.1 Construction

5.1.1 The mooring equipment is arranged to minimize the need for complex mooring line configurations during the normal operation of the ship. This should include the use of direct leads from the mooring winch to the fairlead, i.e. mooring arrangements involving a complex conveying of hawsers across deck by means of guide rollers (turtles), guide pulleys, bollards, fairleads should be avoided. Furthermore, the mooring arrangement should be so designed that there is [only] one dedicated fairlead for each mooring line on each side of the ship, if applicable.

5.1.2 The position of the mooring deck and placing of fairleads should be planned with respect to the typical mooring pattern corresponding to type of ship and the berth configuration of the ports the ships is expected to call at. In this respect it should be possible to obtain a sufficient length of hawser line from the fairlead to the quayside bollard. Furthermore, the mooring deck should as far as foreseeable be arranged in respect to the vertical distance to the quayside in order to ensure an efficient pull towards the quayside.

5.1.3 Effective means of communication (verbal, hand signals, radio, etc.) for both the shipboard and dockside mooring crews shall be provided, and should not be impaired by machinery noise or obstructed lines-of-sight.

5.1.3 The mooring deck should be arranged to give the crew the best possible view during mooring operations. This should involve that:

- .1 the officer in charge has the ability to safely obtain an unobstructed view of the mooring deck as well as the berth arrangements planned to be used;
- .2 the winch-operator has an unobstructed view of the mooring area involved;
- .3 mooring personnel, in general, have an unobstructed view of the mooring deck on which they are planned to operate; and
- .4 adequate lighting is provided.

5.1.4 The mooring arrangement should be designed to provide adequate space for the crew to safely and effectively operate the equipment involved [not adversely affected by other] structural elements of the ship. This should include that mooring operations are not impeded by e.g. restricted space for the mooring operation due to ships' structural elements, accommodation, ventilation exhausts, cargo equipment or similar obstacles.

5.1.5 The mooring arrangement should be so designed that the crew is at no stage exposed to lines under tension through snap back [or by sudden movements] of mooring lines. This could be established through e.g. short distances from mooring winch to fairlead, by placing the mooring winch directly before the fairlead, by enclosing the mooring line behind a barrier or through alternative design where crew members do not need to work close to or have to pass [mooring lines under tension or potentially under tension].

5.1.6 The mooring arrangement should be so designed that manual handling of towing and mooring lines is minimized [(As Low As Reasonably Practicable)]. This could be accomplished through use of fixed/dedicated mooring lines, use of spooling equipment and by placing mooring winches close to the ship side served.

5.2 Equipment

5.2.1 A sufficient number of mooring winches should be installed so that, during normal mooring operations, manual use of winch drum ends, stoppers, capstans and bollards are minimized as far as possible.

5.2.2 The mooring arrangement should, as far as reasonably practical, be designed to prevent unsafe and unhealthy work situations through manual handling of mooring lines.

5.2.3 The mooring arrangement should be designed to ensure flexibility during exceptional mooring operations, e.g.

- .1 a sufficient number of winch drum ends/capstans, bollards and fittings related to mooring should be available on each mooring deck; and
- .2 additional (loose) mooring lines should be stored close to and easily accessible to the winch drum/bollard where they are expected to be used.

5.2.4 Mooring winches should be so designed that minimal manual handling of mooring lines is needed, e.g. if split-drum type mooring winches are fitted, the layout should be designed to avoid any requirement for manual intervention in transfer of the mooring line from storage drum to winch drum and vice versa.

5.2.5 The mooring arrangement should be designed to avoid overload on mooring winches and mooring lines. In order to achieve this, considerations should be given to fit/adjust mooring winches with brake capacity of less than the minimum breaking load of the mooring line, mooring lines with integrated high stress indicators or mooring winches which monitor the stress load on the equipment and the mooring lines.

5.2.6 The mooring arrangement should be designed such that the bearing surface of the fairlead structure and mooring line prevents chafing.

5.3 Operation

5.3.1 The mooring winches and the dedicated mooring lines should at all times be compatible in e.g. design, diameter, strength and suitability, and maintained with the original purpose and concept of the mooring arrangement. This should be established through the mooring manual (which may be part of the SMS) which informs upon:

- .1 a mooring arrangement plan or other means of information about the mooring equipment (i.e. numbers and location of winches, pedestal leads, fair leads and rollers);
- .2 the mooring winches installed, design limitations and safe working loads;
- .3 the appropriate mooring lines, including tails, and connecting apparatus to be used and the planned operating parameters/maximum permissible loads;
- .4 the planned mooring arrangement, including the most appropriate lead of mooring lines in the most common mooring operations;
- .5 relevant mooring procedures on the specific ship, including potential snap-back risk areas across the mooring deck; and
- .6 proper maintenance and inspection of the mooring arrangement, including parameters on the identification and handling of worn-out mooring lines. The frequency of inspection and maintenance should be based on the manufacturer's recommendations, the conditions the equipment is exposed to and the frequency of use, so as to ensure that excessive wear or damage is identified prior to failure and the equipment remains fit for purpose.

5.3.2 The number of crew members planned to take part in the mooring operation should be appointed while taking account of the overall layout of the mooring arrangement, the experience of the involved crew members and the anticipated particulars of the port facilities.

5.3.3 Only personnel trained in mooring operations and familiarized with the mooring arrangements on board should be permitted access to mooring decks during mooring operations.

5.3.4 Mooring operations should be properly planned, in advance of arrival at a berth. A mooring plan should take into account the information provided in the mooring manual, the particulars of the berth, the availability and use of tugs, the outcome of any mooring analysis undertaken and environmental conditions expected.

5.3.5 Proper and reliable communication methods should be established and agreed throughout the mooring operations on board the ship as well as towards dock workers assisting in the mooring operation at the port interface.

[5.3.6 New crew members who are to take part in mooring operations should be familiarized with the mooring manual, the mooring equipment and the set-up of this particular ship before taking part in a mooring operation.]

5.3.7 Consideration should be given to control and certification of mooring ropes, wires, tails and associated attachments. Manufacturer's test certificates for mooring lines, joining shackles and synthetic tails should be kept in a file or with the mooring manual, clearly showing to which winch each particular component has been fitted.

5.3.8 As far as possible, mooring lines of the same size and type (i.e. material) should be used for all leads, but at least for lines in the same service, e.g. headlines, breastlines, springs.

5.3.9 Mooring lines should as far as possible be arranged so that all lines in the same service are about the same length between the ship and the shore bollard.

5.3.10 The effectiveness of mooring arrangement for the port/berth should be reviewed. This should be finalized and coordinated with the pilot/mooring master prior to any mooring operation.

5.3.11 The number, position, lead and tension of mooring lines should be reviewed as appropriate prior to the release of tugs and the disembarkation of a pilot. Mooring lines should be monitored throughout the period at the berth.

5.3.12 No extra weight should be attached to the heaving lines for any reason.

5.3.13 Breast lines provide the maximum transverse restraint and spring lines the maximum longitudinal restraint against vessel movement in athwart and in fore-aft direction, respectively. Head and stern lines are much less effective for these purposes. The applied mooring layout should follow these principles, as far as possible with respect to the port facilities and as far as reasonable with respect to the vertical line angles.

6 Risk assessment

6.1 The complete mooring concept should be planned at the early design phase in order to identify risks and unhealthy work situations to those involved in the mooring operation. This should include a study of the interface and effectiveness of the ships mooring equipment and the anticipated shore mooring equipment that the ship may encounter. This should describe shore mooring capability, environmental operational windows and an analysis of external loads that can be reasonably anticipated, such as the load exerted by passing ships, weather, sea and current.

6.2 Risks of injury and occupational health should be identified and assessed and measures should be initiated to eliminate or minimize risks to as low as reasonable practicable through appropriate design solutions and by use of appropriate equipment and by implementation of appropriate operational procedures. This process should be based on a hazard identification exercise and should be finalized well ahead of planned construction.

6.3 As a tool to ensure that the functional objectives reflected in section 5.4 are identified and that the risks of the planned mooring arrangement are mitigated in accordance with the aims of paragraphs 6.1 and 6.2, a risk assessment should be applied. [In the operational phase, risk assessment should be used as a tool within the ongoing processes for assessing and responding to operational risk as required by the ISM Code; it provides the dynamic assessment of whether the ship is operating within the limits of its equipment during a particular operation.]

[6.4 Mooring arrangement design should be risk based. Ship designers should use an appropriate risk-based design processes to design mooring arrangements which achieve the functional objectives outlined in paragraphs 5.1 and 5.2. The risk assessment process

should be [based on the procedures included in][take into account the procedures included in][include the follow steps from the procedures outlined in] MSC.1/Circ.1455.] In the operational phase, risk assessment should be used as a tool within the ongoing processes for assessing and responding to operational risk as required by the ISM Code; it provides the dynamic assessment of whether the ship is operating within the limits of its equipment during a particular operation.]

6.5 A risk assessment should be a tool used already at the design stage, in order to verify and accommodate that the planned mooring arrangement provides an acceptable level of safety and preservation of occupational health.

6.6 A representative range of risk assessments should be developed covering relevant mooring patterns with emphasis on all major risk contributors.

6.7 As a minimum the following areas should be addressed:

- .1 at design level: all mooring decks and equipment;
- .2 before entering into service: all mooring and towing procedures; and
- .3 during the ship's service: the mooring manual and the continued preparedness of equipment and crew members during port calls.

6.8 Involved areas/items should be identified and assessed for the dedicated systems and procedures. The assessment should for example include:

- .1 operation, activity, equipment or component under consideration;
- .2 aspect under consideration;
- .3 significant hazards;
- .4 "Who is at risk?";
- [.5 the port/terminal side of the operations; and
- .6 reviews upon change in circumstances, equipment or operations.]

6.9 The outcome is then to be summarized into a figure reflecting likelihood and severity that, when multiplied provides the level of risk (e.g. negligible, acceptable, unacceptable).

6.10 The second part of the assessment is to establish the actions needed to lower identified unacceptable risks. This part should for example include the following:

- .1 mitigation measure(s) taken by designer;
- .2 effectiveness of the measures to eliminate the risk;
- .3 description of action taken;
- .4 reason why action was not taken at a higher mitigation/elimination level;
- .5 recommendations which may be used in conjunction with mitigating measures;

- .6 notes to assist the recipient in further reducing the residual hazard risk; and
- .7 reference to standard(s) and legislation.

6.11 The outcome is then to be summarized into a "new figure" reflecting likelihood and severity that, when multiplied, gives [the modified assessment figure resulting from the actions taken].

6.12 The calculated risk assessment figure should be evaluated by an independent competent person. The evaluation should be made in connection with the authority approval of the mooring arrangement, thus ensuring an acceptable level of risk.

6.13 The acceptable level of risk of hazard should be established taking into account common international standards. The approval of the risk assessment must reflect the common risk assessment or a set of individual minimum criteria related to unsafe situations with a high level of likelihood combined with a major or serious level of severity.

[6.14 Operational risk assessment(s) on mooring operations should be an ongoing process using appropriate procedures in compliance with the requirements of the ISM Code.]

6.15 An example of a mooring risk assessment on roller guides can be found in the appendix.

[7 Acceptable mooring arrangements

A basis for determining an acceptable mooring arrangement could be:

- .1 no individual risk assessment figure is above the value of [15];
- .2 the average value of the highest 10 individual risk assessment figures is not more than [8]; and
- .3 port State or flag State authorities must satisfy themselves that mooring operations on the ship meet the standards in these guidelines.]

APPENDIX

An example of a risk assessment on roller guides

The evaluated identified risk items are, in general, divided into three risk groups, as is shown below. Each risk level represents the product of the risks identified, expressed in terms of likelihood and severity.

L = Low	Acceptable. No resources required to reduce the risk any more.
M = Medium	Tolerable. More training, change in design/arrangement or change in procedures needed to reduce the severity or likelihood to an acceptable level.
H = High	Not acceptable. Change in design/arrangement or training procedures is essential to reduce the risk to an acceptable level.

An example could be as follows: "Has the mooring deck been arranged for straight mooring lines from the mooring winch to the fairlead?" No, it is planned to install roller guides (turtles) to promote flexibility.

The use of roller guides (turtles) includes risk of injury (unsafe situations) to the crew members as roller guides may fail or collapse.

Accordingly, the likelihood of the unsafe situation must be evaluated with respect to a given acceptable level expressed by the historical possibility of the situation occurring, how often (frequently) this type of situation will occur, and finally the probability of the unsafe situation occurring.

The likelihood is to be taken as an average level:

Historically: Has occurred many times during mooring.

Frequency: Expected to occur at every third mooring operation or more.

Probability: More likely to occur.

Historical	Frequency	Probability		
Never happened during mooring	Not expected to occur for years	This event may occur only in exceptional circumstances	Very unlikely	1
	Expected to occur at 1/25 mooring	Unlikely to occur	Unlikely	2
Has occurred during mooring	Expected to occur at 1/10 mooring	Reasonable chance of occurring	Possible	3
	Expected to occur at 1/5 mooring	The event may occur in some circumstances	Likely	4
Has occurred many times during mooring	Expected to occur at 1/3 mooring or more	More likely to occur	Very likely	5

As such incidents occur frequently, it will be considered to have a likelihood of "very likely".

The severity if an unsafe situation occurs must be valid in respect to a given set of consequences expressed by the total loss. The severity must be taken with respect to a given situation that might occur.

The sum of loss (total loss) is to be evaluated with respect to personal injury, damage to equipment/property, consequences given from class/authorities, and finally impact on reputation and image. The severity must be taken as an average level.

Personal injury: Injury with no permanent disability. Absence is more than 3 days, but less than 20 days.

Equipment/property: Item can consistently not be accounted for. The failure/loss/damage causes a delay in the operation of more than 2 hours, but less than 12 hours.

Control/authorities: Incident to be reported to port State control and flag authorities.

Reputation/image: Negative publicity in the local press. Damage to reputation with a customer.
