標題

SOLAS II-1 Reg.3-8 改正による曳航係留設備の新要件について

ClassNK
テクニカル
インフォメーション

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各位

第 102 回海上安全委員会(MSC102)において、係留設備に関する SOLAS II-1/3-8 及び曳航係留設備のガイダンス（MSC.1/Circ.1175）の改正が採択されました。
併せて、安全な係留設備の設計及び装置の選定に関する新ガイドライン（MSC.1/Circ.1619）、係船索を含む係留設備の点検及び保守に関する新ガイドライン（MSC.1/Circ.1620）が承認されました。
新ガイドラインは、SOLAS II-1/3-8 にて参照されております。改正された SOLAS II-1/3-8 は 2024 年 1 月 1 日に発効するため、建造日に関わらず全ての適用船舶は、一部の規定を除き、発効日までに要件を満足する必要があります。
船主、船舶管理会社及び造船所又は設計会社におかれましては、下記を参照いただきご対応をお願いいたします。

1. 適用
総トン数 500 トン以上の国際航海に従事する船舶について、次の通り適用されます。

1.1 新造船（SOLAS II-1/3-8 Para.7 or 8）
- 2024 年 1 月 1 日以降に建造契約がなされる船舶
- 建造契約が無い場合には、2024 年 7 月 1 日以降にキールが据え付けられる船舶又はこれと同様の建造段階にある船舶
- 2027 年 1 月 1 日以降に引渡しが行われる船舶

(1) 上記 1.1 に該当する新造船のうち、総トン数 3,000 トン以上の船舶（SOLAS II-1/3-8 Para.7）
MSC.1/Circ.1175/Rev.1 及び MSC.1/Circ.1619 への適合
(2) 総トン数 3,000 トン未満の船舶（SOLAS II-1/3-8 Para.8）
MSC.1/Circ.1175/Rev.1 及び合理的に実行可能な限り MSC.1/Circ.1619 の要件への適合、もしくは主管庁が定める自国の基準への適合

1.2 全ての船舶（SOLAS II-1/3-8 Para.9）
全ての船舶（新造船及び既存船）に対して、MSC.1/Circ.1620 の適用

（次頁に続く）

2. 追加された主な新規要件

* 本テクニカルインフォメーション内で使用されている用語の定義については、「5.用語の定義」をご参照ください。

2.1 新造船

2.1.1 索の選定基準（MSC.1/Circ.1619 Para.5.2.3.）

・ 索の LDBF は、MBLsd の 100%から 105%とすること。
・ 許容可能な最小曲げ半径（D/d 比）を考慮すること。

2.1.2 係船ウインチの選定基準（MSC.1/Circ.1619 Para.5.2.4）

・ 係船ウインチ、係留設備及び係船索の過荷重を避けるため、MBLsd より小さい制動能力を持つ又は調整可能な制動能力を持つ係船ウインチとすること。

2.1.3 係留設備、キャプスタンの選定基準（MSC.1/Circ.1619 Para.5.2.2）

・ 係留設備は、原則として弊会が適当と認める規格に従ったものであって、少なくも MBLsd に基づき選定すること。
・ 許容可能な最小曲げ半径（D/d 比）を考慮すること。

2.1.4 係船索の技術仕様書の本船保持

下記(1)から(3)に関する内容を含む技術仕様書を本船上に保管すること。

(1) 係船索に接触する係留設備の製造者が推奨する最小直径 D
(2) 係船索の設計切断荷重（LDBF）
(3) 曲げ半径比（D/d 比）に関する係船索の特性

2.2 全ての船舶

2.2.1 係船索を含む係留設備の点検及び保守のための管理計画書の本船保持（MSC.1/Circ.1620）

2024 年 1 月 1 日以降、全ての船舶には、MSC.1/Circ.1620 に基づき作成された管理計画書を本船上に保管すること。管理計画書は、下記(1)から(6)に関する内容を含む資料とすること。

（カッコ内の数字は MSC.1/Circ.1620 のパラグラフ番号を指します。）

(1) 係船索を含む係留設備の点検及び保守の手順(3.1)
(2) 係船索、テールロープ及び関連する係留設備の識別及び管理のための手順(3.3)
(3) 係船索の交換に関する製造業者の基準(4.3.1)
(4) 係留設備の点検及び保守、並びに係船索の点検及び交換の記録(4.4.3 and 6.1)
(5) 係船索、連結用シャックル及び合成繊維テールロープの製造者試験証明書(6.2)
(6) 建造時の設計コンセプト、機器、配置及び仕様の記録(4.4.4)

（次頁に続く）

3. 船主･管理会社の必要対応事項（上記 1.2 及び 2.2 関連）
船主並びに船舶管理会社にて対応が必要となる事項は下記の通りです。

3.1 係船索を含む係留設備の点検及び保守のための管理計画書の作成
既存船については 2024 年 1 月 1 日以降の最初の SC 証書の定期的検査までに、2024 年 1 月 1 日以降に引渡しが行われる船舶については登録検査までに、管理計画書について下記の対応が必要となります。

(1) 船主並びに船舶管理会社をはじめとする関連各社におかれましては、係船索、係留設備、及びウインチについて、上記 2.2.1 で要求される情報をメーカーより入手し、既存の SMS マニュアル/手順書等をご活用･参照しつつ、管理計画書をご作成ください。

(2) 上記 2.2.1(6)に記載される建造時の設計コンセプトにつきましては、建造造船所の作成図面である曳航及び係留設備配置図又は艤装数計算書等から情報を得ることが可能です。

(3) 係船の設計コンセプトのうち、重要なパラメータである MBLsd は、以下の表に基づき求めることができます。

表 1 適用年度別 MBLsd 対応表

	2007/1/1 より前の起工船	2007/1/1 以降の起工船	2018/7/1 以降の建造契約船	2022/1/1 以降の建造契約船	2024/1/1 以降の建造契約船、又は 2028/1/1 以降の完工船
適用 Circ.	Nil	MSC.1/Circ.1175			MSC.1/Circ.1175/Rev.1
適用 UR	UR A2 original & Rev.1	UR A2 Rev.2 & 3	UR A2 Rev.4	UR A2 Rev.5 (Circ.1175/Rev.1 の一部を先行取入れ)	
MBL	艤装数により決定[*1,3)]		艤装数≦2000: 艤装数により決定[*2,3)] 艤装数>2000: 船体投影面積より算定		
MBLsd[*4)]	艤装数計算書内に記載の MBL		艤装数計算書、又は曳航及び係留設備配置図に記載される MBL	艤装数計算書、又は曳航及び係留設備配置図に記載される MBLsd	

*1) IACS Rec.10 Rev.2 の Table 5 から求めることが可能です。

*2) IACS Rec.10 Rev.3 の Table 5 から求めることが可能です。但し、甲板上に貨物を積載する船種（コンテナ船、木材を運搬するばら積貨物船等）の場合、船側投影面積 A に甲板貨物の影響を考慮して別途艤装数を算出する必要があるため、NK-SHIPS 内の値はそのまま使用できない点ご留意ください。

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*3) 索の本数を増やすことで、IACS Rec.10 Rev.2 or 3 の Table 5 に記載の値より MBL を下げているケースがあるため、艤装数計算書を確認されることを推奨いたします。
*4) 船主独自の基準や業界標準（OCIMF MEG4 等）を適用し MBLsd を決定する場合、その値を参照して差し支えございません。

3.2 係船索を含む係留設備の点検及び保守のための管理計画書の維持･管理
前回の定期的検査以降に、係留設備の点検･整備又は係船索の点検･交換が実施された場合、管理記録書は適切に更新され、船内で閲覧できるようにする必要があります。

3.3 索の交換
係船索の交換の際は、曳航及び係留設備配置図に明示された船上の係留設備との互換性が考慮され、管理計画書に明記された設計仕様に合致したものとする必要があります。設計仕様から逸脱し、かつ MBLsd の 105%を超える LDBF を有する係船索に交換する場合は、係留設備及び支持構造の再評価が要求される場合があります。

4. 管理計画書の本船搭載に関する検査（上記 1.2 及び 2.2 関連）（MSC.1/Circ.1362/Rev.2）
2024 年 1 月 1 日以降の最初の SC 証書の定期的検査、又は登録検査（2024 年 1 月 1 日以降に引渡しが行われる船舶）において、上記 2.2.1 に示す管理計画書が本船上に保管されていることを検査員が確認します。
なお、当該管理計画書に対する図面承認は MSC.1/Circ.1620 上、要求されていないため、船上での検査による適合確認のみ実施します。これら対象船の船主、船舶管理会社への周知及び注意喚起を目的として、対象船の Survey Status に Note を追記する予定です。

5. 用語の定義

用語	定義
D/d 比	係留設備の直径 D を、係留設備の周囲に巻き付ける、又は沿わせる係船索の直径 d で割ったもの。（MSC.1/Circ.1620 にて新たに定義）
艤装数	アンカーやアンカーチェーン、係船索の切断荷重等の要求値を算出する基準となる船舶固有の値。弊会船級船においては、NK-SHIPS 内の個船情報項目のうち、Particulars のタブ内に表示があります。
艤装数計算書	「艤装数」を算出した根拠が記載された図面（艤装数計算は、中央断面図に記載されている場合もあります）
LDBF	係船索の設計切断荷重で、索そのものが有する最小切断強度 （MSC.1/Circ.1619 にて新たに定義）
MBLsd	船舶に備える係船索、係留設備、係留設備の船体支持構造の選定又は設計のための設計荷重。（MSC.1/Circ.1175/Rev.1 にて新たに定義。IACS UR A2 Rev.5 にて先行取入れ）

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用語	定義
MBL	船体投影面積又は艤装数から定まる係船索の最小要求切断荷重 （MSC.1/Circ.1175 及び IACS Rec.10 に記載される Minimum breaking strength と同義）
SMS	安全管理システム。会社の職員が安全及び環境保護の方針を効果的に実施できるよう組織化され文書化されたシステム
曳航及び係留設備配置図	船上の曳航及び係留設備、係船索の配置を含む係船索、並びに係船のために許容される環境条件に関する具体的な情報を示した図（2007 年 1 月 1 日以降起工船の場合、MSC.1/Circ.1175 Para.5 に基づき、本船上保管が要求されている）

なお、本件に関してご不明な点は、以下の部署にお問い合わせください。

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添付:

1. MSC. 474(102): Amendments to the international convention for the Safety of Life at Sea, 1974, as amended
2. MSC.1/Circ.1175: Guidance on shipboard towing and mooring equipment
3. MSC.1/Circ.1175/Rev.1: Guidance on shipboard towing and mooring equipment
4. MSC.1/Circ.1619: Guidelines on the design of mooring arrangements and the selection of appropriate mooring equipment and fittings for safe mooring
5. MSC.1/Circ.1620: Guidelines for inspection and maintenance of mooring equipment including lines
6. MSC.1/Circ.1362/Rev.2: UNIFIED INTERPRETATION OF SOLAS CHAPTER II-1
7. IACS UR A2 Rev.4: Shipboard fittings and supporting hull structures associated with towing and mooring on conventional ships
8. IACS UR A2 Rev.5: Shipboard fittings and supporting hull structures associated with towing and mooring on conventional ships
9. IACS Rec. 10 Rev.2: Chain Anchoring, Mooring and Towing Equipment
10. IACS Rec. 10 Rev.3: Chain Anchoring, Mooring and Towing Equipment

ANNEX 1

RESOLUTION MSC.474(102)
(adopted on 11 November 2020)

AMENDMENTS TO THE INTERNATIONAL CONVENTION FOR THE SAFETY OF LIFE AT SEA, 1974, AS AMENDED

THE MARITIME SAFETY COMMITTEE,

RECALLING Article 28(b) of the Convention on the International Maritime Organization concerning the functions of the Committee,

RECALLING ALSO article VIII(b) of the International Convention for the Safety of Life at Sea, 1974 ("the Convention"), concerning the amendment procedure applicable to the annex to the Convention, other than to the provisions of chapter I,

HAVING CONSIDERED, at its 102nd session, amendments to the Convention proposed and circulated in accordance with article VIII(b)(i) of the Convention,

1 ADOPTS, in accordance with article VIII(b)(iv) of the Convention, amendments to the Convention the text of which is set out in the annex to the present resolution;

2 DETERMINES, in accordance with article VIII(b)(vi)(2)(bb) of the Convention, that the said amendments shall be deemed to have been accepted on 1 July 2023, unless, prior to that date, more than one third of the Contracting Governments to the Convention or Contracting Governments the combined merchant fleets of which constitute not less than 50% of the gross tonnage of the world's merchant fleet have notified the Secretary-General of their objections to the amendments;

3 INVITES Contracting Governments to the Convention to note that, in accordance with article VIII(b)(vii)(2) of the Convention, the amendments shall enter into force on 1 January 2024 upon their acceptance in accordance with paragraph 2 above;

4 REQUESTS the Secretary-General, for the purposes of article VIII(b)(v) of the Convention, to transmit certified copies of the present resolution and the text of the amendments contained in the annex to all Contracting Governments to the Convention;

5 REQUESTS ALSO the Secretary-General to transmit copies of this resolution and its annex to Members of the Organization which are not Contracting Governments to the Convention.

ANNEX

AMENDMENTS TO THE INTERNATIONAL CONVENTION FOR THE SAFETY OF LIFE AT SEA, 1974, AS AMENDED

CHAPTER II-1
CONSTRUCTION – STRUCTURE, SUBDIVISION AND STABILITY, MACHINERY AND ELECTRICAL INSTALLATIONS

Part A
General

Regulation 1 – Application

1 The existing paragraph 1.3 is replaced by the following:

"1.3 For the purpose of this chapter:

.1 the expression *ships constructed* means ships the keels of which are laid or which are at a similar stage of construction;

.2 the expression *ships constructed on or after 1 January 2024* means ships:

.1 for which the building contract is placed on or after 1 January 2024; or

.2 in the absence of a building contract, the keel of which is laid or which are at a similar stage of construction on or after 1 July 2024; or

.3 the delivery of which is on or after 1 January 2028.

.3 the expression *all ships* means ships constructed before, on or after 1 January 2009;

.4 a cargo ship, whenever built, which is converted to a passenger ship shall be treated as a passenger ship constructed on the date on which such a conversion commences."

Part A-1
Structure of ships

Regulation II-1/3-8 – Towing and mooring equipment

2 Regulation 3-8 is replaced by the following:

"1 Paragraphs 4 to 6 of this regulation apply to ships constructed on or after 1 January 2007.

2 Paragraphs 7 and 8 of this regulation only apply to ships:

.1 for which the building contract is placed on or after 1 January 2024; 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 1 July 2024; or

.3 the delivery of which is on or after 1 January 2027.

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

4 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.

5 Arrangements, equipment and fittings provided in accordance with paragraph 4 above shall meet the appropriate requirements of the Administration or an organization recognized by the Administration under regulation I/6.*

* Refer to the *Guidance on shipboard towing and mooring equipment* (MSC.1/Circ.1175) for ships constructed on or after 1 January 2007 but before 1 January 2024 and the *Guidance on shipboard towing and mooring equipment* (MSC.1/Circ.1175/Rev.1) for ships constructed on or after 1 January 2024.

6 Each fitting or item of equipment provided under this regulation shall be clearly marked with any limitations associated with its safe operation, taking into account the strength of the supporting ship's structure and its attachment to it.

7 For ships of 3,000 gross tonnage and above, 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, based on the guidelines developed by the Organization.† Ship-specific information shall be provided and kept on board.‡

† Refer to the *Guidelines on the design of mooring arrangements and the selection of appropriate mooring equipment and fittings for safe mooring* (MSC.1/Circ.1619).

‡ Refer to towing and mooring arrangement plan in the *Guidelines on the design of mooring arrangements and the selection of appropriate mooring equipment and fittings for safe mooring (*MSC.1/Circ.1619).

8 Ships of less than 3,000 gross tonnage should comply with the requirement in paragraph 7 above as far as reasonably practicable, or with applicable national standards of the Administration.

9 For all ships, mooring equipment, including lines, shall be inspected and maintained in a suitable condition for their intended purposes.§

§ Refer to the *Guidelines for inspection and maintenance of mooring equipment including lines* (MSC.1/Circ.1620.

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MSC/Circ.1175
24 May 2005

GUIDANCE ON SHIPBOARD TOWING AND MOORING EQUIPMENT

1 The Maritime Safety Committee, at its eightieth session (11 to 20 May 2005), following the recommendations made by the Sub-Committee on Ship Design and Equipment at its forty-eighth session, approved guidance concerning shipboard equipment, fittings and supporting hull structures associated with towing and mooring, as set out in the annex, with a view to ensuring a uniform approach towards the application of the provisions of SOLAS regulation II-1/3-8, which is expected to become effective on 1 January 2007.

2 Member Governments are invited to use the annexed guidance when applying SOLAS regulation II-1/3-8, and to bring it to the attention of all parties concerned.

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ANNEX

SHIPBOARD EQUIPMENT, FITTINGS AND SUPPORTING HULL STRUCTURES ASSOCIATED WITH TOWING AND MOORING

1 Application

1.1 Under regulation II-1/3-8 of the 1974 SOLAS Convention, as adopted by resolution MSC.194(80) in 2005, new displacement type ships, except high-speed craft and offshore units, 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 operations of the ship. The arrangements, equipment and fittings shall meet the appropriate requirements of the Administration or an organization recognized by the Administration.

1.2 This circular is intended to provide standards for the design and construction of shipboard fittings and supporting hull structures associated with towing and mooring, which Administrations are recommended to implement. The provisions of this guidance do not require tow lines nor mandate standards for mooring lines onboard the ship.

1.3 Equipment that is used for both towing and mooring should be in accordance with sections 3 and 4.

2 Definitions

For the purpose of this guidance:

2.1 *Shipboard fittings* mean bollards and bitts, fairleads, stand rollers and chocks used for the normal mooring of the ship and similar components used for the normal towing of the ship. Other components such as capstans, winches, etc. are not covered by this guidance. Any weld, bolt or other fastening connecting the shipboard fitting to the supporting hull structure is part of the shipboard fitting and subject to any industry standard applicable to such fitting.

2.2 *Supporting hull structure* means that part of the ship structure on/in which the shipboard fitting is placed and which is directly submitted to the forces exerted on the shipboard fitting. The hull structure supporting capstans, winches, etc. used for the normal towing and mooring operations mentioned above should also be subject to this guidance.

2.3 *Industry standard* means international or national standards which are recognized in the country where the ship is built, subject to the approval of the Administration.

3 Towing fittings

3.1 Strength

The strength of shipboard fittings used for normal towing operations and their supporting hull structures should comply with the provisions of 3.2 to 3.6.

3.2 Arrangements

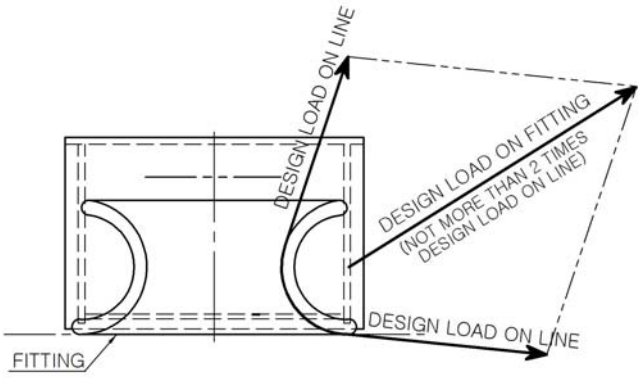
Shipboard fittings for towing should be located on longitudinals, beams and/or girders, which are part of the deck construction so as to facilitate efficient distribution of the towing load. Other equivalent arrangements may be accepted (for Panama chocks, etc.).

3.3 Load considerations

3.3.1 The design load used for normal towing operations (e.g. harbour/manoeuvring) should be 1.25 times the intended maximum towing load (e.g. static bollard pull) as indicated on the towing and mooring arrangements plan. The design load should be applied through the tow line according to the arrangement shown on the towing and mooring arrangements plan.

3.3.2 For other towage service (e.g. escort), the design load used for each fitting should be the nominal breaking strength of the tow line defined in table 1 based on the equipment number (EN) described in the appendix. The design load should be applied through the tow line according to the arrangement shown on the towing and mooring arrangements plan.

3.3.3 The method of application of the design load to the fittings and supporting hull structure should be taken into account such that the total load need not be more than twice the design load specified in 3.3.1 or 3.3.2, i.e. no more than one turn of one line (see figure below).



3.4 Shipboard fittings

The selection of shipboard fittings should be made by the shipyard in accordance with industry standards (e.g. ISO 3913:1977 Shipbuilding-Welded steel bollards) accepted by the Administration. When the shipboard fitting is not selected from an accepted industry standard, the design load used to assess its strength and its attachment to the ship should be in accordance with 3.3 above.

3.5 Supporting hull structure

Arrangement

3.5.1 The arrangement of the reinforced members (carling) beneath shipboard fittings should consider any variation of direction (laterally and vertically) of the towing forces (which should be not less than the design load as per 3.3) acting through the arrangement of connection to the shipboard fittings.

Acting point of towing force

3.5.2 The acting point of the towing force on shipboard fittings should be taken at the attachment point of a towing line or at a change in its direction.

Allowable stresses

3.5.3 Allowable bending stress: 100% of the specified yield point for the material used; allowable shearing stress: 60% of the specified yield point for the material used; no stress concentration factors being taken into account.

3.6 Safe working load (SWL)

3.6.1 The SWL used for normal towing operations (harbour/manoeuvring) should not exceed 80% of the design load as given in 3.3.1 and the SWL used for other towing operations (e.g. escort) should not exceed the design load as given in 3.3.2. For fittings used for both harbour and escort purposes, the greater of the design loads of 3.3.1 and 3.3.2 should be used.

3.6.2 The SWL of each shipboard fitting should be marked (by weld bead or equivalent) on the deck fittings used for towing.

3.6.3 The above provisions on SWL apply for a single post basis (no more than one turn of one line).

3.6.4 The towing and mooring arrangements plan described in section 5 should define the method of use of towing lines.

4 Mooring fittings

4.1 Strength

The strength of shipboard fittings used for mooring operations and their supporting hull structures should comply with the provisions of 4.2 to 4.6.

4.2 Arrangements

Shipboard fittings for mooring should be located on longitudinals, beams and/or girders, which are part of the deck construction so as to facilitate efficient distribution of the mooring load. Other equivalent arrangements may be accepted (for Panama chocks, etc.).

4.3 Load considerations

4.3.1 The design load applied to shipboard fittings and supporting hull structures should be 1.25 times the breaking strength of the mooring line provided in accordance with table 1 based on the equipment number (EN) described in the appendix. The design load should be applied through the mooring line according to the arrangement shown on the towing and mooring arrangements plan.

4.3.2 The design load applied to supporting hull structures for winches, etc. should be 1.25 times the breaking strength of the mooring line according to 4.3.1 above and, for capstans, 1.25 times the maximum hauling-in force. The design load should be applied through the mooring line according to the arrangement shown on the towing and mooring arrangements plan.

4.3.3 The method of application of the design load to the fittings and supporting hull structure should be taken into account such that the total load need not be more than twice the design load specified in 4.3.1, i.e. no more than one turn of one line.

4.4 Shipboard fittings

The selection of shipboard fittings should be made by the shipyard in accordance with industry standards (e.g. ISO 3913:1977 Shipbuilding-Welded steel bollards) accepted by the Administration. When the shipboard fitting is not selected from an accepted industry standard, the fittings should be equivalent to a recognized industry standard in compliance with the design load as per 4.3.

4.5 Supporting hull structure

Arrangement

4.5.1 The arrangement of the reinforced members (carling) beneath shipboard fittings should consider any variation of direction (laterally and vertically) of the mooring forces (which should be not less than the design load given in 4.3) acting through the arrangement of connection to the shipboard fittings.

Acting point of mooring force

4.5.2 The acting point of the mooring force on shipboard fittings should be taken at the attachment point of a mooring line or at a change in its direction.

Allowable stresses

4.5.3 Allowable bending stress: 100% of the specified yield point for the material used; allowable shearing stress: 60% of the specified yield point for the material used; no stress concentration factors being taken into account.

4.6 Safe working load (SWL)

4.6.1 The SWL should not exceed 80% of the design load given in 4.3.

4.6.2 The SWL of each shipboard fitting should be marked (by weld bead or equivalent) on the deck fittings used for mooring.

4.6.3 The above provisions on SWL apply for a single post basis (no more than one turn of one line).

4.6.4 The towing and mooring arrangements plan described in section 5 should define the method of use of mooring lines.

5 Towing and mooring arrangements plan

5.1 The SWL for the intended use for each shipboard fitting should be noted in the towing and mooring arrangements plan available on board for the guidance of the Master.

5.2 Information provided on the plan should include in respect of each shipboard fitting:

.1 location on the ship;

.2 fitting type;

.3 SWL;

.4 purpose (mooring/harbour towing/escort towing); and

.5 method of applying load of towing or mooring line including limiting fleet angles.

Table 1

MOORING AND TOW LINES

EQUIPMENT NUMBER		MOORING LINES	TOW LINE*
Exceeding	**Not exceeding**	**Minimum breaking strength (kN)**	**Breaking strength (kN)**
1	***2***	***3***	***4***
50	70	34	98
70	90	37	98
90	110	39	98
110	130	44	98
130	150	49	98
150	175	54	98
175	205	59	112
205	240	64	129
240	280	69	150
280	320	74	174
320	360	78	207
360	400	88	224
400	450	98	250
450	500	108	277
500	550	123	306
550	600	132	338
600	660	147	370
660	720	157	406
720	780	172	441
780	840	186	479
840	910	201	518
910	980	216	559
980	1060	230	603
1060	1140	250	647
1140	1220	270	691
1220	1300	284	738
1300	1390	309	786
1390	1480	324	836
1480	1570	324	888
1570	1670	333	941
1670	1790	353	1024
1790	1930	378	1109
1930	2080	402	1168
2080	2230	422	1259
2230	2380	451	1356
2380	2530	480	1453
2530	2700	480	1471
2700	2870	490	1471
2870	3040	500	1471
3040	3210	520	1471
3210	3400	554	1471

EQUIPMENT NUMBER		MOORING LINES	TOW LINE*
Exceeding	**Not exceeding**	**Minimum breaking strength (kN)**	**Breaking strength (kN)**
1	***2***	***3***	***4***
3400	3600	588	1471
3600	3800	618	1471
3800	4000	647	1471
4000	4200	647	1471
4200	4400	657	1471
4400	4600	667	1471
4600	4800	677	1471
4800	5000	686	1471
5000	5200	686	1471
5200	5500	696	1471
5500	5800	706	1471
5800	6100	706	1471
6100	6500	716	
6500	6900	726	
6900	7400	726	
7400	7900	726	
7900	8400	736	
8400	8900	736	
8900	9400	736	
9400	10000	736	
10000	10700	736	
10700	11500	736	
11500	12400	736	
12400	13400	736	
13400	14600	736	
14600	16000	736	

* Information is provided in relation to 3.3.2 and provision onboard of such a line is not necessary under this guidance.

APPENDIX

EQUIPMENT NUMBER

The equipment number (EN) should be calculated as follows:

$$EN = \Delta^{2/3} + 2.0hB + \frac{A}{10}$$

where:

Δ = moulded displacement, in tonnes, to the Summer Load Waterline

B = moulded breadth, in metres

h = effective height, in metres, from the Summer Load Waterline to the top of the uppermost house; for the lowest tier "h" should be measured at centreline from the upper deck or from a notional deck line where there is local discontinuity in the upper deck

$$h = a + \Sigma h_i$$

where:

a = distance, in metres, from the Summer Load Waterline amidships to the upper deck

h_i = height, in metres, on the centreline of each tier of houses having a breadth greater than B/4

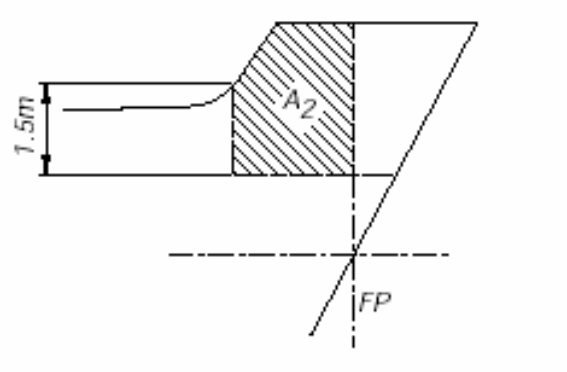
A = area, in square metres, in profile view, of the hull, superstructures and houses above the Summer Load Waterline which are within the equipment length of the ship and also have a breadth greater than B/4

NOTES

1 When calculating h, sheer and trim should be ignored, i.e. h is the sum of freeboard amidships plus the height (at centreline) of each tier of houses having a breadth greater than B/4.

2 If a house having a breadth greater than B/4 is above a house with a breadth of B/4 or less, then the wide house should be included but the narrow house ignored.

3 Screens or bulwarks 1.5 m or more in height should be regarded as parts of houses when determining h and A. The height of the hatch coamings and that of any deck cargo, such as containers, may be disregarded when determining h and A. With regard to determining A, when a bulwark is more than 1.5 m high, the area shown below as A_2 should be included in A.



4 The equipment length of the ships is the length between perpendiculars but should not be less than 96% nor greater than 97% of the extreme length on the Summer Waterline (measured from the forward end of the waterline).

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MSC.1/Circ.1175/Rev.1
9 December 2020

REVISED GUIDANCE ON SHIPBOARD TOWING AND MOORING EQUIPMENT

1 The Maritime Safety Committee, at its eightieth session (11 to 20 May 2005), approved guidance concerning shipboard equipment, fittings and supporting hull structures associated with towing and mooring for the uniform implementation of SOLAS regulation II-1/3-8, adopted by resolution MSC.194(80), which became effective on 1 January 2007.

2 The 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, 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 *Revised guidance on shipboard towing and mooring equipment*, as set out in the annex.

3 This revised guidance is applicable to ships constructed on or after 1 January 2024 and does not supersede the *Guidance on shipboard towing and mooring equipment* (MSC.1/Circ.1175) which remains applicable to ships constructed on or after 1 January 2007 but before 1 January 2024.

4 Member Governments are invited to use the annexed guidance when applying the revised SOLAS regulation II-1/3-8, and to bring it to the attention of all parties concerned.

***

ANNEX

SHIPBOARD EQUIPMENT, FITTINGS AND SUPPORTING HULL STRUCTURES ASSOCIATED WITH TOWING AND MOORING

1 Application

1.1 Under regulation II-1/3-8 of the 1974 SOLAS Convention, as adopted by resolution MSC.473(102), new displacement type ships, except high-speed craft and offshore units, 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 operations of the ship. The arrangements, equipment and fittings shall meet the appropriate requirements of the Administration or an organization recognized by the Administration.

1.2 The *Revised guidance on shipboard towing and mooring equipment* (MSC.1/Circ.1175/Rev.1) should apply to ships constructed on or after 1 January 2024. To ships constructed on or after 1 January 2007 and before 1 January 2024, the *Guidance on shipboard towing and mooring equipment* (MSC.1/Circ.1175) should apply.

1.3 This circular provides standards for the design and construction of shipboard fittings and supporting hull structures associated with normal towing and mooring operations in harbours or sheltered waters, which Administrations are recommended to implement. This circular also contains design guidance for fittings of ships that are further intended to be towed by another ship or tug, e.g. in an emergency. This circular does not require tow lines nor mandate standards for mooring lines on board the ship. Furthermore, this guidance is not applicable to the design and construction of shipboard fittings and supporting hull structures used for special towing services defined as:

.1 *Escort towing*: Towing service required in some estuaries to control the ship in case of failures of the propulsion or steering system. It should be referred to local escort requirements;

.2 *Canal transit towing*: Towing service for ships transiting canals, e.g. the Panama Canal. It should be referred to local canal transit requirements; and

.3 *Emergency towing for tankers*: Towing service to assist tankers in case of emergency. It should be referred to paragraph 1 of SOLAS regulation II-1/3-4.

1.4 Equipment that is used for both towing and mooring should be in accordance with sections 3 and 4.

2 Definitions

For the purpose of this guidance:

2.1 *Normal towing* means towing operations necessary for manoeuvring in ports and sheltered waters associated with the normal operations of the ship.

2.2 *Other towing* means towing by another ship or a tug, such as to assist the ship in case of emergency.

2.3 *Shipboard fittings* mean bollards and bitts, fairleads, pedestal rollers and chocks used for mooring of the ship and similar components used for normal or other towing of the ship. Any weld, bolt or other fastening connecting the shipboard fitting to the supporting hull structure is part of the shipboard fitting and subject to any industry standard applicable to such fitting.

2.4 *Supporting hull structure* means that part of the ship structure on/in which the shipboard fitting is placed and which is directly submitted to the forces exerted on the shipboard fitting. The hull structure supporting capstans, winches, etc. used for normal or other towing and mooring operations mentioned above should also be subject to this guidance.

2.5 *Industry standard* means international or national standards which are recognized in the country where the ship is built, subject to the approval of the Administration.

2.6 *Safe working load (SWL)* means the safe load limit of shipboard fittings used for mooring operations in harbours or similar sheltered waters.

2.7 *Safe towing load (TOW)* means the safe load limit of shipboard fittings used for normal and other towing.

2.8 *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.

3 Towing

3.1 Strength

The strength of shipboard fittings used for normal towing operations and their supporting hull structures should comply with the provisions of 3.2 to 3.6. Where a ship is equipped with shipboard fittings intended to be used for other towing services, the strength of these fittings and their supporting hull structures should also comply with these provisions. The strength of shipboard fittings intended to be used for both towing and mooring and of their supporting hull structures should also comply with the provisions of section 4.

3.2 Arrangements

Shipboard fittings for towing should be located on stiffeners and/or girders which are part of the deck construction so as to facilitate efficient distribution of the towing load. Other equivalent arrangements may be accepted (for chocks in bulwarks, etc.), provided the strength is confirmed as adequate for the intended service.

3.3 Load considerations

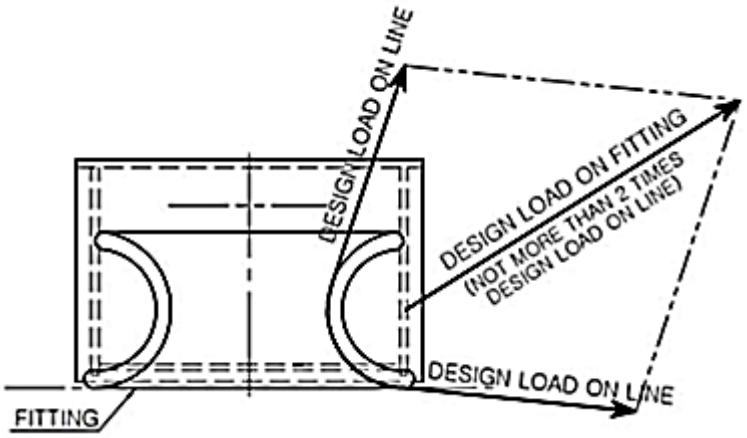
3.3.1 The minimum design load applied to supporting hull structures for shipboard fittings should be:

.1 for normal towing operations, 1.25 times the intended maximum towing load (e.g. static bollard pull), as indicated on the towing and mooring arrangements plan;

.2 for other towing services, the ship design minimum breaking load of the tow line defined in appendix A; and

.3 for fittings intended to be used for both normal and other towing operations, the greater of the design loads according to .1 and .2.

3.3.2 The design load should be applied to fittings in all directions that may occur by taking into account the arrangement shown on the towing and mooring arrangements plan. Where the towing line takes a turn at a fitting, the total design load applied to the fitting is equal to the resultant of the design loads acting on the line. However, in no case does the design load applied to the fitting need to be more than twice the design load on the line as specified in 3.3.1 (see figure below).



3.4 Shipboard fittings

3.4.1 Shipboard fittings may be selected from an industry standard accepted by the Administration and at least based on the following loads:

.1 for normal towing operations, the intended maximum towing load (e.g. static bollard pull) as indicated on the towing and mooring arrangements plan;

.2 for other towing services, the ship design minimum breaking load of the tow line according to appendix A; and

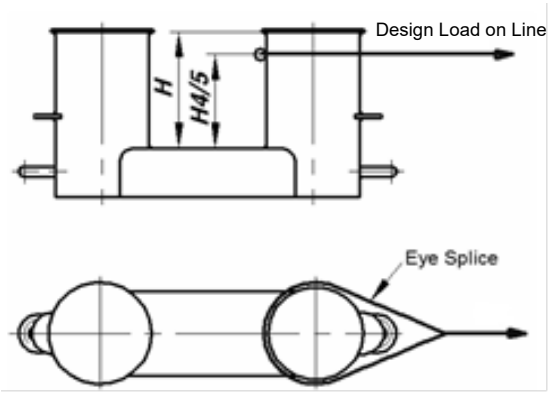
.3 for fittings intended to be used for both normal and other towing operations, the greater of the loads according to .1 and .2.

3.4.2 When the shipboard fitting is not selected from an accepted industry standard, the strength of the fitting and of its attachment to the supporting hull structure should be in accordance with 3.3 and 3.5.

3.5 Supporting hull structure

3.5.1 The reinforcing members beneath shipboard fittings should be effectively arranged for any variation of direction (horizontally and vertically) of the towing forces acting upon the shipboard fittings. Proper alignment of fitting and supporting hull structures should be ensured.

3.5.2 The acting point of the towing force on shipboard fittings should be taken at the attachment point of a towing line or at a change in its direction. For bollards and bitts the attachment point of the towing line should be taken not less than 4/5 of the tube height above the base (see figure below).



3.5.3 Under the design load conditions as specified in 3.3 the allowable normal stress should be taken as 100% and the allowable shearing stress as 60% of the specified yield point for the material used. Normal stress is the sum of bending stress and axial stress with the corresponding shearing stress acting perpendicular to the normal stress. No stress concentration factors being taken into account.

3.6 Safe towing load (TOW)

3.6.1 TOW used for normal towing operations should not exceed 80% of the design load as given in 3.3.1.1 and TOW used for other towing operations should not exceed 80% of the design load as given in 3.3.1.2. For fittings used for both, normal and other towing operations, the greater of the safe towing loads should be used.

3.6.2 TOW, in tonnes, of each shipboard fitting should be marked (by weld bead or equivalent) on the fittings intended for towing. For fittings intended to be used for both, towing and mooring, SWL, in tonnes, according to 4.6, should be marked in addition to TOW.

3.6.3 The above provisions on TOW apply for the use of no more than one towing line.

3.6.4 The towing and mooring arrangements plan described in section 5 should define the method of use of towing lines.

4 Mooring

4.1 Strength

The strength of shipboard fittings used for mooring operations and of their supporting hull structures, as well as the strength of supporting hull structures of winches and capstans, should comply with the provisions of 4.2 to 4.6. The strength of shipboard fittings, intended to be used for both, mooring and towing, and of their supporting hull structures, should also comply with the provisions of section 3.

4.2 Arrangements

Shipboard fittings, winches and capstans for mooring should be located on stiffeners and/or girders, which are part of the deck construction, so as to facilitate efficient distribution of the mooring load. Other equivalent arrangements may be accepted (for chocks in bulwarks, etc.) provided the strength is confirmed adequate for the service.

4.3 Load considerations

4.3.1 The minimum design load applied to supporting hull structures:

.1 of shipboard fittings should be 1.15 times the ship design minimum breaking load of the mooring line provided in accordance with appendix A;

.2 of winches should be 1.25 times the intended maximum brake holding load, where the maximum brake holding load should be assumed not less than 80% of the ship design minimum breaking load of the mooring line according to appendix A; and

.3 of capstans 1.25 times the maximum hauling-in force.

4.3.2 The design load should be applied to fittings in all directions that may occur by taking into account the arrangement shown on the towing and mooring arrangements plan. Where the mooring line takes a turn at a fitting, the total design load applied to the fitting is equal to the resultant of the design loads acting on the line. However, in no case does the design load need to be more than twice the design load on the line as specified in 4.3.1 (see figure in 3.3).

4.4 Shipboard fittings

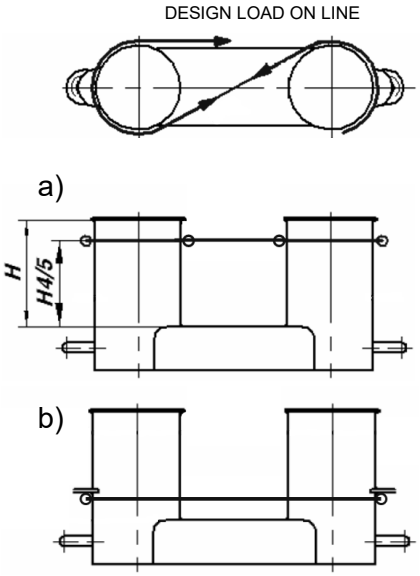
4.4.1 Shipboard fittings may be selected from industry standards accepted by the Administration at least based on the ship design minimum breaking load of the mooring line according to appendix A.

4.4.2 When the shipboard fitting is not selected from an accepted industry standard, the strength of the fittings and of its attachment to the supporting hull structure should be in accordance with 4.3 and 4.5.

4.5 Supporting hull structure

4.5.1 Arrangement of reinforcing members beneath shipboard fittings, winches and capstans should consider any variation of direction (horizontally and vertically) of the mooring forces acting upon the shipboard fittings. Proper alignment of fitting and supporting hull structures should be ensured.

4.5.2 The acting point of the mooring force on shipboard fittings should be taken at the attachment point of a mooring line or at a change in its direction. For bollards and bitts the attachment point of the mooring line should be taken not less than 4/5 of the tube height above the base (see figure a) below). However, if fins are fitted to the bollard tubes to keep the mooring line as low as possible, the attachment point of the mooring line may be taken at the location of the fins (see figure b) below).



4.5.3 Under the design load conditions, as specified in 4.3, the allowable normal stress should be taken as 100% and the allowable shearing stress as 60% of the specified yield point for the material used. Normal stress is the sum of bending stress and axial stress with the corresponding shearing stress acting perpendicular to the normal stress, no stress concentration factors being taken into account.

4.6 Safe working load (SWL)

4.6.1 The SWL, for the purpose of marking, should be equal to the ship design minimum breaking load of the mooring line according to appendix A.

4.6.2 The SWL, in tonnes, of each shipboard fitting should be marked (by weld bead or equivalent) on the fittings intended for mooring. For fittings intended to be used for both mooring and towing, TOW, in tonnes, according to 3.6, should be marked in addition to SWL.

4.6.3 The above provisions on SWL apply for the use of no more than one mooring line.

4.6.4 The towing and mooring arrangements plan described in section 5 should define the method of use of mooring lines.

5 Towing and mooring arrangements plan

5.1 The SWL and TOW for the intended use for each shipboard fitting should be noted in the towing and mooring arrangements plan available on board for the guidance of the master. It should be noted that TOW is the load limit for towing purposes and SWL is the load limit for mooring purposes.

5.2 Information provided in the plan should include, in respect of each shipboard fitting:

.1 location on the ship;

.2 fitting type;

.3 SWL/TOW;

.4 purpose (mooring, normal towing or other towing); and

.5 method of applying load of towing or mooring line including limiting fleet angle, i.e. angle of change in direction of a line at the fitting.

5.3 Furthermore, information provided on the plan is to include:

.1 the arrangement of mooring lines showing number of lines (N);

.2 the ship design minimum breaking load of each mooring line (MBL_{SD});

.3 the length of each mooring line;

.4 restrictions or limitations on the type (including material and construction), stiffness and diameter of mooring lines which are compatible with the mooring equipment and fittings; and

.5 the acceptable environmental conditions as given in appendix A, section 3 for the recommended ship design minimum breaking load of mooring lines for ships with Equipment Number EN > 2000:

.1 30 second mean wind speed from any direction (v_W or v_W* according to 3.1.3 or 3.2.2, respectively); and

.2 maximum current speed acting on bow or stern (±10°).

Note: When the applied design environmental criteria exceed the above given criteria, information provided in the plan should include the design environmental criteria, similar to the parameters in appendix A:

.1 wind speed and direction; and

.2 current speed and direction.

APPENDIX A

MOORING AND TOW LINES

1 General

1.1 The mooring lines for ships with Equipment Number (EN) of less than or equal to 2,000 are given in section 2. For other ships the mooring lines are given in section 3.

1.2 The applicable provisions for tow lines are given in section 2.

1.3 The EN should be calculated in compliance with appendix B. Deck cargo as given by the loading manual should be included for the determination of side-projected area A.

1.4 Sections 2 and 3 specify the minimum recommended number and minimum strength of mooring lines (MBL_{SD}). The designer should consider verifying the adequacy of mooring lines based on assessments carried out for the individual mooring arrangement, expected shore-side mooring facilities and expected prevalent environmental conditions.

2 Mooring lines for ships with EN ≤ 2000 and tow lines

2.1 The minimum recommended mooring lines for ships having an EN of less than or equal to 2,000 are given in table 1.

2.2 For ships having the ratio A/EN > 0.9 the following number of lines should be added to the number of mooring lines as given in table 1:

one line where $0.9 < \frac{A}{EN} \leq 1.1$,

two lines where $1.1 < \frac{A}{EN} \leq 1.2$,

three lines where $1.2 < \frac{A}{EN}$.

2.3 The tow lines are given in table 1 and are intended as own tow line of a ship to be towed by a tug or another ship.

Table 1: Mooring and tow lines for ships with EN ≤ 2000

EQUIPMENT NUMBER		MOORING LINES		TOW LINE*
Exceeding	**Not exceeding**	**No. of mooring lines**	**Ship design minimum breaking load (kN)**	**Ship design minimum breaking load (kN)**
1	***2***	***3***	***4***	***5***
50	70	3	37	98
70	90	3	40	98
90	110	3	42	98
110	130	3	48	98
130	150	3	53	98
150	175	3	59	98
175	205	3	64	112
205	240	4	69	129
240	280	4	75	150
280	320	4	80	174
320	360	4	85	207
360	400	4	96	224
400	450	4	107	250
450	500	4	117	277
500	550	4	134	306
550	600	4	143	338
600	660	4	160	370
660	720	4	171	406
720	780	4	187	441
780	840	4	202	479
840	910	4	218	518
910	980	4	235	559
980	1,060	4	250	603
1,060	1,140	4	272	647
1,140	1,220	4	293	691
1,220	1,300	4	309	738
1,300	1,390	4	336	786
1,390	1,480	4	352	836
1,480	1,570	5	352	888
1,570	1,670	5	362	941
1,670	1,790	5	384	1,024
1,790	1,930	5	411	1,109
1,930	2,080	5**	437**	1,168
2,080	2,230	**	**	1,259
2,230	2,380	**	**	1,356
2,380	2,530	**	**	1,453
2,530	-	**	**	1,471

* Information is provided in relation to 3.3.1.2 and 3.4.1.2 of the annex to Revised guidance and provision on board of such a line is not necessary under this guidance.

** For ships with EN > 2,000 see section 3 of appendix A.

3 Mooring lines for ships with EN > 2,000

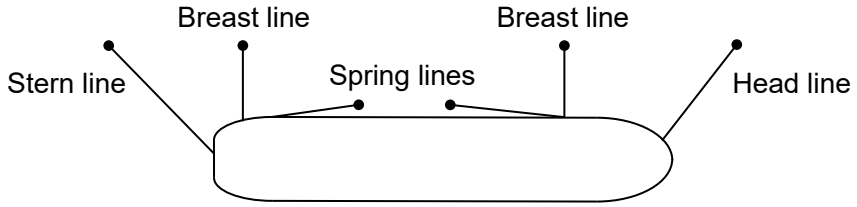
3.1 General

3.1.1 The following is defined with respect to the purpose of mooring lines (see also figure below):

.1 *Breast line*: A mooring line that is deployed perpendicular to the ship, restraining the ship in the off-berth direction;

.2 *Spring line*: A mooring line that is deployed almost parallel to the ship, restraining the ship in fore or aft direction; and

.3 *Head/Stern line*: A mooring line that is oriented between longitudinal and transverse direction, restraining the ship in the off-berth and in fore or aft direction. The amount of restraint in fore or aft and off-berth direction depends on the line angle relative to these directions.



.4 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.

3.1.2 The strength of mooring lines and the number of head, stern and breast lines for ships with an EN > 2,000 are based on the side-projected area A_1. Side projected area A_1 should be calculated similar to the side-projected area A according to appendix B but considering the following conditions:

.1 For oil tankers, chemical tankers, bulk carriers and ore carriers the lightest ballast draft should be considered for the calculation of the side-projected area A_1. For other ships the lightest draft of usual loading conditions should be considered if the ratio of the freeboard in the lightest draft and the full load condition is equal to or above two. Usual loading conditions mean loading conditions as given by the trim and stability booklet that are to be expected to regularly occur during operations, excluding light weight conditions, propeller inspection conditions, etc.

.2 Wind shielding of the pier can be considered for the calculation of the side-projected area A_1 unless the ship is intended to be regularly moored to jetty-type piers. A height of the pier surface of 3 m above the waterline may be assumed, i.e. the lower part of the side-projected area with a height of 3 m above the waterline for the considered loading condition may be disregarded for the calculation of the side-projected area A_1.

.3 Deck cargoes as given by the loading manual should be included for the determination of side-projected area A_1. Deck cargo may not need to be considered if a usual light draft condition without cargo on deck generates a larger side-projected area A_1 than the full load condition with cargo on deck. The larger of both side-projected areas should be chosen as side-projected area A_1.

3.1.3 The mooring lines as given hereunder are based on a maximum current speed of 1.0 m/s and the following maximum wind speed v_w, in m/s:

v_w = 25.0 - 0.002 (A_1 – 2,000) for passenger ships, ferries and car carriers with 2,000 $m^2 < A_1 \leq 4{,}000\ m^2$

= 21.0 for passenger ships, ferries and car carriers with $A_1 > 4{,}000\ m^2$

= 25.0 for other ships

3.1.4 The wind speed is considered representative of a 30 second mean speed from any direction and at a height of 10 m above the ground. The current speed is considered representative of the maximum current speed acting on bow or stern (±10°) and at a depth of one-half of the mean draft. Furthermore, it is considered that ships are moored to solid piers that provide shielding against cross current.

3.1.5 Additional loads caused by, for example, higher wind or current speeds, cross currents, additional wave loads or reduced shielding from non-solid piers may need to be particularly considered. Furthermore, it should be observed that unbeneficial mooring layouts can considerably increase the loads on single mooring lines.

3.2 Ship design minimum breaking load

3.2.1 The ship design minimum breaking load, in kN, of the mooring lines should be taken as:

$$MBL_{SD} = 0.1 \cdot A_1 + 350$$

3.2.2 The ship design minimum breaking load may be limited to 1,275 kN (130 t). However, in this case the moorings are to be considered as not sufficient for environmental conditions given by A.3.1.3. For these ships, the acceptable wind speed v_w,* in m/s, can be estimated as follows:

$$v_w^* = v_w \cdot \sqrt{\frac{MBL_{SD}{}^*}{MBL_{SD}}}$$

where v_w is the wind speed as per 3.1.3 above, MBL_{SD}* the breaking strength of the mooring lines intended to be supplied and MBL_{SD} the breaking strength as recommended according to the above formula. However, the ship design minimum breaking load should not be taken less than corresponding to an acceptable wind speed of 21 m/s:

$$MBL_{SD}{}^* \geq \left(\frac{21}{v_w}\right)^2 \cdot MBL_{SD}$$

3.2.3 If lines are intended to be supplied for an acceptable wind speed v_w* higher than v_w as per 3.1.3, the ship design minimum breaking load should be taken as:

$$MBL_{SD}{}^{*} = \left(\frac{v_w^*}{v_w}\right)^2 \cdot MBL_{SD}$$

3.3 Number of mooring lines

3.3.1 The total number of head, stern and breast lines should be taken as:

$$n = 8.3 \cdot 10^{-4} \cdot A_1 + 6$$

3.3.2 For oil tankers, chemical tankers, bulk carriers and ore carriers, the total number of head, stern and breast lines should be taken as:

$$n = 8.3 \cdot 10^{-4} \cdot A_1 + 4$$

3.3.3 The total number of head, stern and breast lines should be rounded to the nearest whole number.

3.3.4 The number of head, stern and breast lines may be increased or decreased in conjunction with an adjustment to the strength of the lines. The adjusted strength, MBL_{SD},** should be taken as:

MBL_{SD}** = 1.2 · MBL_{SD} · n/n** ≤ MBL_{SD} for increased number of lines,

MBL_{SD}** = MBL_{SD} · n/n** for reduced number of lines,

where MBL_{SD} is MBL_{SD} or MBL_{SD}* specified in 3.2, as appropriate; n** is the increased or decreased total number of head, stern and breast lines and n the number of lines for the considered ship type as calculated according to 3.3.1 or 3.3.2 without rounding.

3.3.5 Vice versa, the strength of head, stern and breast lines may be increased or decreased in conjunction with an adjustment to the number of lines.

3.3.6 The total number of spring lines should be taken not less than:

two lines where EN < 5,000; and

four lines where EN ≥ 5,000.

3.3.7 The strength of spring lines should be the same as that of the head, stern and breast lines. If the number of head, stern and breast lines is increased in conjunction with an adjustment to the strength of the lines, the number of spring lines should be taken as follows, but rounded up to the nearest even number:

$$n_S^* = MBL_{SD} / MBL_{SD}^{**} \cdot n_S$$

where MBL_{SD} is MBL_{SD} or MBL_{SD}* specified in 3.2, as appropriate, MBL_{SD}** the adjusted strength of lines as specified in 3.3.4, n_S the number of spring lines as given in 3.3.6 and n_S* the increased number of spring lines.

APPENDIX B

EQUIPMENT NUMBER

The equipment number (EN) should be calculated as follows:

$$EN = \Delta^{2/3} + 2.0hB + \frac{A}{10}$$

where:

Δ= Moulded displacement, in tonnes, to the Summer Load Waterline.

B = Moulded breadth, in metres.

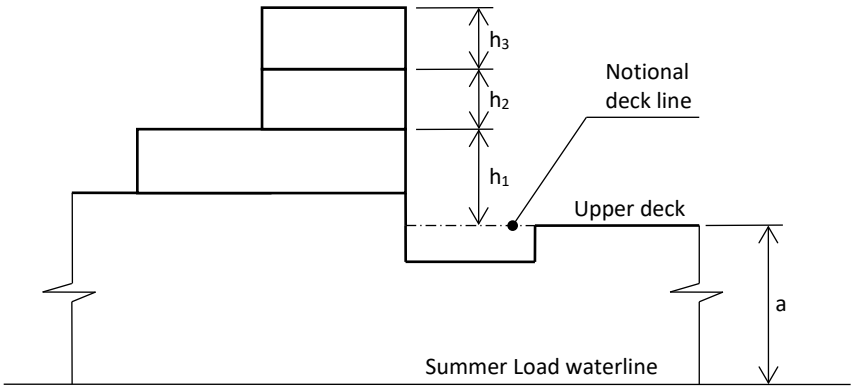
h = Effective height, in metres, from the Summer Load Waterline to the top of the uppermost house; for the lowest tier 'h' should be measured at centreline from the upper deck or from a notional deck line where there is local discontinuity in the upper deck (see figure below for an example).

$$h = a + \Sigma h_i$$

a = Distance, in metres, from the Summer Load Waterline amidships to the upper deck.

hi = Height, in metres, on the centreline of each tier of houses having a breadth greater than B/4.

A = Side-projected area, in square metres, of the hull, superstructures and houses above the Summer Load Waterline which are within the equipment length of the ship and also have a breadth greater than B/4.

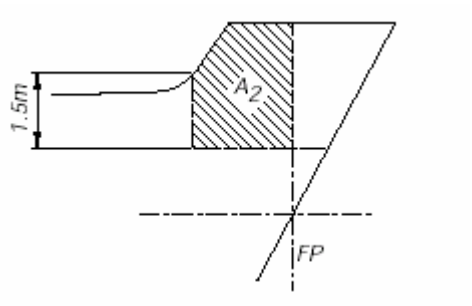


NOTES:

1 When calculating h, sheer and trim should be ignored, i.e. h is the sum of freeboard amidships plus the height (at centreline) of each tier of houses having a breadth greater than B/4.

2 If a house having a breadth greater than B/4 is above a house with a breadth of B/4 or less, then the wide house should be included but the narrow house ignored.

3 Screens or bulwarks 1.5 metres or more in height should be regarded as parts of houses when determining h and A. The height of the hatch coamings and that of any deck cargo, such as containers, may be disregarded when determining h and A. With regard to determining A, when a bulwark is more than 1.5 metres high, the area shown below as A2 should be included in A.



4 The equipment length of the ships is the length between perpendiculars but should not be less than 96% nor greater than 97% of the extreme length on the Summer Waterline (measured from the forward end of the waterline).

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MSC.1/Circ.1619
11 December 2020

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 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;

.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.

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MSC.1/Circ.1620
24 December 2020

GUIDELINES FOR INSPECTION AND MAINTENANCE OF MOORING EQUIPMENT INCLUDING LINES

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, and recognizing the importance of inspection and maintenance of mooring equipment including lines, approved the *Guidelines for inspection and maintenance of mooring equipment including lines*, as set out in the annex.

2 Member States are invited to bring the annexed Guidelines to the attention of shipowners, ship managers, bareboat charterers and other organizations or persons responsible for operation of ships.

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, for providing guidance on inspection and maintenance of mooring equipment including mooring lines.

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ANNEX

GUIDELINES FOR INSPECTION AND MAINTENANCE OF MOORING EQUIPMENT INCLUDING LINES

1 General

1.1 Purpose

The purpose of these Guidelines 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 Application

These Guidelines apply to all ships. Certain provisions are intended for reference by shipboard personnel, and other provisions are intended for Company personnel responsible for selecting and procuring replacement mooring lines.

2 Definitions

For the purpose of these Guidelines:

2.1 *Bend radius (D/d ratio)* means 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.

2.2 *Company* means company, as defined in SOLAS regulation IX/1.2.

2.3 *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.

2.4 *Mooring arrangement* means 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.

2.5 *Mooring boat* means the boat handling mooring lines between the ship and ashore mooring facilities during mooring and unmooring operations and does not include harbour ship assist tugs (see the *Guidelines on minimum training and education of mooring personnel* (FAL.6/Circ.11/Rev.1)).

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

2.7 *Mooring line configuration* means 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.

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

2.9 *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.

2.10 *Rotation of mooring lines* means periodical change of mooring lines for respective mooring drums to equalize the wear of mooring lines.

2.11 *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.

2.12 *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.

3 Safe use of mooring equipment

3.1 Safe use of mooring equipment and fittings

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. In order to ensure all mooring equipment functions as designed, the Company should establish procedures for mooring operations, inspection and maintenance of mooring equipment, including mooring lines, taking into account appropriate references listed in paragraph 7 of these Guidelines.

3.2 Protection and storage of mooring lines

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

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

3.3 Control of mooring lines

3.3.1 The Company should establish procedures to allow the identification and control of mooring lines, tails and associated attachments when on board and to facilitate inspection and maintenance of mooring lines. Such procedures should include:

.1 providing a means of recording the number, type and location 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 or an alternative established by the requirements of the Company; and

.2 providing a means of linking specific mooring lines, tails and associated attachments to the relevant records and a manufacturer's certificate, if available.

3.3.2 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. If no actions are taken as appropriate the competent authorities should be informed, as necessary.

4 Inspection and maintenance of mooring lines

4.1 Inspection of mooring lines

4.1.1 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.

4.1.2 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:

.1 the recommendations of the mooring line and/or tail manufacturer, particularly the criteria provided for the assessment of mooring line condition;

.2 operational experience regarding the performance of the mooring line and/or mooring line tail during previous mooring operations; and

.3 the environmental conditions to which the mooring lines and/or mooring line tails are routinely exposed.

4.1.3 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.

4.2 Maintenance of mooring lines

The Company should establish the maintenance procedures as required in paragraph 3.1 of these Guidelines. The maintenance procedures should specify replacement of in-service mooring lines and may include the rotation of mooring lines.

4.3 Criteria for condemning worn-out mooring lines

4.3.1 The replacement of in-service mooring lines which have been assessed as no longer suitable for use should be based on the removal prior to failure and in accordance with criteria provided by the manufacturer.

4.3.2 For visual inspection and replacement of mooring lines, additional advice is provided in industry guidance on mooring line and mooring line tail inspections.

4.4 Inspection and maintenance of equipment and fittings

4.4.1 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.

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

4.4.3 Records of inspection and maintenance of equipment and fittings should be available on board.

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

4.4.5 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).

5 Selection of replacement mooring lines

5.1 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:

.1 breaking strength;
.2 environmental conditions to be used (e.g. temperature);
.3 linear density;
.4 tenacity;
.5 D/d ratios;
.6 compression fatigue; and
.7 stiffness.

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

5.3 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 expectations 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.

5.4 For wire ropes, corrosion protection should be considered.

5.5 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.

5.6 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.

5.7 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.

5.8 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.

6 Updating of ship documents and record-keeping

6.1 Records of inspection and maintenance of mooring equipment and inspection and replacement of mooring lines should be retained on board. Such records should be kept for a period determined by the Company, but in any event the records should be kept until completion of the next annual survey.

6.2 Consideration should be given to control and certification of mooring lines, wires, tails and associated attachments. Manufacturers' test certificates for mooring lines, joining shackles and synthetic tails should be kept on board and properly linked back to the equipment.

6.3 The items to be recorded during inspection and maintenance should be determined, taking into account the recommendations of the manufacturers of the mooring lines.

6.4 Any change of mooring line configuration requires updating of the towing and mooring arrangements plan.

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.

(3) Walter Vervloesem AMNI, *The Nautical Institute, Mooring and Anchoring Ships Vol.2, Inspection and Maintenance*, ISBN: 9781870077941, 2009.

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MSC.1/Circ.1362/Rev.2
14 July 2023

UNIFIED INTERPRETATION OF SOLAS CHAPTER II-1

1 The Maritime Safety Committee, at its eighty-seventh session (12 to 21 May 2010), with a view to providing more specific guidance for application of the relevant requirements of the 1974 SOLAS Convention, approved a unified interpretation of SOLAS regulation II-1/2.14, prepared by the Sub-Committee on Stability and Load Lines and on Fishing Vessels Safety, at its fifty-second session.

2 The Maritime Safety Committee, at its 105th session (20 to 29 April 2022), agreed to amend the above unified interpretation by incorporating interpretations for SOLAS regulations II-1/5.4 and II-1/5.5, prepared by the Sub-Committee on Ship Design and Construction, at its eighth session (17 to 21 January 2022).

3 The Maritime Safety Committee, at its 107th session (31 May to 9 June 2023), in order to clarify the documentation which is necessary to support an Administration or a recognized organization (RO) in verifying compliance with SOLAS regulation II-1/3-8, as well as to provide clarification for pressure testing of penetrations in watertight divisions after a fire test (SOLAS regulation II-1/13.2.3), approved amendments to MSC.1/Circ.1362/Rev.1, prepared by the Sub-Committee on Ship Design and Construction, at its ninth session.

4 Member Governments are invited to use the annexed unified interpretations as guidance when applying relevant provisions of SOLAS chapter II-1 and to bring them to the attention of all parties concerned.

5 This circular revokes MSC.1/Circ.1362/Rev.1.

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ANNEX

UNIFIED INTERPRETATION OF SOLAS CHAPTER II-1

Regulation 2.14 – Definitions

For ships constructed on or after 21 May 2010: In determining the permeability of a space, the volume of a space should be taken as the moulded volume, i.e. the immersed volume of a space should be the underwater moulded volume of that space multiplied by the permeability.

Regulation 3-8

SOLAS regulation II-1/3-8, as amended by resolution MSC.474(102) reads:

"**Regulation 3-8**

Towing and mooring equipment

1 Paragraphs 4 to 6 of this regulation apply to ships constructed on or after 1 January 2007.

2 Paragraphs 7 and 8 of this regulation only apply to ships:

.1 for which the building contract is placed on or after 1 January 2024; 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 1 July 2024; or

.3 the delivery of which is on or after 1 January 2027.

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

4 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.

5 Arrangements, equipment and fittings provided in accordance with paragraph 4 above shall meet the appropriate requirements of the Administration or an organization recognized by the Administration under regulation I/6.[1]

6 Each fitting or item of equipment provided under this regulation shall be clearly marked with any limitations associated with its safe operation, taking into account the strength of the supporting ship's structure and its attachment to it.

[1] Refer to the *Guidance on shipboard towing and mooring equipment* (MSC.1/Circ.1175) for ships constructed on or after 1 January 2007 but before 1 January 2024 and the *Guidance on shipboard towing and mooring equipment* (MSC.1/Circ.1175/Rev.1) for ships constructed on or after 1 January 2024.

7 For ships of 3,000 gross tonnage and above, 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, based on the guidelines developed by the Organization.[2] Ship-specific information shall be provided and kept on board.[3]

8 Ships of less than 3,000 gross tonnage should comply with the requirement in paragraph 7 above as far as reasonably practicable, or with applicable national standards of the Administration.

9 For all ships, mooring equipment, including lines, shall be inspected and maintained in a suitable condition for their intended purposes.[4]"

Interpretation

1 The expression "all ships" in SOLAS regulation II-1/3-8.9 means ships constructed before, on, or after 1 January 2009 in accordance with SOLAS regulation ~~II-1/1.3.3~~II-1/1.1.3.2.

2 Irrespective of the scope of review by the Administration or a recognized organization (RO), as clarified below, for ships covered by the application provisions described in SOLAS regulations II-1/3-8.1 and II-1/3-8.2, as amended by resolution MSC.474(102), owners and designers should comply with the:

.1 *Revised guidance on shipboard towing and mooring equipment* (MSC.1/Circ.1175/Rev.1);

.2 *Guidelines on the design of mooring arrangements and the selection of appropriate mooring equipment and fittings for safe mooring* (MSC.1/Circ.1619); and

.3 *Guidelines for inspection and maintenance of mooring equipment including lines* (MSC.1/Circ.1620),

footnoted in SOLAS regulation II-1/3-8, in its entirety, and ensure that appropriate measures are taken to mitigate any occupational risks arising from deviations.

3 While applying the requirements of SOLAS regulation II-1/3-8.4 to regulation II-1/3-8.6 and SOLAS regulation II-1/3-8.8, for ships of less than 3,000 gross tonnage, the following is recommended:

.1 the "Towing and mooring arrangements plan" should be provided for information, where the winch brake holding capacities should be included in addition to the information provided in section 5 (Towing and mooring arrangements plan) of the annex to MSC.1/Circ.1175/Rev.1. A technical specification document of the mooring lines supplied with the ship should be provided for information. The manufacturers' recommended minimum diameter D of each fitting in contact with the mooring lines and the Line Design Break Force (LDBF) of the mooring lines should be included in the document;

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2 Refer to the *Guidelines on the design of mooring arrangements and the selection of appropriate mooring equipment and fittings for safe mooring* (MSC.1/Circ.1619).

3 Refer to towing and mooring arrangement plan in the *Guidelines on the design of mooring arrangements and the selection of appropriate mooring equipment and fittings for safe mooring* (MSC.1/Circ.1619).

4 Refer to the *Guidelines for inspection and maintenance of mooring equipment including lines* (MSC.1/Circ.1620).

.2 for confirmation of the appropriate selection of mooring line, the properties of mooring lines related to LDBF and bend radius (D/d ratio) should be submitted to the Administration or the RO. A warning should be provided that the wear rate of lines may be higher for lower diameter (paragraph 5.6 of MSC.1/Circ.1620); and

.3 at delivery of the ship, the Administration or the RO should confirm that the towing and mooring arrangements plan is provided on board.

4 While applying the requirements of SOLAS regulation II-1/3-8.4 to regulation II-1/3-8.6 and the SOLAS regulation II-1/3-8.7, for ships of 3,000 gross tonnage and above, the following is recommended in addition to those specified under paragraph 3 of this interpretation:

.1 a document should be provided by the designer for information and as a supplement to the towing and mooring arrangements plan, confirming that MSC.1/Circ.1619 has been considered. The document should explicitly state that the deviations, if any, were unavoidable;

.2 deviations should be recorded (paragraph 6.1 of MSC.1/Circ.1619), justification and suitable safety measures should be provided (paragraph 6.2 of MSC.1/Circ.1619) in the supplement to the towing and mooring arrangements plan. A reference to the supplement should be included in the towing and mooring arrangements plan (paragraph 6.3 of MSC.1/Circ.1619);

.3 if deviations are not found necessary, and the supplement is not needed, then this should be mentioned explicitly in the towing and mooring arrangements plan;

.4 the mooring winches' brake holding capacities should be less than 100% of the Ship Design Minimum Breaking Load (MBL_{SD}) (paragraphs 5.2.3.3 and 5.2.4 of MSC.1/Circ.1619). The winches should be fitted with brakes that allow for the reliable setting of the brake rendering load; and

.5 at delivery of the ship, the Administration or the RO should confirm that the towing and mooring arrangements plan and the supplement describing deviations and suitable safety measures is provided on board.

5 While applying the requirements of SOLAS regulation II-1/3-8.9, the following should be complied with, and compliance should be confirmed by the surveyor at the initial survey for new ships or at the first annual survey for the issuance of the Cargo Ship Safety Construction Certificate or renewal survey for the issuance of the Passenger Ship Safety Certificate after 1 January 2024 for existing ships:

.1 procedures for mooring operations, inspection and maintenance of mooring equipment, including mooring lines, should be established and available on board (paragraph 3.1 of MSC.1/Circ.1620), taking into account industry practices (section 7 of MSC.1/Circ.1620);

.2 procedures to allow the identification and control of mooring lines, tails and associated attachments should be established and available on board (paragraph 3.3 of MSC.1/Circ.1620);

.3 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 (paragraph 4.1.1 of MSC.1/Circ.1620);

.4 manufacturers' criteria for replacement of mooring lines should be available (paragraph 4.3.1 of MSC.1/Circ.1620);

.5 records of the original design concept, equipment, arrangements and specifications should be available on board (paragraph 4.4.4 of MSC.1/Circ.1620). For ships the keels of which were laid before 1 January 2007 and without appropriate documentation, owners may establish the MBL_{SD} for mooring based on the safe working load of mooring equipment provided on board. If no safe working load is specified, then owners are advised to check strength of mooring equipment and their supporting hull structure based on MSC.1/Circ.1175/Rev.1 and determine MBL_{SD} based on actual capacity of the equipment and their supporting hull structure 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, if available (paragraph 6.2 of MSC.1/Circ.1620); and

.6 a document should be provided on board for gathering the information above and describe how the information listed above is filed and collected.

6 While applying the requirements of SOLAS regulation II-1/3-8.9, the following should be complied with, and the compliance should be confirmed by the surveyor at the periodical survey for endorsement/issue of the Cargo Ship Safety Construction Certificate or the renewal survey for the Passenger Ship Safety Certificate after 1 January 2024 for existing ships:

.1 the records of inspection and maintenance of mooring equipment and inspection and replacement of mooring lines, since the last periodical survey, should be kept updated and available on board (paragraphs 4.4.3 and 6.1 of MSC.1/Circ.1620).

Regulations 5.4 and 5.5

SOLAS regulations II-1/5.4 and II-1/5.5 read:

"**Regulation 5**

Intact stability

…

4 Where any alterations are made to a ship so as to materially affect the stability information supplied to the master, amended stability information shall be provided. If necessary, the ship shall be re-inclined. The ship shall be re-inclined if anticipated deviations exceed one of the values specified in paragraph 5.

5 At periodical intervals not exceeding five years, a lightweight survey shall be carried out on all passenger ships to verify any changes in lightship displacement and longitudinal centre of gravity. The ship shall be re-inclined whenever, in comparison with the approved stability information, a deviation from the lightship displacement exceeding 2% or a deviation of the longitudinal centre of gravity exceeding 1% of L is found or anticipated."

Revised Explanatory Notes to SOLAS regulation II-1/5.4 (resolutions MSC.429(98)/Rev.1 and Rev.2) read:

"Regulation 5.4

1 When alterations are made to a ship in service that result in calculable differences in the lightship properties, a detailed weights and centres of gravity calculation to adjust the lightship properties should be carried out. If the adjusted lightship displacement or longitudinal centre of gravity, when compared to the approved values, exceeds one of the deviation limits specified in regulation 5.5, the ship should be re-inclined. In addition, if the adjusted lightship vertical centre of gravity, when compared to the approved value, exceeds 1%, the ship should be re-inclined. The lightship transverse centre of gravity is not subject to a deviation limit.

2 When a ship does not exceed the deviation limits specified in explanatory note 1 above, amended stability information should be provided to the master using the new calculated lightship properties if any of the following deviations from the approved values are exceeded:

.1 1% of the lightship displacement; or

.2 0.5% of L for the longitudinal centre of gravity; or

.3 0.5% of the vertical centre of gravity.

However, in cases when these deviation limits are not exceeded, it is not necessary to amend the stability information supplied to the master.

3 When multiple alterations are made to a ship in service over a period of time and each alteration is within the deviation limits specified above, the cumulative total changes to the lightship properties from the most recent inclining also should not exceed the deviation limits specified above or the ship should be re-inclined."

Interpretation

Definition of lightweight calculation

For the purposes of this interpretation, the term "lightweight calculation" means a detailed calculation of weights on and weights off a ship, resulting from all alterations to the ship since the date of the last approved inclining test, to determine the adjusted lightship properties. Lightship properties include weights and the centre of gravity. The documented weights and their centres of gravity should be verified on board/on-site by the attending class surveyor.

When weights are added, removed or relocated, the final cumulative change is to be compared to the last approved inclining test.

"*Lightweight survey*" is defined in the International Code on Intact Stability 2008, paragraph 2.24.

Definition of stability information

"*Stability information*" includes any document (whether on paper or electronic) or electronic means of calculation of stability which includes lightship properties. This could include, but is not limited to, the approved stability book, computer software for onboard calculation of stability, the approved strength book and the loading instrument.

Amendment of stability information in conjunction with alterations of lightship properties

1 If the lightweight calculation, regardless of keel laying date, shows a deviation in lightweight mass, or the longitudinal or vertical position of the centre of gravity:

.1 beyond any of the tolerance limits specified in explanatory note 1 to SOLAS regulation II-1/5.4 (resolutions MSC.429(98)/Rev.1 and Rev.2), then the ship should be re-inclined and the stability information, as defined above, should be updated to reflect the lightship properties derived from the inclining test and should be approved;

.2 within the tolerance limits specified in the explanatory note 1 and exceeding any of the deviations specified in explanatory note 2 to SOLAS regulation II-1/5.4 (resolutions MSC.429(98)/Rev.1 and Rev.2), then the stability information should be updated to reflect the lightship properties derived from the lightweight calculation and should be approved; or

.3 within the tolerance limits specified in explanatory note 2 to SOLAS regulation II-1/5.4 (resolutions MSC.429(98)/Rev.1 and Rev.2), then a copy of the endorsed lightweight calculation report should be provided on board for future reference with no further amendments required to the stability information. However, even if addition, removal or relocation of any weight results in lightship particulars being within tolerable limits, that weight should still be noted and the "constant" adjusted for lightweight calculation in the stability information for all future references and calculations.

2 A summary of paragraph 1 of this interpretation is provided in the following table. Where stability information is to be updated, it should be approved and provided to the master with the instruction that it should now be used for all stability calculations.

Scenario, as calculated by lightweight calculation	**Requirement for inclining test**	**Update of stability information**
Lightweight change > 2%	Yes	Yes, using new incline result
LCG change > 1% of L (either forward or aft)	Yes	Yes, using new incline result
VCG change > 1%	Yes	Yes, using new incline result
1% < Lightweight change ≤ 2%	No	Yes, using lightweight calculation
0.5% of L < LCG change ≤ 1% of L (either forward or aft)	No	Yes, using lightweight calculation
0.5% < VCG change ≤ 1%	No	Yes, using lightweight calculation
Lightweight change ≤ 1%	No	No
LCG change ≤ 0.5% of L (either forward or aft)	No	No
VCG change ≤ 0.5%	No	No

3 Lightship properties should be consistent in all documents which use them, e.g. loading manual, stability manual and computer data.

4 A change in lightweight will result in a change in deadweight unless there is an associated change in freeboard. The consequences of the change could have an impact on compliance with other regulations, e.g. MARPOL Annex VI.

Regulation 13

SOLAS regulation II-1/13.2.3 reads:

"**Regulation 13**
Openings in watertight bulkheads below the bulkhead deck in passenger ships

2.3 Lead or other heat-sensitive materials shall not be used in systems which penetrate watertight bulkheads, where deterioration of such systems in the event of fire would impair the watertight integrity of the bulkheads."

Interpretation

1 Any penetration used for the passage of heat-sensitive piping systems through a watertight bulkhead or deck on a passenger ship under SOLAS regulation II-1/13.2.3 should be tested with the heat-sensitive piping and should be type-approved for watertight integrity as per paragraphs 4 and 5 of the explanatory notes to regulation II-1/13.2.3 contained in the annex of resolutions MSC.429(98)/Rev.1 and Rev.2, as applicable, after the fire test.

2 SOLAS regulation II-1/13.2.3 should be applicable to heat-sensitive piping systems and should not be applied to cable penetrations in watertight bulkheads and decks.

A2 Shipboard fittings and supporting hull structures associated with towing and mooring on conventional ships

(Jan 2004) (Corr.1 Feb 2004) Rev.1 July 2004) (Rev.2 Sept 2006) (Rev.3 July 2007) (Corr.1 Sept 2014) (Rev.4 Oct 2016) (Corr.1 Dec 2016) (Corr.2 Mar 2017)

A2.0 Application and definitions

Conventional ships are to 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 operations of the ship.

This Unified Requirement is to apply to design and construction of shipboard fittings and supporting structures used for the normal towing and mooring operations. Normal towing means towing operations necessary for manoeuvring in ports and sheltered waters associated with the normal operations of the ship.

For ships, not subject to SOLAS Regulation II-1/3-4 Paragraph 1, but intended to be fitted with equipment for towing by another ship or a tug, e.g. such as to assist the ship in case of emergency as given in SOLAS Regulation II-1/3-4 Paragraph 2, the requirements designated as ‘other towing’ in this Unified Requirement are to be applied to design and construction of those shipboard fittings and supporting hull structures.

This Unified Requirement is not applicable to design and construction of shipboard fittings and supporting hull structures used for special towing services defined as:

- **Escort towing**: Towing service, in particular, for laden oil tankers or LNG carriers, required in specific estuaries. Its main purpose is to control the ship in case of failures of the propulsion or steering system. It should be referred to local escort requirements and guidance given by, e.g., the Oil Companies International Marine Forum (OCIMF).

Note:

1) Corr.1 Feb 2004 is to be applied by all Member Societies and Associates to ships contracted for construction after 1 Jan 2005.

2) The “contracted for construction” date means the date on which the contract to build the vessel is signed between the prospective owner and the shipbuilder. For further details regarding the date of “contract for construction”, refer to IACS Procedural Requirement (PR) No. 29.

3) Revision 2 of this UR is to be applied by all IACS Members and Associates to ships contracted for construction from 1 January 2007.

4) Revision 3 of this UR is to be uniformly implemented by all IACS Members and Associates to ships contracted for construction from 1 January 2007.

5) Revision 4 of this UR is to be uniformly implemented by all IACS Societies to ships contracted for construction from 1 July 2018.

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(cont)

- **Canal transit towing**: Towing service for ships transiting canals, e.g. the Panama Canal. It should be referred to local canal transit requirements.

- **Emergency towing for tankers**: Towing service to assist tankers in case of emergency. For the emergency towing arrangements, ships subject to SOLAS regulation II-1/3-4 Paragraph 1 are to comply with that regulation and resolution MSC.35(63) as may be amended.

IACS Recommendation No. 10 “Anchoring, Mooring and Towing Equipment” may be referred to for recommendations concerning mooring and towing.

The net minimum scantlings of the supporting hull structure are to comply with the requirements given in A2.1.5 and A2.2.5. The net thicknesses, t_{net}, are the member thicknesses necessary to obtain the above required minimum net scantlings. The required gross thicknesses are obtained by adding the corrosion addition, t_c, given in A2.4, to t_{net}. Shipboard fittings are to comply with the requirements given in A2.1.4 and A2.2.4. For shipboard fittings not selected from an accepted industry standard the corrosion addition, t_c, and the wear allowance, t_w, given in A2.4 and A2.5, respectively, are to be considered.

For the purpose of this Unified Requirement the following is defined:

- Conventional ships means new displacement-type ships of 500 GT and above, excluding high speed craft, special purpose ships, and offshore units of all types. As per MSC.266(84), ‘Special purpose ship’ means a mechanically self-propelled ship which by reason of its function carries on board more than 12 special personnel.

- Shipboard fittings mean those components limited to the following: Bollards and bitts, fairleads, stand rollers, chocks used for normal mooring of the ship and the similar components used for normal or other towing of the ship. Other components such as capstans, winches, etc. are not covered by this Unified Requirement. Any weld or bolt or equivalent device connecting the shipboard fitting to the supporting structure is part of the shipboard fitting and if selected from an industry standard subject to that standard.

- Supporting hull structures means that part of the ship structure on/in which the shipboard fitting is placed and which is directly submitted to the forces exerted on the shipboard fitting. The supporting hull structure of capstans, winches, etc. used for normal or other towing and mooring operations mentioned above is also subject to this Unified Requirement.

- Industry standard means international standards (ISO, etc.) or standards issued by national association such as DIN or JMSA, etc. which are recognized in the country where the ship is built.

A2
(cont)

A2.1 Towing

A2.1.1 Strength

The strength of shipboard fittings used for normal towing operations at bow, sides and stern and their supporting hull structures are to comply with the requirements of this Unified Requirement.

Where a ship is equipped with shipboard fittings intended to be used for other towing services, the strength of these fittings and their supporting hull structures are to comply with the requirements of this Unified Requirement.

A2.1.2 Arrangement

Shipboard fittings for towing are to be located on stiffeners and/or girders, which are part of the deck construction so as to facilitate efficient distribution of the towing load. Other arrangements may be accepted (for chocks in bulwarks, etc.) provided the strength is confirmed adequate for the intended service.

A2.1.3 Load considerations

The minimum design load applied to supporting hull structures for shipboard fittings is to be:

(1) For normal towing operations, 1.25 times the intended maximum towing load (e.g. static bollard pull) as indicated on the towing and mooring arrangements plan,

(2) For other towing service, the minimum breaking strength of the tow line according to IACS Recommendation No. 10 “Anchoring, Mooring and Towing Equipment” (see Notes),

(3) For fittings intended to be used for, both, normal and other towing operations, the greater of the design loads according to (1) and (2).

Notes:

1. *Side projected area including that of deck cargoes as given by the loading manual is to be taken into account for selection of towing lines and the loads applied to shipboard fittings and supporting hull structure.*

2. *The increase of the minimum breaking strength for synthetic ropes according to Recommendation No. 10 needs not to be taken into account for the loads applied to shipboard fittings and supporting hull structure*.

When a safe towing load TOW greater than that determined according to A2.1.6 is requested by the applicant, then the design load is to be increased in accordance with the appropriate TOW/design load relationship given by A2.1.3 and A2.1.6.

The design load is to be applied to fittings in all directions that may occur by taking into account the arrangement shown on the towing and mooring arrangements plan. Where the towing line takes a turn at a fitting the total design load applied to the fitting is equal to the resultant of the design loads acting on the line, see figure below. However, in no case does the design load applied to the fitting need to be greater than twice the design load on the line.

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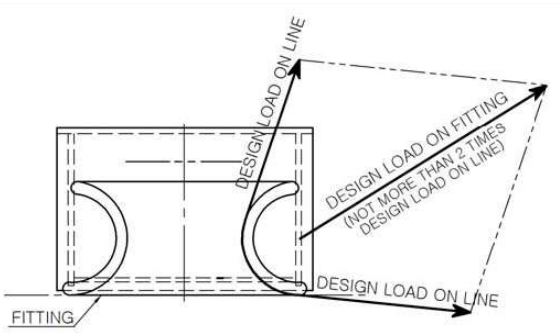


A2.1.4 Shipboard fittings

Shipboard fittings may be selected from an industry standard accepted by the Society and at least based on the following loads.

(1) For normal towing operations, the intended maximum towing load (e.g. static bollard pull) as indicated on the towing and mooring arrangements plan,

(2) For other towing service, the minimum breaking strength of the tow line according to IACS Recommendation No. 10 “Anchoring, Mooring and Towing Equipment” (see Notes in A2.1.3),

(3) For fittings intended to be used for, both, normal and other towing operations, the greater of the loads according to (1) and (2).

Towing bitts (double bollards) may be chosen for the towing line attached with eye splice if the industry standard distinguishes between different methods to attach the line, i.e. figure-of-eight or eye splice attachment.

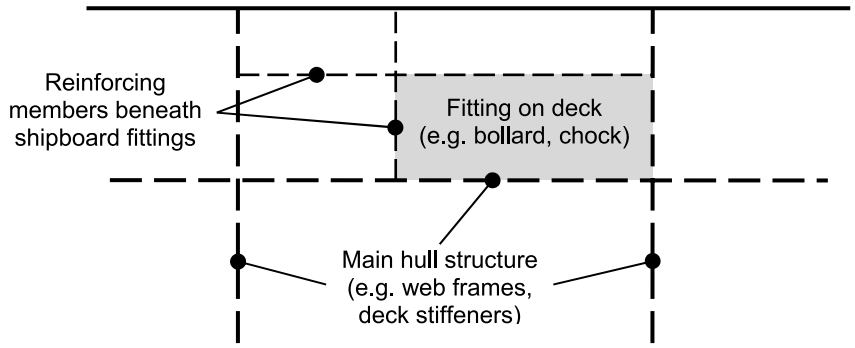
When the shipboard fitting is not selected from an accepted industry standard, the strength of the fitting and of its attachment to the ship is to be in accordance with A2.1.3 and A2.1.5. Towing bitts (double bollards) are required to resist the loads caused by the towing line attached with eye splice. For strength assessment beam theory or finite element analysis using net scantlings is to be applied, as appropriate. Corrosion additions are to be as defined in A2.4. A wear down allowance is to be included as defined in A2.5. At the discretion of the Society, load tests may be accepted as alternative to strength assessment by calculations.

A2.1.5 Supporting hull structure

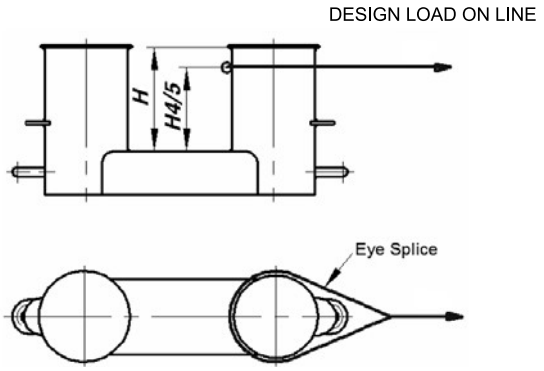
The design load applied to supporting hull structure is to be in accordance with A2.1.3.

The reinforced members beneath shipboard fittings are to be effectively arranged for any variation of direction (horizontally and vertically) of the towing forces acting upon the shipboard fittings, see figure below for a sample arrangement. Proper alignment of fitting and supporting hull structure is to be ensured.

A2
(cont)



The acting point of the towing force on shipboard fittings is to be taken at the attachment point of a towing line or at a change in its direction. For bollards and bitts the attachment point of the towing line is to be taken not less than 4/5 of the tube height above the base, see figure below.



Allowable stresses under the design load conditions as specified in A2.1.3 are as follows:

(1) For strength assessment with beam theory or grillage analysis:

Normal stress: 100% of the specified minimum yield point of the material;
Shearing stress: 60% of the specified minimum yield point of the material.

Normal stress is the sum of bending stress and axial stress with the corresponding shearing stress acting perpendicular to the normal stress. No stress concentration factors being taken into account.

(2) For strength assessment with finite element analysis:

Equivalent stress: 100% of the specified minimum yield point of the material.

For strength calculations by means of finite elements, the geometry is to be idealized as realistically as possible. The ratio of element length to width is not to exceed 3. Girders are to be modelled using shell or plane stress elements. Symmetric girder flanges may be modelled by beam or truss elements. The element height of girder webs must not exceed one-third of the web height. In way of small openings in girder webs the web thickness is to be reduced to a mean thickness over the web height. Large openings are to be modelled. Stiffeners may be modelled by using shell, plane stress, or beam elements. Stresses are to be read from the centre of the individual element. For shell elements the stresses are to be evaluated at the mid plane of the element.

A2
(cont)

A2.1.6 Safe Towing Load (TOW)

1) The safe towing load (TOW) is the load limit for towing purpose.

2) TOW used for normal towing operations is not to exceed 80% of the design load per A2.1.3 (1).

3) TOW used for other towing operations is not to exceed 80% of the design load according to A2.1.3 (2).

4) For fittings used for both normal and other towing operations, the greater of the safe towing loads according to 2) and 3) is to be used.

5) For fittings intended to be used for, both, towing and mooring, A2.2 applies to mooring.

6) TOW, in t, of each shipboard fitting is to be marked (by weld bead or equivalent) on the deck fittings used for towing. For fittings intended to be used for, both, towing and mooring, SWL, in t, according to A2.2.6 is to be marked in addition to TOW.

7) The above requirements on TOW apply for the use with no more than one line. If not otherwise chosen, for towing bitts (double bollards) TOW is the load limit for a towing line attached with eye-splice.

8) The towing and mooring arrangements plan mentioned in A2.3 is to define the method of use of towing lines.

A2
(cont)

A2.2 Mooring

A2.2.1 Strength

The strength of shipboard fittings used for mooring operations and of their supporting hull structures as well as the strength of supporting hull structures of winches and capstans is to comply with the requirements of this Unified Requirement.

A2.2.2 Arrangement

Shipboard fittings, winches and capstans for mooring are to be located on stiffeners and/or girders, which are part of the deck construction so as to facilitate efficient distribution of the mooring load. Other arrangements may be accepted (for chocks in bulwarks, etc.) provided the strength is confirmed adequate for the service.

A2.2.3 Load considerations

1) The minimum design load applied to supporting hull structures for shipboard fittings is to be 1.15 times the minimum breaking strength of the mooring line according to IACS Recommendation No. 10 “Anchoring, Mooring and Towing Equipment” (see Notes).

2) 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 according to IACS Recommendation No. 10 “Anchoring, Mooring and Towing Equipment”, see Notes. For supporting hull structures of capstans, 1.25 times the maximum hauling-in force is to be taken as the minimum design load.

3) When a safe working load SWL greater than that determined according to A2.2.6 is requested by the applicant, then the design load is to be increased in accordance with the appropriate SWL/design load relationship given by A2.2.3 and A2.2.6.

4) The design load is to be applied to fittings in all directions that may occur by taking into account the arrangement shown on the towing and mooring arrangements plan. Where the mooring line takes a turn at a fitting the total design load applied to the fitting is equal to the resultant of the design loads acting on the line, refer to the figure in A2.1.3. However, in no case does the design load applied to the fitting need to be greater than twice the design load on the line.

Notes:

1. *If not otherwise specified by Recommendation No. 10, side projected area including that of deck cargoes as given by the loading manual is to be taken into account for selection of mooring lines and the loads applied to shipboard fittings and supporting hull structure.*

2. *The increase of the minimum breaking strength for synthetic ropes according to Recommendation No. 10 needs not to be taken into account for the loads applied to shipboard fittings and supporting hull structure.*

A2.2.4 Shipboard fittings

Shipboard fittings may be selected from an industry standard accepted by the Society and at least based on the minimum breaking strength of the mooring line according to IACS Recommendation No. 10 “Anchoring, Mooring and Towing Equipment” (see Notes in A2.2.3).

A2 (cont)

Mooring bitts (double bollards) are to be chosen for the mooring line attached in figure-of-eight fashion if the industry standard distinguishes between different methods to attach the line, i.e. figure-of-eight or eye splice attachment.

When the shipboard fitting is not selected from an accepted industry standard, the strength of the fitting and of its attachment to the ship is to be in accordance with A2.2.3 and A2.2.5. Mooring bitts (double bollards) are required to resist the loads caused by the mooring line attached in figure-of-eight fashion, see Note. For strength assessment beam theory or finite element analysis using net scantlings is to be applied, as appropriate. Corrosion additions are to be as defined in A2.4. A wear down allowance is to be included as defined in A2.5. At the discretion of the classification Society, load tests may be accepted as alternative to strength assessment by calculations.

Note:

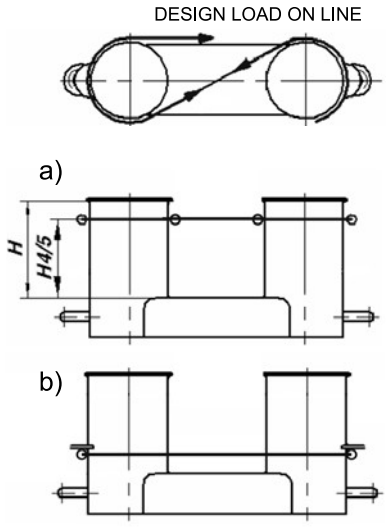
With the line attached to a mooring bitt in the usual way (figure-of-eight fashion), either of the two posts of the mooring bitt can be subjected to a force twice as large as that acting on the mooring line. Disregarding this effect, depending on the applied industry standard and fitting size, overload may occur.

A2.2.5 Supporting hull structure

The design load applied to supporting hull structure is to be in accordance with A2.2.3.

The arrangement of reinforced members beneath shipboard fittings, winches and capstans is to consider any variation of direction (horizontally and vertically) of the mooring forces acting upon the shipboard fittings, see figure in A2.1.5 for a sample arrangement. Proper alignment of fitting and supporting hull structure is to be ensured.

The acting point of the mooring force on shipboard fittings is to be taken at the attachment point of a mooring line or at a change in its direction. For bollards and bitts the attachment point of the mooring line is to be taken not less than 4/5 of the tube height above the base, see a) in figure below. However, if fins are fitted to the bollard tubes to keep the mooring line as low as possible, the attachment point of the mooring line may be taken at the location of the fins, see b) in figure below.



A2 (cont)

Allowable stresses under the design load conditions as specified in A2.2.3 are as follows:

(1) For strength assessment with beam theory or grillage analysis:

Normal stress: 100% of the specified minimum yield point of the material;
Shearing stress: 60% of the specified minimum yield point of the material.
Normal stress is the sum of bending stress and axial stress with the corresponding shearing stress acting perpendicular to the normal stress. No stress concentration factors being taken into account.

(2) For strength assessment with finite element analysis:

Equivalent stress: 100% of the specified minimum yield point of the material.

For strength calculations by means of finite elements, the geometry is to be idealized as realistically as possible. The ratio of element length to width is not to exceed 3. Girders are to be modelled using shell or plane stress elements. Symmetric girder flanges may be modelled by beam or truss elements. The element height of girder webs must not exceed one-third of the web height. In way of small openings in girder webs the web thickness is to be reduced to a mean thickness over the web height. Large openings are to be modelled. Stiffeners may be modelled by using shell, plane stress, or beam elements. Stresses are to be read from the centre of the individual element. For shell elements the stresses are to be evaluated at the mid plane of the element.

A2.2.6 Safe Working Load (SWL)

1) The Safe Working Load (SWL) is the load limit for mooring purpose.

2) Unless a greater SWL is requested by the applicant according to A2.2.3 3), the SWL is not to exceed the minimum breaking strength of the mooring line according to IACS Recommendation No. 10 “Anchoring, Mooring and Towing Equipment”, see Notes in A2.2.3.

3) The SWL, in t, of each shipboard fitting is to be marked (by weld bead or equivalent) on the deck fittings used for mooring. For fittings intended to be used for, both, mooring and towing, TOW, in t, according to A2.1.6 is to be marked in addition to SWL.

4) The above requirements on SWL apply for the use with no more than one mooring line.

5) The towing and mooring arrangements plan mentioned in A2.3 is to define the method of use of mooring lines.

A2
(cont)

A2.3 Towing and mooring arrangements plan

1) The SWL and TOW for the intended use for each shipboard fitting is to be noted in the towing and mooring arrangements plan available on board for the guidance of the Master. It is to be noted that TOW is the load limit for towing purpose and SWL that for mooring purpose. If not otherwise chosen, for towing bitts it is to be noted that TOW is the load limit for a towing line attached with eye-splice.

2) Information provided on the plan is to include in respect of each shipboard fitting:

   1. location on the ship;

   2. fitting type;

   3. SWL/TOW;

   4. purpose (mooring/harbour towing/other towing);

   5. manner of applying towing or mooring line load including limiting fleet angles.

   Item 3 with respect to items 4 and 5, is subject to approval by the Society.

   Furthermore, information provided on the plan is to include:

   1. the arrangement of mooring lines showing number of lines (N);

   2. the minimum breaking strength of each mooring line (MBL);

   3. the acceptable environmental conditions as given in IACS Recommendation No. 10 “Anchoring, Mooring and Towing Equipment” for the recommended minimum breaking strength of mooring lines for ships with Equipment Number EN > 2000:

      - 30 second mean wind speed from any direction (v_w or v_w* according to IACS Recommendation No. 10).

      - Maximum current speed acting on bow or stern (±10°).

3) The information as given in 2) is to be incorporated into the pilot card in order to provide the pilot proper information on harbour and other towing operations.

A2
(cont)

A2.4 Corrosion addition

The corrosion addition, t_c, is not to be less than the following values:

1) Ships covered by Common Structural Rules for Bulk Carriers and Oil Tankers: Total corrosion addition to be as defined in these rules.

2) Other ships:

- For the supporting hull structure, according to the Society's Rules for the surrounding structure (e.g. deck structures, bulwark structures).
- For pedestals and foundations on deck which are not part of a fitting according to an accepted industry standard, 2.0 mm.
- For shipboard fittings not selected from an accepted industry standard, 2.0 mm.

A2.5 Wear allowance

In addition to the corrosion addition given in A2.4 the wear allowance, t_w, for shipboard fittings not selected from an accepted industry standard is not to be less than 1.0 mm, added to surfaces which are intended to regularly contact the line.

A2.6 Survey after construction

The condition of deck fittings, their pedestals or foundations, if any, and the hull structures in the vicinity of the fittings are to be examined in accordance with the Society's Rules.

End of Document

A2 Shipboard fittings and supporting hull structures associated with towing and mooring on conventional ships

A2 (Jan 2004) (Corr.1 Feb 2004) (Rev.1 July 2004) (Rev.2 Sept 2006) (Rev.3 July 2007) (Corr.1 Sept 2014) (Rev.4 Oct 2016) (Corr.1 Dec 2016) (Corr.2 Mar 2017) (Rev.5 Sep 2020)

A2.0 Application and definitions

Conventional ships are to 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 operations of the ship.

This Unified Requirement is to apply to design and construction of shipboard fittings and supporting structures used for the normal towing and mooring operations. Normal towing means towing operations necessary for manoeuvring in ports and sheltered waters associated with the normal operations of the ship.

For ships, not subject to SOLAS Regulation II-1/3-4 Paragraph 1, but intended to be fitted with equipment for towing by another ship or a tug, e.g. such as to assist the ship in case of emergency as given in SOLAS Regulation II-1/3-4 Paragraph 2, the requirements designated as ‘other towing’ in this Unified Requirement are to be applied to design and construction of those shipboard fittings and supporting hull structures.

This Unified Requirement is not applicable to design and construction of shipboard fittings and supporting hull structures used for special towing services defined as:

- **Escort towing**: Towing service, in particular, for laden oil tankers or LNG carriers, required in specific estuaries. Its main purpose is to control the ship in case of failures of the propulsion or steering system. It should be referred to local escort requirements and guidance given by, e.g., the Oil Companies International Marine Forum (OCIMF).

Note:

1) Corr.1 Feb 2004 is to be applied by all Member Societies and Associates to ships contracted for construction after 1 Jan 2005.

2) The “contracted for construction” date means the date on which the contract to build the vessel is signed between the prospective owner and the shipbuilder. For further details regarding the date of “contract for construction”, refer to IACS Procedural Requirement (PR) No. 29.

3) Revision 2 of this UR is to be applied by all IACS Members and Associates to ships contracted for construction from 1 January 2007.

4) Revision 3 of this UR is to be uniformly implemented by all IACS Members and Associates to ships contracted for construction from 1 January 2007.

5) Revision 4 of this UR is to be uniformly implemented by all IACS Societies to ships contracted for construction from 1 July 2018.

6) Revision 5 of this UR is to be uniformly implemented by all IACS Societies to ships contracted for construction from 1 January 2022.

A2 (cont)

- **Canal transit towing**: Towing service for ships transiting canals, e.g. the Panama Canal. It should be referred to local canal transit requirements.

- **Emergency towing for tankers**: Towing service to assist tankers in case of emergency. For the emergency towing arrangements, ships subject to SOLAS regulation II-1/3-4 Paragraph 1 are to comply with that regulation and resolution MSC.35(63) as may be amended.

IACS Recommendation No. 10 “Anchoring, Mooring and Towing Equipment” may be referred to for recommendations concerning mooring and towing.

The net minimum scantlings of the supporting hull structure are to comply with the requirements given in A2.1.5 and A2.2.5. The net thicknesses, t_{net}, are the member thicknesses necessary to obtain the above required minimum net scantlings. The required gross thicknesses are obtained by adding the corrosion addition, t_c, given in A2.4, to t_{net}. Shipboard fittings are to comply with the requirements given in A2.1.4 and A2.2.4. For shipboard fittings not selected from an accepted industry standard the corrosion addition, t_c, and the wear allowance, t_w, given in A2.4 and A2.5, respectively, are to be considered.

For the purpose of this Unified Requirement the following is defined:

- Conventional ships means new displacement-type ships of 500 GT and above, excluding high speed craft, special purpose ships, and offshore units of all types. As per MSC.266(84), ‘Special purpose ship’ means a mechanically self-propelled ship which by reason of its function carries on board more than 12 special personnel.

- Shipboard fittings mean those components limited to the following: Bollards and bitts, fairleads, stand rollers, chocks used for normal mooring of the ship and the similar components used for normal or other towing of the ship. Other components such as capstans, winches, etc. are not covered by this Unified Requirement. Any weld or bolt or equivalent device connecting the shipboard fitting to the supporting structure is part of the shipboard fitting and if selected from an industry standard subject to that standard.

- Supporting hull structures means that part of the ship structure on/in which the shipboard fitting is placed and which is directly submitted to the forces exerted on the shipboard fitting. The supporting hull structure of capstans, winches, etc. used for normal or other towing and mooring operations mentioned above is also subject to this Unified Requirement.

- Industry standard means international standards (ISO, etc.) or standards issued by national association such as DIN or JMSA, etc. which are recognized in the country where the ship is built.

- The nominal capacity condition is defined as the theoretical condition where the maximum possible deck cargoes are included in the ship arrangement in their respective positions. For container ships the nominal capacity condition represents the theoretical condition where the maximum possible number of containers is included in the ship arrangement in their respective positions.

- Ship Design Minimum Breaking Load (MBL_{SD}) means the minimum breaking load of new, dry mooring lines or tow line for which shipboard fittings and supporting hull structures are designed in order to meet mooring restraint requirements or the towing requirements of other towing service.

A2 (cont)

- 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.

A2.1 Towing

A2.1.1 Strength

The strength of shipboard fittings used for normal towing operations at bow, sides and stern and their supporting hull structures are to comply with the requirements of this Unified Requirement.

Where a ship is equipped with shipboard fittings intended to be used for other towing services, the strength of these fittings and their supporting hull structures are to comply with the requirements of this Unified Requirement.

For fittings intended to be used for, both, towing and mooring, A2.2 applies to mooring.

A2.1.2 Arrangement

Shipboard fittings for towing are to be located on stiffeners and/or girders, which are part of the deck construction so as to facilitate efficient distribution of the towing load. Other arrangements may be accepted (for chocks in bulwarks, etc.) provided the strength is confirmed adequate for the intended service.

A2.1.3 Load considerations

The minimum design load applied to supporting hull structures for shipboard fittings is to be:

(1) For normal towing operations, 1.25 times the intended maximum towing load (e.g. static bollard pull) as indicated on the towing and mooring arrangements plan,

(2) For other towing service, the ship design minimum breaking load according to IACS Recommendation No. 10 “Anchoring, Mooring and Towing Equipment” (see Notes),

(3) For fittings intended to be used for, both, normal and other towing operations, the greater of the design loads according to (1) and (2).

Notes:

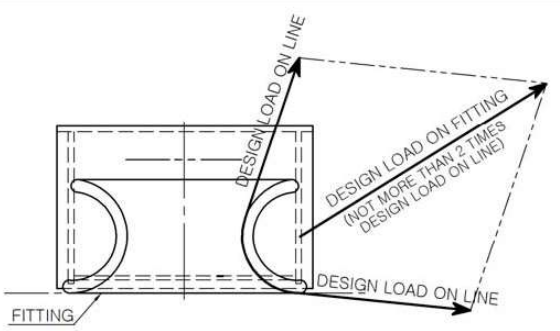
1. *Side projected area including that of deck cargoes as given by the ship nominal capacity condition is to be taken into account for selection of towing lines and the loads applied to shipboard fittings and supporting hull structures. The nominal capacity condition is defined in A2.0.*

2. *The increase of the line design break force for synthetic ropes according to Recommendation No. 10 needs not to be taken into account for the loads applied to shipboard fittings and supporting hull structures*.

When a safe towing load TOW greater than that determined according to A2.1.6 is requested by the applicant, then the design load is to be increased in accordance with the appropriate TOW/design load relationship given by A2.1.3 and A2.1.6.

A2
(cont)

The design load is to be applied to fittings in all directions that may occur by taking into account the arrangement shown on the towing and mooring arrangements plan. Where the towing line takes a turn at a fitting the total design load applied to the fitting is equal to the resultant of the design loads acting on the line, see figure below. However, in no case does the design load applied to the fitting need to be greater than twice the design load on the line.



A2.1.4 Shipboard fittings

Shipboard fittings may be selected from an industry standard accepted by the Society and at least based on the following loads.

(1) For normal towing operations, the intended maximum towing load (e.g. static bollard pull) as indicated on the towing and mooring arrangements plan,

(2) For other towing service, the ship design minimum breaking load of the tow line according to IACS Recommendation No. 10 “Anchoring, Mooring and Towing Equipment” (see Notes in A2.1.3),

(3) For fittings intended to be used for, both, normal and other towing operations, the greater of the loads according to (1) and (2).

Towing bitts (double bollards) may be chosen for the towing line attached with eye splice if the industry standard distinguishes between different methods to attach the line, i.e. figure-of-eight or eye splice attachment.

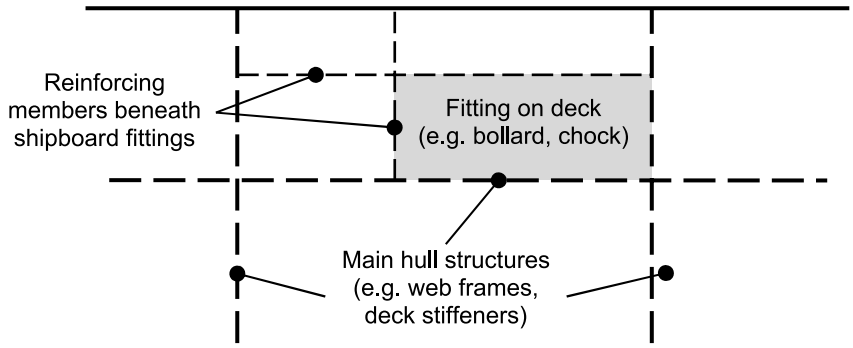
When the shipboard fitting is not selected from an accepted industry standard, the strength of the fitting and of its attachment to the ship is to be in accordance with A2.1.3 and A2.1.5. Towing bitts (double bollards) are required to resist the loads caused by the towing line attached with eye splice. For strength assessment beam theory or finite element analysis using net scantlings is to be applied, as appropriate. Corrosion additions are to be as defined in A2.4. A wear down allowance is to be included as defined in A2.5. At the discretion of the Society, load tests may be accepted as alternative to strength assessment by calculations.

A2.1.5 Supporting hull structures

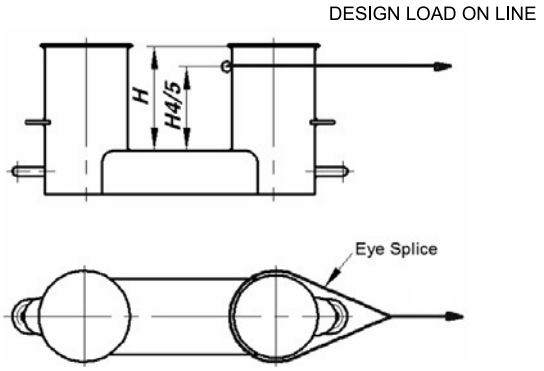
The design load applied to supporting hull structures is to be in accordance with A2.1.3.

The reinforced members beneath shipboard fittings are to be effectively arranged for any variation of direction (horizontally and vertically) of the towing forces acting upon the shipboard fittings, see figure below for a sample arrangement. Proper alignment of fitting and supporting hull structure is to be ensured.

A2
(cont)



The acting point of the towing force on shipboard fittings is to be taken at the attachment point of a towing line or at a change in its direction. For bollards and bitts the attachment point of the towing line is to be taken not less than 4/5 of the tube height above the base, see figure below.



Allowable stresses under the design load conditions as specified in A2.1.3 are as follows:

(1) For strength assessment by means of beam theory or grillage analysis:

Normal stress: $1.0\ R_{eH}$;
Shearing stress: $0.6\ R_{eH}$.

Normal stress is the sum of bending stress and axial stress No stress concentration factors being taken into account.

(2) For strength assessment by means of finite element analysis:

Von Mises stress: $1.0\ R_{eH}$.

For strength assessment by means of finite element analysis the mesh is to be fine enough to represent the geometry as realistically as possible. The aspect ratios of elements are not to exceed 3. Girders are to be modelled using shell or plane stress elements. Symmetric girder flanges may be modelled by beam or truss elements. The element height of girder webs must not exceed one-third of the web height. In way of small openings in girder webs the web thickness is to be reduced to a mean thickness over the web height as per individual Class Society rules. Large openings are to be modelled. Stiffeners may be modelled by using shell, plane stress, or beam elements. The mesh size of stiffeners is to be fine enough to obtain proper bending stress. If flat bars are modeled using shell or plane stress elements, dummy rod elements are to be modelled at the free edge of the flat bars and the stresses of the

A2 (cont)

dummy elements are to be evaluated. Stresses are to be read from the centre of the individual element. For shell elements the stresses are to be evaluated at the mid plane of the element.

R_{eH} is the specified minimum yield stress of the material.

A2.1.6 Safe Towing Load (TOW)

1) The safe towing load (TOW) is the safe load limit of shipboard fittings used for towing purpose.

2) TOW used for normal towing operations is not to exceed 80% of the design load per A2.1.3 (1).

3) TOW used for other towing operations is not to exceed 80% of the design load according to A2.1.3 (2).

4) For fittings used for both normal and other towing operations, the greater of the safe towing loads according to 2) and 3) is to be used.

5) TOW, in t, of each shipboard fitting is to be marked (by weld bead or equivalent) on the deck fittings used for towing. For fittings intended to be used for, both, towing and mooring, SWL, in t, according to A2.2.6 is to be marked in addition to TOW.

6) The above requirements on TOW apply for the use with no more than one line. If not otherwise chosen, for towing bitts (double bollards) TOW is the load limit for a towing line attached with eye-splice.

7) The towing and mooring arrangements plan mentioned in A2.3 is to define the method of use of towing lines.

A2.2 Mooring

A2.2.1 Strength

The strength of shipboard fittings used for mooring operations and of their supporting hull structures as well as the strength of supporting hull structures of winches and capstans is to comply with the requirements of this Unified Requirement.

For fittings intended to be used for, both, mooring and towing, A2.1 applies to towing.

A2.2.2 Arrangement

Shipboard fittings, winches and capstans for mooring are to be located on stiffeners and/or girders, which are part of the deck construction so as to facilitate efficient distribution of the mooring load. Other arrangements may be accepted (for chocks in bulwarks, etc.) provided the strength is confirmed adequate for the service.

A2.2.3 Load considerations

1) The minimum design load applied to supporting hull structures for shipboard fittings is to be 1.15 times the ship design minimum breaking load according to IACS Recommendation No. 10 “Anchoring, Mooring and Towing Equipment” (see Notes).

A2 (cont)

2) 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 ship design minimum breaking load according to IACS Recommendation No. 10 “Anchoring, Mooring and Towing Equipment”, see Notes. For supporting hull structures of capstans, 1.25 times the maximum hauling-in force is to be taken as the minimum design load.

3) When a safe working load SWL greater than that determined according to A2.2.6 is requested by the applicant, then the design load is to be increased in accordance with the appropriate SWL/design load relationship given by A2.2.3 and A2.2.6.

4) The design load is to be applied to fittings in all directions that may occur by taking into account the arrangement shown on the towing and mooring arrangements plan. Where the mooring line takes a turn at a fitting the total design load applied to the fitting is equal to the resultant of the design loads acting on the line, refer to the figure in A2.1.3. However, in no case does the design load applied to the fitting need to be greater than twice the design load on the line.

Notes:

1. *If not otherwise specified by Recommendation No. 10, side projected area including that of deck cargoes as given by the ship nominal capacity condition is to be taken into account for selection of mooring lines and the loads applied to shipboard fittings and supporting hull structures. The nominal capacity condition is defined in A2.0.*

2. *The increase of the line design break force for synthetic ropes according to Recommendation No. 10 needs not to be taken into account for the loads applied to shipboard fittings and supporting hull structures.*

A2.2.4 Shipboard fittings

Shipboard fittings may be selected from an industry standard accepted by the Society and at least based on the ship design minimum breaking load according to IACS Recommendation No. 10 “Anchoring, Mooring and Towing Equipment” (see Notes in A2.2.3).
Mooring bitts (double bollards) are to be chosen for the mooring line attached in figure-of-eight fashion if the industry standard distinguishes between different methods to attach the line, i.e. figure-of-eight or eye splice attachment.

When the shipboard fitting is not selected from an accepted industry standard, the strength of the fitting and of its attachment to the ship is to be in accordance with A2.2.3 and A2.2.5. Mooring bitts (double bollards) are required to resist the loads caused by the mooring line attached in figure-of-eight fashion, see Note. For strength assessment beam theory or finite element analysis using net scantlings is to be applied, as appropriate. Corrosion additions are to be as defined in A2.4. A wear down allowance is to be included as defined in A2.5. At the discretion of the classification Society, load tests may be accepted as alternative to strength assessment by calculations.

Note:

With the line attached to a mooring bitt in the usual way (figure-of-eight fashion), either of the two posts of the mooring bitt can be subjected to a force twice as large as that acting on the mooring line. Disregarding this effect, depending on the applied industry standard and fitting size, overload may occur.

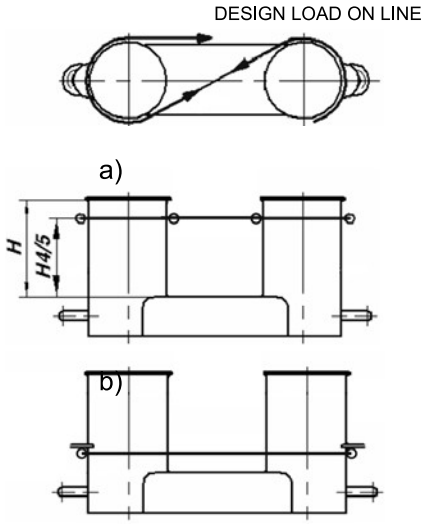
A2
(cont)

A2.2.5 Supporting hull structures

The design load applied to supporting hull structures is to be in accordance with A2.2.3.

The arrangement of reinforced members beneath shipboard fittings, winches and capstans is to consider any variation of direction (horizontally and vertically) of the mooring forces acting upon the shipboard fittings, see figure in A2.1.5 for a sample arrangement. Proper alignment of fitting and supporting hull structure is to be ensured.

The acting point of the mooring force on shipboard fittings is to be taken at the attachment point of a mooring line or at a change in its direction. For bollards and bitts the attachment point of the mooring line is to be taken not less than 4/5 of the tube height above the base, see a) in figure below. However, if fins are fitted to the bollard tubes to keep the mooring line as low as possible, the attachment point of the mooring line may be taken at the location of the fins, see b) in figure below.



Allowable stresses under the design load conditions as specified in A2.2.3 are as follows:

(1) For strength assessment by means of beam theory or grillage analysis:

- Normal stress: $1.0\ R_{eH}$
- Shear stress: $0.6\ R_{eH}$

Normal stress is the sum of bending stress and axial stress. No stress concentration factors being taken into account.

(2) For strength assessment by means of finite element analysis:

Von Mises stress: $1.0\ R_{eH}$.

For strength assessment by means of finite element analysis the mesh is to be fine enough to represent the geometry as realistically as possible. The aspect ratios of elements are not to exceed 3. Girders are to be modelled using shell or plane stress elements. Symmetric girder flanges may be modelled by beam or truss elements. The element height of girder webs must not exceed one-third of the web height. In way of small openings in girder webs the web

A2 (cont)

thickness is to be reduced to a mean thickness over the web height as per individual Class Society rules. Large openings are to be modelled. Stiffeners may be modelled by using shell, plane stress, or beam elements. The mesh size of stiffeners is to be fine enough to obtain proper bending stress. If flat bars are modeled using shell or plane stress elements, dummy rod elements are to be modelled at the free edge of the flat bars and the stresses of the dummy elements are to be evaluated. Stresses are to be read from the centre of the individual element. For shell elements the stresses are to be evaluated at the mid plane of the element.

R_{eH} is the specified minimum yield stress of the material.

A2.2.6 Safe Working Load (SWL)

1) The Safe Working Load (SWL) is the safe load limit of shipboard fittings used for mooring purpose.

2) Unless a greater SWL is requested by the applicant according to A2.2.3 3), the SWL is not to exceed the ship design minimum breaking load according to IACS Recommendation No. 10 “Anchoring, Mooring and Towing Equipment”, see Notes in A2.2.3.

3) The SWL, in t, of each shipboard fitting is to be marked (by weld bead or equivalent) on the deck fittings used for mooring. For fittings intended to be used for, both, mooring and towing, TOW, in t, according to A2.1.6 is to be marked in addition to SWL.

4) The above requirements on SWL apply for the use with no more than one mooring line.

5) The towing and mooring arrangements plan mentioned in A2.3 is to define the method of use of mooring lines.

A2.3 Towing and mooring arrangements plan

1) The SWL and TOW for the intended use for each shipboard fitting is to be noted in the towing and mooring arrangements plan available on board for the guidance of the Master. It is to be noted that TOW is the load limit for towing purpose and SWL that for mooring purpose. If not otherwise chosen, for towing bitts it is to be noted that TOW is the load limit for a towing line attached with eye-splice.

2) Information provided on the plan is to include in respect of each shipboard fitting:

    1. location on the ship;

    2. fitting type;

    3. SWL/TOW;

    4. purpose (mooring/harbour towing/other towing);

    5. manner of applying towing or mooring line load including limiting fleet angle i.e. angle of change in direction of a line at the fitting.

    Item 3 with respect to items 4 and 5, is subject to approval by the Society.

    Furthermore, information provided on the plan is to include:

A2 (cont)

1. the arrangement of mooring lines showing number of lines (N);

2. the ship design minimum breaking load (MBL_{SD});

3. the acceptable environmental conditions
(refer for minimum conditions to IACS Recommendation No. 10 “Anchoring, Mooring and Towing Equipment” for the recommended ship design minimum breaking load for ships with Equipment Number EN > 2000:

   - 30 second mean wind speed from any direction (v_w or v_w* according to IACS Recommendation No. 10).

   - Maximum current speed acting on bow or stern (±10°)).

3) The information as given in 2) is to be incorporated into the pilot card in order to provide the pilot proper information on harbour and other towing operations.

A2.4 Corrosion addition

The total corrosion addition, t_c, is not to be less than the following values:

1) Ships covered by Common Structural Rules for Bulk Carriers and Oil Tankers: t_c, total corrosion addition to be as defined in these rules.

2) Other ships:

   - For the supporting hull structure, according to the Society’s Rules for the surrounding structure (e.g. deck structures, bulwark structures).

   - For pedestals and foundations on deck which are not part of a fitting according to an accepted industry standard, 2.0 mm.

   - For shipboard fittings not selected from an accepted industry standard, 2.0 mm.

A2.5 Wear allowance

In addition to the corrosion addition given in A2.4 the wear allowance, t_w, for shipboard fittings not selected from an accepted industry standard is not to be less than 1.0 mm, added to surfaces which are intended to regularly contact the line.

A2.6 Survey after construction

The condition of deck fittings, their pedestals or foundations, if any, and the hull structures in the vicinity of the fittings are to be examined in accordance with the Society’s Rules.

End of Document

No. 10 Equipment

(1982)
(Rev.1 Aug.1999)
(Corr. Dec. 2004)
(Rev.2 June 2005)

1. Anchoring equipment

1.1 Anchoring equipment for ships having EN below 205 to 50

(a) The design of the anchoring equipment for ships having EN < 205 to 50 is that given in A1 for ships having EN≥ 205.

(b) These requirements are applicable to ships operating in unrestricted service. Reductions of equipment may be permitted for ships operating in restricted service.

1.1.1 Equipment number EN

The equipment of anchors and chain cables is to be as given in Table 1 and it is to be based on an Equipment Number EN calculated in compliance with A1.2

Table 1
Equipment

	Stockless bower anchors			Stud link chain cable for bower anchors			Stream wire or chain	
E.N.	No.	Mass per anchor (kg)	Stockless stream anchor (kg)	Total length (m)	Min. dia. Mild steel Gr. 1 (mm)	Min. dia. Special quality Gr. 2 or 3 (mm)	Length (m)	Breaking strength kN
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
50–70	2	180	60	220	14	12.5	80	65 (64.7)
70–90	2	240	80	220	16	14	85	75 (73.5)
90–110	2	300	100	247.5	17.5	16	85	80 (81.4)
110–130	2	360	120	247.5	19	17.5	90	90 (89.2)
130–150	2	420	140	275	20.5	17.5	90	100 (98.1)
150–175	2	480	165	275	22	19	90	110 (107.9)
175–205	2	570	190	302.5	24	20.5	90	120 (117.7)

NOTE: The stream anchor and stream wire or chain may not be condition of classification of the concerned Society

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No. 10
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1.1.2 Anchors

1.1.2.1 Types of anchors

1.1.2.1.1 Ordinary anchors

(a) The requirements under A1.4.1.1 are to be complied with.
(b) The mass of the stocked anchor, when used, and that of stream anchor, excluding the stock, is to be 80% of the mass required in Table 1 for stockless bower anchors and the mass of the stock is to be 20%.

1.1.2.1.2 High holding power (HHP) anchors

The requirements under A1.4.1.2 are to be complied with.

1.1.2.1.3 Super high holding power (SHHP) anchors

The requirements under A1.4.1.3 are to be complied with.

1.1.2.2 Installation of the anchors on board

The bower anchors are to be connected to their chain cables and are to be ready for use. The stream anchor is to be ready to be connected with its cable.

1.1.2.3 Proof testing of anchors

The requirements under A.1.4.3 are to be complied with.

Table 2 (Blank)

No. 10
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Table 2 (Blank)

1.1.3 Chain cables and wire ropes for anchors

1.1.3.1 Chain cables

(a) The anchors are to be associated with stud link chain cables of one of the grades under A1.5.2, Table 3. For equipment number EN up to 90, as an alternative to stud link chain cables, short link chain cables may be considered, for acceptance, by the concerned Society on the basis of their design, strength and steel quality.

(b) Wire ropes for anchors may be adopted in compliance with 1.1.3.3.1

1.1.3.2 Proof and breaking loads of stud link chain cables

(a) The breaking loads BL and proof loads PL are to be in compliance with the requirements under A1.5.3.

(b) The test loads values, rounded off from the loads in (a) above, which are to be used for testing and acceptance of chain cables are given in Table 4.

No. 10
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Table 4
Test Load Values for Stud Link Chains

Chain diameter mm	Grade 1 Proof load kN	Grade 1 Breaking load kN	Grade 2 Proof load kN	Grade 2 Breaking load kN	Grade 3 Proof load kN	Grade 3 Breaking load kN
1	*2*	*3*	*4*	*5*	*6*	*7*
	2a 2b*	3a 3b*	4a 4b*	5a 5b*	6a 6b*	7a 7b*
11	36 35.8	51 51.2	51 51.2	72 71.7	72 71.7	102 102.4
12.5	46 46.1	66 65.7	66 65.7	92 92.2	92 92.2	132
14	58 57.9	82 82.4	82 82.4	116	116	165
16	76 75.5	107	107	150	150	216
17.5	89 89.2	127	127	179	179	256
19	105	150	150	211	211	301

* The values of the columns 2b, 3b, 4b, 5b, 6b and 7b may be adopted in alternative to the correspondent values of the columns 2a, 3a, 4a, 5a, 6a and 7a.

1.1.3.3 Wire ropes for anchors

1.1.3.3.1 In alternative to the stud link or short link chain cables under 1.1.3.1, wire ropes may be used for:

(a) both the bower anchors of ships below 30 m in length
(b) one of the two bower anchors of ships between 30 m and 40 m in length
(c) stream anchor as stipulated in Table 1.

1.1.3.3.2 The wire ropes under (a) and (b) above are to have:

(i) length equal to 1,5 times the corresponding tabular length of chain cable (col. 5 of Table 1)
(ii) strength equal to that of tabular chain cable of Grade 1.

A short length cable is to be fitted between the wire ropes and bower or stream anchor having a length of 12,5 m or the distance between anchor in stowed position and winch, whichever is less.

1.2 Installation of the chain cables on board (see Note)

1.2.1 Capacity and arrangement of anchor chains locker

(a) The chain locker is to be of capacity and depth adequate to provide an easy direct lead of the cables through the chain pipes and a self-stowing of the cables. The chain locker is to be provided with an internal division so that the port and starboard chain cables may be fully and separately stowed.

(b) The chain locker boundaries and their access openings are to be watertight as necessary to prevent accidental flooding of the chain locker from damaging essential auxiliaries or equipment or affecting the proper operation of the vessel.

(c) Adequate drainage facilities of the chain locker are to be adopted.

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No. 10 cont'd

1.2.2 Securing of the inboard ends of chain cables

(a) The inboard ends of the chain cables are to be secured to the structures by a fastening able to withstand a force not less than 15% BL nor more than 30% BL (BL = breaking load of the chain cable).

(b) The fastening is to be provided with a mean suitable to permit, in case of emergency, an easy slipping of the chain cables to sea, operable from an accessible position outside the chain locker.

NOTE
The statements under 1.2.1 and 1.2.2 may not be condition of classification of the concerned Society.

Table 3
Mass of stud link chain cables

Chain Diameter	Minimum mass per length of 27.5 m		Chain Diameter	Minimum mass per length of 27.5 m	
	With Dee Shackle	With Lugless Shackle		With Dee Shackle	With Lugless Shackle
mm	*kg*	*kg*	*mm*	*kg*	*kg*
26	410	405	78	3640	3535
28	480	475	81	3940	3820
30	550	545	84	4240	4105
32	620	615	87	4555	4405
34	700	690	90	4870	4705
36	785	775	92	5085	4905
38	875	860	95	5405	5210
40	965	950	97	5630	5425
42	1055	1040	100	5970	5745
44	1150	1130	102	6210	5970
46	1260	1240	105	6580	6320
48	1370	1345	107	6845	6575
50	1485	1455	111	7380	7080
52	1605	1575	114	7795	7475
54	1725	1690	117	8220	7870
56	1850	1810	120	8650	8270
58	1985	1945	122	8960	8550
60	2125	2075	124	9275	8835
62	2275	2220	127	9740	9270
64	2430	2370	130	10210	9710
66	2590	2525	132	10540	10005
68	2755	2685	137	11320	10750
70	2925	2850	142	12110	11500
73	3185	3100	147	12950	12300
76	3460	3360	152	13890	13200

No. 10 cont'd

1.3 Windlass design and testing

1.3.1 A windlass suitable for the size of chain cable and complying with the following criteria is to be fitted to the ship.

1.3.2 The windlass unit prime mover is to be able to supply for at least 30 minutes a continuous duty pull Zcont, corresponding to the grade of chain cables given by:

$$\begin{aligned} Zcont = \; & 37.5\ d^2\ N\ (4.33\ d^2\ kgf)\ \text{grade 1} \\ & 42.5\ d^2\ N\ (4.33\ d^2\ kgf)\ \text{grade 2} \\ & 47.5\ d^2\ N\ (4.84\ d^2\ kgf)\ \text{grade 3} \end{aligned}$$

where d = chain diameter (mm).
These figures were determined taking into account the following conditions:
(i) wind force equal to 6 on Beaufort Scale, corresponding, approximately, to 14 m/sec;
(ii) water current velocity 3 knots = 1,54 m/sec.
(iii) anchorage depth 100 m;
using ordinary stockless anchor.

The windlass unit prime mover is to provide the necessary temporary overload capacity for breaking out the anchor. The temporary overload capacity or "short term pull" should not be less than 1.5 the continuous duty pull and should be provided for at least two minutes. The speed in this period can be lower than nominal.

NOTE
(a) The values of Zcont include the influences of buoyancy and hawse pipe efficiency which is assumed to be 70 percent.

(b) The anchor masses are assumed to be the masses, excluding tolerances, as given in Table 2 above and in A1.4.3 Table 2. The chain masses are assumed, owing to the buoyancy, smaller than those in Table 3 and as given by $P = 0{,}0218\ d^2$kg per meter length.

(c) Only one anchor is assumed to be raised at a time.

1.3.3 Nominal speed of the chain cable when hoisting the anchor and cable can be a mean speed only and this speed shall be not less than 0,15 m/sec. The speed is to be measured over two shots of chain cable during the total trip; the trial should be commenced with 3 shots (82,5 m) of chain fully submerged.

1.3.4 The capacity of the windlass brake is to be sufficient for safe stopping of anchor and chain cable when paying out the chain cable. If a chain stopper is not fitted, the windlass is to be able to withstand a pull of 80% of the breaking load of the chain without any permanent deformation of the stressed part and without brake slip. If a chain stopper is fitted it should withstand a pull of 80% of the breaking load of the chain. The windlass with brakes engaged and cable lifters disengaged is to be able to withstand a pull of 45% of the breaking load of the chain without any permanent deformation of the stressed parts and without brake slip.

1.3.5 The stresses in the involved parts of the windlass, windlass frame and stopper have to be below the yield point of the material used. The windlass, its frame and the stoppers are to be efficiently bedded to the deck.

Attention is to be paid to:
(a) stress concentrations in keyways and at other stress raisers;
(b) dynamic effects due to sudden starting or stopping of the prime mover or anchor chain;
(c) calculation methods and approximation used when deriving the design stresses.

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No. 10 cont'd

2. Mooring and towing equipment (See Note)

2.1 Mooring lines and towing line

(a) The mooring lines and towing line are given in Table 5 and are based in an Equipment Number EN calculated in compliance with A1.2 Table 1 or, as appropriate, with paragraph 1.

(b) For ferry boat ships, car ferries and passenger ships having the ratio A/EN > 0,9 the following number of ropes should be added to the number required by Table 5 for mooring lines:

one rope where $0,9 < \frac{A}{EN} \leq 1,1$

two ropes where $1,1 < \frac{A}{EN} \leq 1,2$

three ropes where $1,2 < \frac{A}{EN}$

(c) The tow lines given in col. 6 of Table 5 are intended as own towline of a ship to be towed by a tug or other ship.

NOTE This section may not be condition of classification of the concerned Society.

2.2 Mooring and towing ropes

Towlines and mooring lines may be of wire, natural fibre or synthetic fibre construction or of a mixture of wire and fibre. The lengths of individual mooring ropes may be reduced by up to 7% of the table length, provided that the total length of mooring ropes is not less than would have resulted had all ropes been of equal length.

Notwithstanding the strength requirements given in Table 5, no fibre rope is to be less than 20 mm diameter.

2.2.1 Wire ropes

(a) Where wire ropes are used, they are to be of a flexible construction with not less than:
(i) 72 wires in 6 strands with 7 fibre cores for the loads up to 216 kN
(ii) 144 wires in 6 strands with 7 fibre cores for loads of 216 kN to 490 kN
(iii) 222 wires in 6 strands with 1 fibre core for loads exceeding 490 kN.

(b) Tensile strength of wires for wire rope mooring lines shall be within the following ranges:

1420 - 1570 N/mm^2
1570 - 1770 N/mm^2
1770 - 1960 N/mm^2

(c) Wire ropes with 216 wires in 6 strands with 1 fibre core are substituted for 222 wired.

(d) Wire ropes for use in association with mooring winches where the rope is to be stored on the drum may be constructed with an independent wire rope core instead of fibre core.

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No. 10
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Table 5
Mooring lines and tow line

EQUIPMENT NUMBER			MOORING LINES				TOW LINE	
Exceeding	Not exceeding	No.	Minimum length of each line (m)	Minimum breaking strength (kN)			minimum length (m)	Breaking strength (kN)
1	*2*	*3*	*4*	*5a*	*5*	*5b**	*6*	*7*
50	70	3	80	34		34.3	180	98
70	90	3	100	37		36.8	180	98
90	110	3	110	39		39.2	180	98
110	130	3	110	44		44.1	180	98
130	150	3	120	49		–	180	98
150	175	3	120	54		–	180	98
175	205	3	120	59		–	180	112
205	240	4	120	64		63.7	180	129
240	280	4	120	69		68.6	180	150
280	320	4	140	74		73.6	180	174
320	360	4	140	78		78.4	180	207
360	400	4	140	88		88.3	180	224
400	450	4	140	98		98.1	180	250
450	500	4	140		108		180	277
500	550	4	160		123		190	306
550	600	4	160		132		190	338
600	660	4	160		147		190	370
660	720	4	160		157		190	406
720	780	4	170		172		190	441
780	840	4	170		186		190	479
840	910	4	170		201		190	518
910	980	4	170		216		190	559
980	1060	4	180		230		200	603
1060	1140	4	180		250		200	647
1140	1220	4	180		270		200	691
1220	1300	4	180		284		200	738
1300	1390	4	180		309		200	786
1390	1480	4	180		324		200	836
1480	1570	5	190		324		220	888
1570	1670	5	190		333		220	941
1670	1790	5	190		353		220	1024
1790	1930	5	190		378		220	1109
1930	2080	5	190		402		220	1168
2080	2230	5	200		422		240	1259
2230	2380	5	200		451		240	1356
2380	2530	5	200		480		240	1453
2530	2700	6	200		480		260	1471
2700	2870	6	200		490		260	1471
2870	3040	6	200		500		260	1471
3040	3210	6	200		520		280	1471
3210	3400	6	200		554		280	1471
3400	3600	6	200		588		280	1471

No. 10 cont'd

Table 5 (continued)

EQUIPMENT NUMBER			MOORING LINES				TOW LINE	
Exceeding	Not exceeding	No.	Minimum length of each line (m)	Minimum breaking strength (kN)			minimum length (m)	Breaking strength (kN)
1	*2*	*3*	*4*	*5a*	*5*	*5b**	*6*	*7*
3600	3800	6	200		618		300	1471
3800	4000	6	200		647		300	1471
4000	4200	7	200		647		300	1471
4200	4400	7	200		657		300	1471
4400	4600	7	200		667		300	1471
4600	4800	7	200		677		300	1471
4800	5000	7	200		686		300	1471
5000	5200	8	200		686		300	1471
5200	5500	8	200		696		300	1471
5500	5800	8	200		706		300	1471
5800	6100	9	200		706		300	1471
6100	6500	9	200		716			
6500	6900	9	200		726			
6900	7400	10	200		726			
7400	7900	11	200		726			
7900	8400	11	200		736			
8400	8900	12	200		736			
8900	9400	13	200		736			
9400	10000	14	200		736			
10000	10700	15	200		736			
10700	11500	16	200		736			
11500	12400	17	200		736			
12400	13400	18	200		736			
13400	14600	19	200		736			
14600	16000	21	200		736			

* The values of column 5b may be adopted in alternative to the corresponding values of column 5a.

- For individual mooring lines with breaking strength above 490 kN (50000 kg) the latter may be reduced with corresponding increase of the number of the mooring lines and vice versa, provided that the total breaking load of all lines aboard the ship is not less than the Rules value. The number of lines is not to be less than 6 and no one line is to have a strength less than 490 kN (50000 kg).

2.3 Mooring winches*

2.3.1 Each winch should be fitted with drum brakes the strength of which is sufficient to prevent unreeling of the mooring line when the rope tension is equal to 80 percent of the breaking strength of the rope as fitted on the first layer.

2.3.2 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 the rope's breaking strength and not more than 1/3 times the rope's breaking strength. For automatic winches these figures shall apply when the winch is set on the maximum power with automatic control.

* Requirements of this paragraph are to be considered as a guidance.

▶

No. 10 cont'd

2.3.3 For rendering which the winch can exert on the mooring line (reeled 1st 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 on automatic control. The winch is to be marked with the range of rope strength for which it is designed.

3. Anchoring and mooring equipment for special purpose ships - fishing vessels

3.1 Anchoring equipment

3.1.1 Application

The present Chapter 3 applies to the fishing vessels operating in unrestricted service.*

3.1.2 General requirements

(a) Each vessel is to be provided with anchoring equipment designed for quick and safe operation in all foreseeable service conditions. Anchor equipment should consist of anchors, anchor chain cables and a windlass or other arrangements for dropping and weighing the anchors for holding the ship at anchor.

(b) The equipment of anchors and chain cables given in the following Table is based on an "Equipment Number" which is to be calculated as follows:

$$EN = \Delta^{2/3} + 2Bh + 0.1A;$$

where EN – Equipment Number,
Δ – moulded displacement (t) - to the maximum design waterline,
B – greatest moulded breadth (m)
h – effective height (m) from the maximum design waterline to the top of the uppermost house.

$$h = a + \sum h_i;$$

where a - distance (m) from the maximum design waterline to the upper edge of the uppermost complete deck at the side amidship,
h_i - height (m) on the centreline of each tier of houses having breadth greater than B/4.

For the lowest tier "h" is to be measured at centreline from the upper deck or from a notional deck line where there is local discontinuity in the upper deck.

When calculating h, sheer and trim are to be ignored.

A - area (m^2) in profile view of the hull, within the length of the vessel between perpendiculars, and of superstructures and houses above the maximum design waterline having a width greater than B/4.

Screens and bulwarks more than 1.5 m in height are to be regarded as parts of houses when determining h and A.

* NOTE
Reduction of equipment may be permitted for fishing vessels operating in restricted services.

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No. 10 cont'd

3.1.3 Particular requirements

(a) For vessels below 30m in length the anchor chain may be replaced with wire ropes of equal strength of the tabular anchor cables of Grade 1.

For vessels of length between 30 m and 40 m the chain cable of one anchoring line may be replaced with wire ropes of equal strength of the tabular chain cables of Grade 1 provided normal chain cable is maintained for the second line.

Wire ropes of trawl winches complying with this requirement may be used as anchor chain cables.

(b) When wire ropes are substituted for anchor chain cables then:

the length of the ropes is to be equal to 1.5 times the corresponding tabular length of chain cable.
a short length of chain cable is to be provided between anchor and wire rope having a length of 12.5 m or the distance between anchor in stowed position and winch, whichever is less.

(c) "High Holding Power Anchors" of approved design may be used as bower anchors, the mass of each such anchor may be 75 percent of the Table mass for ordinary stockless bower anchors.

(d) The Table anchor equipment may be increased for vessels fishing in very rough waters.

Table 3.1

Equipment Number		Stockless Bower Anchors		Stud Link Chain Cables for Bower Anchors		
					Diameter (mm)	
Exceeding	Not Exceeding	Number	Mass per Anchor (kg)	Total Length (m)	Mild Steel (Grade 1) (**)	Special Quality Steel Grade 2
1	2	3	4	5	6	7
30	40	2	80	165	11	–
40	50	2	100	192.5	11	–
50	60	2	120	192.5	12.5	–
60	70	2	140	192.5	12.5	–
70	80	2	160	220	14	* 12.5
80	90	2	180	220	14	12.5
90	100	2	210	220	16	14
100	110	2	240	220	16	14
110	120	2	270	247.5	17.5	16
120	130	2	300	247.5	17.5	16
130	140	2	340	275	19	17.5
140	150	2	390	275	19	17.5

▶

No. 10 cont'd

Table 3.1 (Continued)

Equipment Number		Stockless Bower Anchors		Stud Link Chain Cables for Bower Anchors		
					Diameter (mm)	
Exceeding	Not Exceeding	Number	Mass per Anchor (kg)	Total Length (m)	Mild Steel (Grade 1) (**)	Special Quality Steel Grade 2
1	2	3	4	5	6	7
150	175	2	480	275	22	19
175	205	2	570	302.5	24	20.5
205	240	2	660	302.5	26	22
240	280	2	780	330	28	24
280	320	2	900	357.5	30	26
320	360	2	1020	357.5	32	28
360	400	2	1140	385	34	30
400	450	2	1290	385	36	32
450	500	2	1440	412.5	38	34
500	550	2	1590	412.5	40	34
550	600	2	1740	440	42	36
600	660	2	1920	440	44	38
660	720	2	2100	440	46	40

NOTES

* In alternative to stud link chain cables, short link chain cables may be considered, for acceptance, by the concerned Society on the basis of their design, strength and steel quality.

** The steel grades of the chain cables are covered by A1.

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No. 10 cont'd

3.2 Mooring equipment

The mooring equipment is given by Table 3.2

Table 3.2

Equipment Number		Mooring Lines			
exceeding	not exceeding	Number	Minimum Length of each line (m)	Minimum breaking strength (kN)	
1	2	3	4	5	
				5a	5b*
30	40	2	50	29	29,4
40	50	2	60	29	29,4
50	60	2	60	29	29,4
60	70	2	80	29	29,4
70	80	2	100	34	34,3
80	90	2	100	37	36,8
90	100	2	110	37	36,8
100	110	2	110	39	39,2
110	120	2	110	39	39,2
120	130	2	110	44	44,1
130	140	2	120	44	44,1
140	150	2	120	49	–
150	175	2	120	54	–
175	205	2	120	59	–
205	240	2	120	64	64,2
240	280	3	120	71	71,1
280	320	3	140	78	78,4
320	360	3	140	86	85,8
360	400	3	140	93	93,2
400	450	3	140	101	–
450	500	3	140	108	–
500	550	4	160	113	–
550	600	4	160	118	–
600	660	4	160	123	–
660	720	4	160	127	–

* The values of the column 5b may be adopted in alternative to the correspondent values of the column 5a.

◄◄

No. 10 Anchoring, Mooring and Towing Equipment

(1982) (Rev.1 Aug 1999) (Corr. Dec 2004) Rev.2 Jun 2005) (Rev.3 Oct 2016) (Corr.1 Dec 2016)

1. Anchoring equipment

1.1 Anchoring equipment for ships having Equipment Number EN below 205 to 50.

(a) The anchoring equipment given here under applies to ships which are not covered under UR A1, i.e. for ships having 50 ≤ EN < 205.

(b) The design basis of the anchoring equipment, i.e. the Equipment Number EN, is that given in UR A1.

(c) These recommendations are applicable to ships operating in unrestricted service. Reductions of equipment may be considered for ships operating in restricted service.

Note:

References to UR A1 are preceded by 'A1' throughout this document.

1.1.1 Equipment number EN

The equipment of anchors and chain cables should be as given in Table 1 based on an Equipment Number EN calculated in compliance with A1.2.

No. 10 (cont)

Table 1 Anchoring equipment

	Stockless bower anchors		Stockless stream anchor	Stud link chain cable for bower anchors			Stream wire or chain	
EN	No.	Mass per anchor (kg)	Mass per anchor (kg)	Total length (m)	Min. diameter Mild steel Gr. 1 (mm)	Min. diameter Special quality Gr. 2 or 3 (mm)	Length (m)	Breaking strength (kN)
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
50-70	2	180	60	220	14	12.5	80	64.7
70-90	2	240	80	220	16	14	85	73.5
90-110	2	300	100	247.5	17.5	16	85	80.0
110-130	2	360	120	247.5	19	17.5	90	89.2
130-150	2	420	140	275	20.5	17.5	90	98.1
150-175	2	480	165	275	22	19	90	107.9
175-205	2	570	190	302.5	24	20.5	90	117.7

1.1.2 Anchors

1.1.2.1 Types of anchors

1.1.2.1.1 Ordinary anchors

(a) The requirements under A1.4.1.1 should be complied with.

(b) The mass of stocked anchors, when used, and that of stream anchors, excluding the stock should be 80% and the mass of the stock should be 20% of the mass as given in Table 1 for stockless bower anchors.

1.1.2.1.2 High Holding Power (HHP) anchors

The requirements under A1.4.1.2 and A1.4.2 should be complied with.

1.1.2.1.3 Super High Holding Power (SHHP) anchors

The requirements under A1.4.1.3 and A1.4.2 should be complied with.

No. 10 (cont)

1.1.2.2 Installation of the anchors on board

The bower anchors should be connected to their chain cables and ready for use. The stream anchor should be ready to be connected with its cable.

1.1.2.3 Proof testing of anchors

The requirements under A1.4.4 should be complied with.

1.1.3 Chain cables and wire ropes for anchors

1.1.3.1 Chain cables

(a) The anchors should be associated with stud link chain cables of one of the grades under A1.5.2, Table 3. For equipment numbers EN up to 90, as an alternative to stud link chain cables, short link chain cables may be used.

(b) Wire ropes for anchors may be adopted in compliance with 1.1.3.3

1.1.3.2 Proof and breaking loads of stud link chain cables

(a) The breaking loads (BL) and proof loads (PL) should be in compliance with the requirements under A1.5.3.

(b) The test load values, rounded off from the loads defined in (a) above, which should be used for testing and acceptance of chain cables with diameter between 11 and 19 mm are given in Table 2.

Table 2 Test load values for stud link chain cables

Chain cable diameter	Grade 1		Grade 2		Grade 3	
	Proof load	Breaking load	Proof load	Breaking load	Proof load	Breaking load
(mm)	(kN)	(kN)	(kN)	(kN)	(kN)	(kN)
1	*2*	*3*	*4*	*5*	*6*	*7*
11	35.8	51	51	71.7	71.7	102
12.5	46	65.7	65.7	92	92	132
14	57.9	82	82	116	116	165
16	75.5	107	107	150	150	216
17.5	89	127	127	179	179	256
19	105	150	150	211	211	301

1.1.3.3 Wire ropes for anchors

In alternative to the stud link or short link chain cables under 1.1.3.1, wire ropes may be used for:

(a) bower anchors of ships below 40 m in length

(b) stream anchor as stipulated in Table 1.

No. 10 (cont)

The wire ropes under (a) above should have:

(i) length equal to 1.5 times the corresponding tabular length of chain cable (col. 5 of Table 1)

(ii) strength equal to that of tabular chain cable of Grade 1 (col. 2 and 3 of Table 2).

A short length of chain cable should be fitted between the wire rope and bower or stream anchor having a length of 12.5 m or the distance between anchor in stowed position and winch, whichever is less. All surfaces being in contact with the wire need to be rounded with a radius of not less than 10 times the wire rope diameter (including stem).

Table 3 Mass of stud link chain cables

Chain cable diameter (mm)	Minimum mass per length of 27.5 m With Dee shackle (Kg)	Minimum mass per length of 27.5 m With lugless shackle (Kg)	Chain cable diameter (mm)	Minimum mass per length of 27.5 m With Dee shackle (Kg)	Minimum mass per length of 27.5 m With lugless shackle (Kg)
26	410	405	78	3640	3535
28	480	475	81	3940	3820
30	550	545	84	4240	4105
32	620	615	87	4555	4405
34	700	690	90	4870	4705
36	785	775	92	5085	4905
38	875	860	95	5405	5210
40	965	950	97	5630	5425
42	1055	1040	100	5970	5745
44	1150	1130	102	6210	5970
46	1260	1240	105	6580	6320
48	1370	1345	107	6845	6575
50	1485	1455	111	7380	7080
52	1605	1575	114	7795	7475
54	1725	1690	117	8220	7870
56	1850	1810	120	8650	8270
58	1985	1945	122	8960	8550
60	2125	2075	124	9275	8835
62	2275	2220	127	9740	9270
64	2430	2370	130	10210	9710
66	2590	2525	132	10540	10005
68	2755	2685	137	11320	10750
70	2925	2850	142	12110	11500
73	3185	3100	147	12950	12300
76	3460	3360	152	13890	13200

1.2 Anchoring equipment for ships in deep and unsheltered water

1.2.1 Scope and application

The hereunder given recommendations address anchoring equipment for ships in deep and unsheltered water which is not covered by UR A1 and 1.1. These recommendations may be used to design or assess the adequacy of the anchoring equipment for ships intended to anchor in water with depth up to 120 m, current with up to 1.54 m/s, wind with up to 14 m/s

No. 10 (cont)

and waves with significant height of up to 3 m. The scope of chain cable, being the ratio between the length of chain paid out and water depth, is assumed to be not less than 3 to 4. Furthermore, these recommendations are applicable to ships with an equipment length, as defined in A1.2, of not less than 135 m.

1.2.2 Equipment Number for deep and unsheltered water

Anchors and chain cables should be in accordance with Table 4 and based on the Equipment Number EN_1 obtained from the following equation:

$$EN_1 = 0.628\left[a\left(\frac{EN}{0.628}\right)^{1/2.3} + b(1-a)\right]^{2.3}$$

where

$a = 1.83 \cdot 10^{-9} \cdot L^3 + 2.09 \cdot 10^{-6} \cdot L^2 - 6.21 \cdot 10^{-4} \cdot L + 0.0866$

$b = 0.156 \cdot L + 8.372$

L = Equipment length of the ship in compliance with A1.2

EN = Equipment Number calculated in compliance with A1.2.

No. 10 (cont)

Table 4 Anchoring equipment for ships in unsheltered water with depth up to 120 m

Equipment Number EN_1		High holding power stockless bower anchors		Stud link chain cable for bower anchors		
					Min. diameter	
Exceeding	Not exceeding	Number	Mass per anchor (kg)	Length (m)	Special quality (Grade 2) (mm)	Extra special quality (Grade 3) (mm)
	1790	2	14150	1017.5	105	84
1790	1930	2	14400	990	105	84
1930	2080	2	14800	990	105	84
2080	2230	2	15200	990	105	84
2230	2380	2	15600	990	105	84
2380	2530	2	16000	990	105	84
2530	2700	2	15900	990	105	84
2700	2870	2	15800	990	105	84
2870	3040	2	15700	990	105	84
3040	3210	2	15600	990	105	84
3210	3400	2	15500	990	105	84
3400	3600	2	15400	990	105	84
3600	3800	2	16600	990	107	87
3800	4000	2	17800	962.5	107	87
4000	4200	2	18900	962.5	111	90
4200	4400	2	20100	962.5	114	92
4400	4600	2	22000	962.5	117	95
4600	4800	2	22400	962.5	120	97
4800	5000	2	23500	962.5	124	99
5000	5200	2	24000	935	127	102
5200	5500	2	24500	907.5	132	107
5500	5800	2	25000	907.5	132	107
5800	6100	2	25500	880	137	111
6100	6500	2	25500	880	142	114
6500	6900	2	26000	852.5	142	117
6900	7400	2	26500	852.5	147	117
7400	7900	2	27000	825	152	122
7900	8400	2	27000	825	-	127
8400	8900	2	27000	797.5	-	127
8900	9400	2	27000	770	-	132
9400	10000	2	27000	770	-	137
10000	10700	2	27000	770	-	142
10700	11500	2	27000	770	-	142
11500	12400	2	29500	770	-	147
12400	13400	2	31500	770	-	152
13400	14600	2	34500	770	-	157
14600		2	38000	770	-	162

1.2.3 Anchors

The bower anchors should be connected to their chain cables and positioned on board ready for use.

Anchors should be of the stockless High Holding Power (HHP) type. The mass of the head of a stockless anchor, including pins and fittings, should not be less than 60% of the total mass of the anchor. For the conditions of HHP anchors reference is made to A1.4.1.2 (a) and for the approval and/or acceptance of HHP anchors reference is made to A1.4.1.2 (c).

No. 10 (cont)

The mass, per anchor, of bower anchors given in Table 4 is for anchors of equal mass. The mass of individual anchors may vary to 7% of the tabular mass, but the total mass of anchors should not be less than that recommended for anchors of equal mass.

Suitable arrangements should be provided for securing the anchors when stowed, see 1.3.3.

For manufacture of anchors reference is made to UR W29. For proof testing of the anchors reference is made to A1.4.4.2.

1.2.4 Chain cables for bower anchors

Bower anchors should be associated with stud link chain cables of special (Grade 2) or extra special (Grade 3) quality. The total length of chain cable, as given in Table 4 should be reasonably divided between the two bower anchors. For the proof and breaking loads of stud link chain cables reference is made to A1.5.3, Table 4.

For manufacture of anchor chain cables reference is made to UR W18.

For the installation of the chain cables on board, 1.3 should be observed.

1.2.5 Anchor windlass and chain stopper

The windlass unit prime mover should be able to supply for at least 30 minutes a continuous duty pull Z_{cont}, in N, given by:

$$Z_{cont} = 35\ d^2 + 13.4\ m_A$$

where

d = chain diameter, in mm, as per Table 4
m_A = HHP anchor mass, in kg, as per Table 4

As far as practicable, for testing purpose the speed of the chain cable during hoisting of the anchor and cable should be measured over 37.5 m of chain cable and initially with at least 120 m of chain and the anchor submerged and hanging free. The mean speed of the chain cable during hoisting of the anchor from the depth of 120 m to the depth of 82.5 m should be at least 4.5 m/min.

For the hull supporting structure of anchor windlass and chain stopper reference is made to A1.7.

1.3 Installation of chain cables and anchors on board

1.3.1 Capacity and arrangement of anchor chain locker

(a) The chain locker should be of capacity and depth adequate to provide an easy direct lead of the cables through the chain pipes and a self-stowing of the cables. The chain locker should be provided with an internal division so that the port and starboard chain cables may be fully and separately stowed.

(b) The chain locker boundaries and their access openings should be watertight as necessary to prevent accidental flooding of the chain locker and damaging essential auxiliaries or equipment or affecting the proper operation of the ship.

(c) Adequate drainage facilities of the chain locker should be adopted.

No. 10 (cont)

1.3.2 Securing of the inboard ends of chain cables

(a) The inboard ends of the chain cables should be secured to the structures by a fastening able to withstand a force not less than 15% BL nor more than 30% BL (BL = breaking load of the chain cable).

(b) The fastening should be provided with a mean suitable to permit, in case of emergency, an easy slipping of the chain cables to sea, operable from an accessible position outside the chain locker.

1.3.3 Securing of stowed anchors

(a) To hold the anchor tight in against the hull or the anchor pocket, respectively, it is recommended to fit anchor lashings, e.g., a ‘devil’s claw’.

(b) Anchor lashings should be designed to resist a load at least corresponding to twice the anchor mass plus 10 m of cable without exceeding 40% of the yield strength of the material.

No. 10 (cont)

2. Mooring and towing equipment

2.1 Mooring lines

The mooring lines for ships with Equipment Number EN of less than or equal to 2000 are given in 2.1.1. For other ships the mooring lines are given in 2.1.2.

The Equipment Number EN should be calculated in compliance with A1.2. Deck cargo as given by the loading manual should be included for the determination of side-projected area A.

2.1.1 Mooring lines for ships with EN ≤ 2000

The minimum recommended mooring lines for ships having an Equipment Number EN of less than or equal to 2000 are given in Table 5.

For ships having the ratio A/EN > 0.9 the following number of lines should be added to the number of mooring lines as given by Table 5:

One line where $0.9 < \frac{A}{EN} \leq 1.1$,

two lines where $1.1 < \frac{A}{EN} \leq 1.2$,

three lines where $1.2 < \frac{A}{EN}$.

No. 10 (cont)

Table 5 Mooring lines for ships with EN ≤ 2000

EQUIPMENT NUMBER		MOORING LINES		
Exceeding	Not exceeding	No. of mooring lines	Minimum length of each line * (m)	Minimum breaking strength (kN)
1	*2*	*3*	*4*	*5*
50	70	3	80	37
70	90	3	100	40
90	110	3	110	42
110	130	3	110	48
130	150	3	120	53
150	175	3	120	59
175	205	3	120	64
205	240	4	120	69
240	280	4	120	75
280	320	4	140	80
320	360	4	140	85
360	400	4	140	96
400	450	4	140	107
450	500	4	140	117
500	550	4	160	134
550	600	4	160	143
600	660	4	160	160
660	720	4	160	171
720	780	4	170	187
780	840	4	170	202
840	910	4	170	218
910	980	4	170	235
980	1060	4	180	250
1060	1140	4	180	272
1140	1220	4	180	293
1220	1300	4	180	309
1300	1390	4	180	336
1390	1480	4	180	352
1480	1570	5	190	352
1570	1670	5	190	362
1670	1790	5	190	384
1790	1930	5	190	411
1930	2000	5	190	437

* 2.1.3 should be observed

2.1.2 Mooring lines for ships with EN > 2000

The minimum recommended strength and number of mooring lines for ships with an Equipment Number EN > 2000 are given in 2.1.2.1 and 2.1.2.2, respectively. The length of mooring lines is given by 2.1.3.

The strength of mooring lines and the number of head, stern, and breast lines (see Note) for ships with an Equipment Number EN > 2000 are based on the side-projected area A_1. Side projected area A_1 should be calculated similar to the side-projected area A according to A1.2 but considering the following conditions:

- For oil tankers, chemical tankers, bulk carriers, and ore carriers the lightest ballast draft should be considered for the calculation of the side-projected area A_1. For other ships the lightest draft of usual loading conditions should be considered if the ratio of the freeboard in the lightest draft and the full load condition is equal to or above two. Usual loading conditions mean loading conditions as given by the trim and stability booklet

No. 10 (cont)

that are to be expected to regularly occur during operation and, in particular, excluding light weight conditions, propeller inspection conditions, etc.

- Wind shielding of the pier can be considered for the calculation of the side-projected area A_1 unless the ship is intended to be regularly moored to jetty type piers. A height of the pier surface of 3 m over waterline may be assumed, i.e. the lower part of the side-projected area with a height of 3 m above the waterline for the considered loading condition may be disregarded for the calculation of the side-projected area A_1.

- Deck cargo as given by the loading manual should be included for the determination of side-projected area A_1. Deck cargo may not need to be considered if a usual light draft condition without cargo on deck generates a larger side-projected area A_1 than the full load condition with cargo on deck. The larger of both side-projected areas should be chosen as side-projected area A_1.

The mooring lines as given here under are based on a maximum current speed of 1.0 m/s and the following maximum wind speed v_w, in m/s:

v_w	=	$25.0 - 0.002 (A_1 - 2000)$	for passenger ships, ferries, and car carriers with $2000\ m^2 < A_1 \leq 4000\ m^2$
	=	21.0	for passenger ships, ferries, and car carriers with $A_1 > 4000\ m^2$
	=	25.0	for other ships

The wind speed is considered representative of a 30 second mean speed from any direction and at a height of 10 m above the ground. The current speed is considered representative of the maximum current speed acting on bow or stern (±10°) and at a depth of one-half of the mean draft. Furthermore, it is considered that ships are moored to solid piers that provide shielding against cross current.

Additional loads caused by, e.g., higher wind or current speeds, cross currents, additional wave loads, or reduced shielding from non-solid piers may need to be particularly considered. Furthermore, it should be observed that unbeneficial mooring layouts can considerably increase the loads on single mooring lines.

Note:

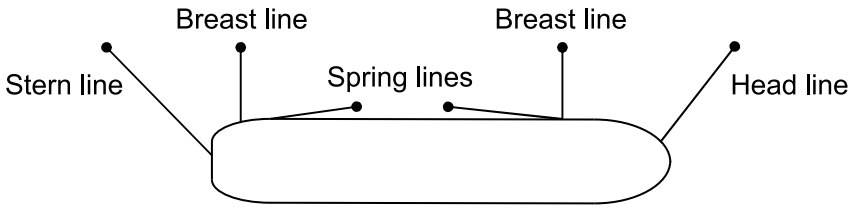
The following is defined with respect to the purpose of mooring lines, see also figure below:

Breast line: A mooring line that is deployed perpendicular to the ship, restraining the ship in the off-berth direction.

Spring line: A mooring line that is deployed almost parallel to the ship, restraining the ship in fore or aft direction.

Head/Stern line: A mooring line that is oriented between longitudinal and transverse direction, restraining the ship in the off-berth and in fore or aft direction. The amount of restraint in fore or aft and off-berth direction depends on the line angle relative to these directions.

No. 10 (cont)



2.1.2.1 Minimum breaking strength

The minimum breaking strength, in kN, of the mooring lines should be taken as:

$$MBL = 0.1 \cdot A_1 + 350$$

The minimum breaking strength may be limited to 1275 kN (130 t). However, in this case the moorings are to be considered as not sufficient for environmental conditions given by 2.1.2. For these ships, the acceptable wind speed v_w*, in m/s, can be estimated as follows:

$$v_w^* = v_w \cdot \sqrt{\frac{MBL^*}{MBL}}$$

where v_w is the wind speed as per 2.1.2, MBL* the breaking strength of the mooring lines intended to be supplied and MBL the breaking strength as recommended according to the above formula. However, the minimum breaking strength should not be taken less than corresponding to an acceptable wind speed of 21 m/s:

$$MBL^* \geq \left(\frac{21}{v_w}\right)^2 \cdot MBL$$

If lines are intended to be supplied for an acceptable wind speed v_w* higher than v_w as per 2.1.2, the minimum breaking strength should be taken as:

$$MBL^* = \left(\frac{v_w^*}{v_w}\right)^2 \cdot MBL$$

2.1.2.2 Number of mooring lines

The total number of head, stern and breast lines (see Note in 2.1.2) should be taken as:

$$n = 8.3 \cdot 10^{-4} \cdot A_1 + 6$$

For oil tankers, chemical tankers, bulk carriers, and ore carriers the total number of head, stern and breast lines should be taken as:

$$n = 8.3 \cdot 10^{-4} \cdot A_1 + 4$$

The total number of head, stern and breast lines should be rounded to the nearest whole number.

The number of head, stern and breast lines may be increased or decreased in conjunction with an adjustment to the strength of the lines. The adjusted strength, MBL*, should be taken as:

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MBL* = 1.2 · MBL · n/n* ≤ MBL for increased number of lines,

MBL* = MBL · n/n* for reduced number of lines.

where n* is the increased or decreased total number of head, stern and breast lines and n the number of lines for the considered ship type as calculated by the above formulas without rounding.

Vice versa, the strength of head, stern and breast lines may be increased or decreased in conjunction with an adjustment to the number of lines.

The total number of spring lines (see Note in 2.1.2) should be taken not less than:

Two lines where EN < 5000,

Four lines where EN ≥ 5000.

The strength of spring lines should be the same as that of the head, stern and breast lines. If the number of head, stern and breast lines is increased in conjunction with an adjustment to the strength of the lines, the number of spring lines should be likewise increased, but rounded up to the nearest even number.

2.1.3 Length of mooring lines

The length of mooring lines for ships with EN of less than or equal to 2000 may be taken from Table 5. For ships with EN > 2000 the length of mooring lines may be taken as 200 m.

The lengths of individual mooring lines may be reduced by up to 7% of the above given lengths, but the total length of mooring lines should not be less than would have resulted had all lines been of equal length.

2.2 Tow line

The tow lines are given in Table 6 and are intended as own tow line of a ship to be towed by a tug or other ship. For the selection of the tow line from Table 6, the Equipment Number EN should be taken according to 2.1.

No. 10 (cont)

Table 6 Tow lines

EQUIPMENT NUMBER Exceeding	Not exceeding	TOW LINE Minimum length (m)	Minimum breaking strength (kN)
1	*2*	*3*	*4*
50	70	180	98
70	90	180	98
90	110	180	98
110	130	180	98
130	150	180	98
150	175	180	98
175	205	180	112
205	240	180	129
240	280	180	150
280	320	180	174
320	360	180	207
360	400	180	224
400	450	180	250
450	500	180	277
500	550	190	306
550	600	190	338
600	660	190	370
660	720	190	406
720	780	190	441
780	840	190	479
840	910	190	518
910	980	190	559
980	1060	200	603
1060	1140	200	647
1140	1220	200	691
1220	1300	200	738
1300	1390	200	786
1390	1480	200	836
1480	1570	220	888
1570	1670	220	941
1670	1790	220	1024
1790	1930	220	1109
1930	2080	220	1168
2080	2230	240	1259
2230	2380	240	1356
2380	2530	240	1453
2530	2700	260	1471
2700	2870	260	1471
2870	3040	260	1471
3040	3210	280	1471
3210	3400	280	1471
3400	3600	280	1471
3600	-	300	1471

2.3 Mooring and tow line construction

Tow lines and mooring lines may be of wire, natural fibre or synthetic fibre construction or of a mixture of wire and fibre. For synthetic fibre ropes it is recommended to use lines with reduced risk of recoil (snap-back) to mitigate the risk of injuries or fatalities in the case of breaking mooring lines.

Notwithstanding the strength recommendations given in 2.1 and 2.2, no fibre rope should be less than 20 mm in diameter. For polyamide ropes the minimum breaking strength should be increased by 20% and for other synthetic ropes by 10% to account for strength loss due to, among others, aging and wear.

No. 10 (cont)

2.4 Mooring winches

2.4.1 Each winch should be fitted with brakes the holding capacity of which is sufficient to prevent unreeling of the mooring line when the rope tension is equal to 80% of the minimum breaking strength of the rope as fitted on the first layer. The winch should be fitted with brakes that will allow for the reliable setting of the brake rendering load.

2.4.2 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 minimum breaking strength. For automatic winches these figures apply when the winch is set to the maximum power with automatic control.

2.4.3 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.

2.5 Mooring and towing arrangement

2.5.1 Mooring arrangement

Mooring lines in the same service (e.g. breast lines, see Note in 2.1.2) should be of the same characteristic in terms of strength and elasticity.

As far as possible, sufficient number of mooring winches should be fitted to allow for all mooring lines to be belayed on winches. This allows for an efficient distribution of the load to all mooring lines in the same service and for the mooring lines to shed load before they break. If the mooring arrangement is designed such that mooring lines are partly to be belayed on bitts or bollards, it should be considered that these lines may not be as effective as the mooring lines belayed on winches.

Mooring lines should have as straight a lead as is practicable from the mooring drum to the fairlead.

At points of change in direction sufficiently large radii of the contact surface of a rope on a fitting should be provided to minimize the wear experienced by mooring lines and as recommended by the rope manufacturer for the rope type intended to be used.

2.5.2 Towing arrangement

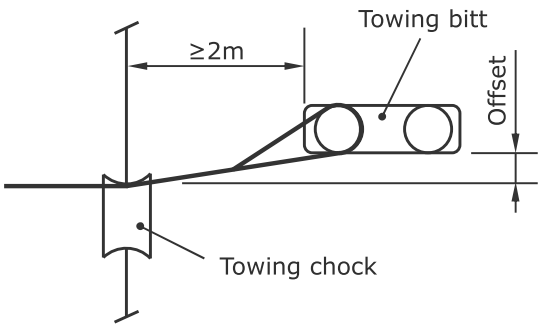
Towing lines should be led through a closed chock. The use of open fairleads with rollers or closed roller fairleads should be avoided.

For towing purpose it is recommended to provide at least one chock close to centreline of the ship forward and aft. It is also beneficial to provide additional chocks on port and starboard side at the transom and at the bow.

Towing lines should have a straight lead from the towing bitt or bollard to the chock.

For the purpose of towing, bitts or bollards serving a chock should be located slightly offset and in a distance of at least 2 m away from the chock, see figure below:

No. 10 (cont)



Warping drums should preferably be positioned not more than 20 m away from the chock, measured along the path of the line.

Attention should be given to the arrangement of the equipment for towing and mooring operations in order to prevent interference of mooring and towing lines as far as practicable. It is beneficial to provide dedicated towing arrangements separate from the mooring equipment.

For emergency towing arrangements for tankers reference should be made to SOLAS Chapter II-1, Regulation 3-4. For all ships other than tankers it is recommended to provide towing arrangements fore and aft of sufficient strength for ‘other towing’ service as defined in UR A2.0.

No. 10 (cont)

3. Anchoring and mooring equipment for fishing vessels

3.1 Anchoring equipment

3.1.1 Application

The following provisions apply to fishing vessels operating in unrestricted service. Reduction of equipment may be considered for fishing vessels operating in restricted services.

3.1.2 General recommendations

(a) Each ship should be provided with anchoring equipment designed for quick and safe operation in all foreseeable service conditions. Anchor equipment should consist of anchors, anchor chain cables and a windlass or other arrangements for dropping and weighing the anchors and for holding the ship at anchor.

(b) The equipment of anchors and chain cables given in Table 7 is based on the Equipment Number EN which should be calculated as follows:

$$EN = \Delta^{2/3} + 2Bh + 0.1A$$

where

Δ = moulded displacement, in t, to the maximum design waterline,
B = greatest moulded breadth, in m,
h = effective height, in m, from the maximum design waterline to the top of the uppermost house.
= $a + \Sigma h_i$
a = distance, in m, from the maximum design waterline to the upper edge of the uppermost complete deck at the side amidships,
h_i = height, in m, on the centreline of each tier of houses having breadth greater than B/4.

For the lowest tier h is measured at centreline from the upper deck or from a notional deck line where there is local discontinuity in the upper deck.

When calculating h, sheer and trim can be ignored.

A = side-projected area, in m^2, of the hull, within the length of the ship between perpendiculars, and of superstructures and houses above the maximum design waterline having a width greater than B/4.

Screens and bulwarks more than 1.5 m in height should be regarded as parts of houses when determining h and A.

3.1.3 Particular recommendations

(a) For ships below 40 m in length the anchor chain may be replaced with wire ropes of equal strength of the tabular anchor cables of Grade 1. Wire ropes of trawl winches complying with this recommendation may be used as anchor chain cables.

(b) When wire ropes are substituted for anchor chain cables then:

(i) the length of the ropes should be equal to 1.5 times the corresponding tabular length of chain cable (col. 5 of Table 7),

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(ii) a short length of chain cable should be fitted between the wire rope and anchor having a length of 12.5 m or the distance between anchor in stowed position and winch, whichever is less,

(iii) all surfaces being in contact with the wire should be rounded with a radius of not less than 10 times the wire rope diameter (including stem).

(c) High holding power anchors of approved design may be used as bower anchors. The mass of each such anchor may be 75% of the tabular mass for ordinary stockless bower anchors.

(d) The tabular anchor equipment may be increased for ships fishing in very rough waters.

No. 10 (cont)

Table 7 Equipment for fishing vessels

Equipment Number		Stockless bower anchors			Stud link chain cables for bower anchors	
					Min. diameter (mm)	
Exceeding	Not exceeding	Number	Mass per anchor (kg)	Total length (m)	Mild steel (Grade 1)**	Special quality steel (Grade 2)**
1	*2*	*3*	*4*	*5*	*6*	*7*
30	40	2	80	165	11	-
40	50	2	100	192.5	11	-
50	60	2	120	192.5	12.5	-
60	70	2	140	192.5	12.5 *	-
70	80	2	160	220	14	12.5
80	90	2	180	220	14	12.5
90	100	2	210	220	16	14
100	110	2	240	220	16	14
110	120	2	270	247.5	17.5	16
120	130	2	300	247.5	17.5	16
130	140	2	340	275	19	17.5
140	150	2	390	275	19	17.5
150	175	2	480	275	22	19
175	205	2	570	302.5	24	20.5
205	240	2	660	302.5	26	22
240	280	2	780	330	28	24
280	320	2	900	357.5	30	26
320	360	2	1020	357.5	32	28
360	400	2	1140	385	34	30
400	450	2	1290	385	36	32
450	500	2	1440	412.5	38	34
500	550	2	1590	412.5	40	34
550	600	2	1740	440	42	36
600	660	2	1920	440	44	38
660	720	2	2100	440	46	40

NOTES

* Alternative to stud link chain cables, short link chain cables may be considered.

** The steel grades of the chain cables are covered by UR A1, A1.5.2.

3.2 Mooring equipment

The mooring equipment is given by Table 8.

No. 10 (cont)

Table 8 Mooring lines for fishing vessels

Equipment Number		Mooring lines		
Exceeding	Not exceeding	Number	Minimum length of each line (m)	Minimum breaking strength (kN)
1	*2*	*3*	*4*	*5*
30	40	2	50	29
40	50	2	60	29
50	60	2	60	29
60	70	2	80	29
70	80	2	100	34
80	90	2	100	36.8
90	100	2	110	36.8
100	110	2	110	39
110	120	2	110	39
120	130	2	110	44
130	140	2	120	44
140	150	2	120	49
150	175	2	120	54
175	205	2	120	59
205	240	2	120	64
240	280	3	120	71
280	320	3	140	78
320	360	3	140	85.8
360	400	3	140	93
400	450	3	140	101
450	500	3	140	108
500	550	4	160	113
550	600	4	160	118
600	660	4	160	123
660	720	4	160	127

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