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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

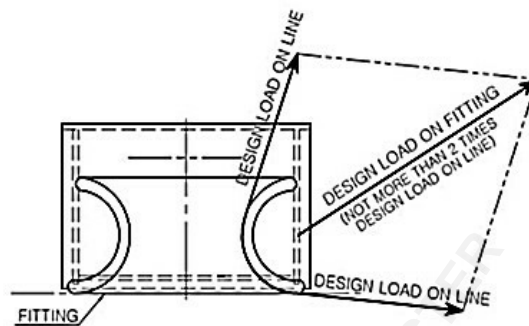
Shipboard fittings for towing should be located on stiffeners and/or girders which are part of the deck construction so as to facilitate efficient distribution of the towing load. Other equivalent arrangements may be accepted (for chocks in bulwarks, etc.), provided the strength is confirmed as adequate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

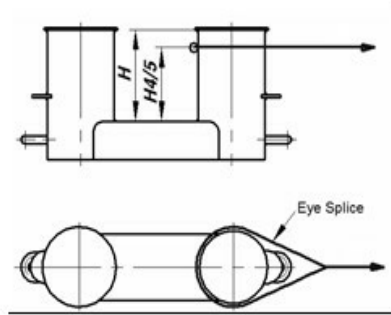
- .1 for normal towing operations, the intended maximum towing load (e.g. static bollard pull) as indicated on the towing and mooring arrangements plan;
- .2 for other towing services, the ship design minimum breaking load of the tow line according to appendix A; and
- .3 for fittings intended to be 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

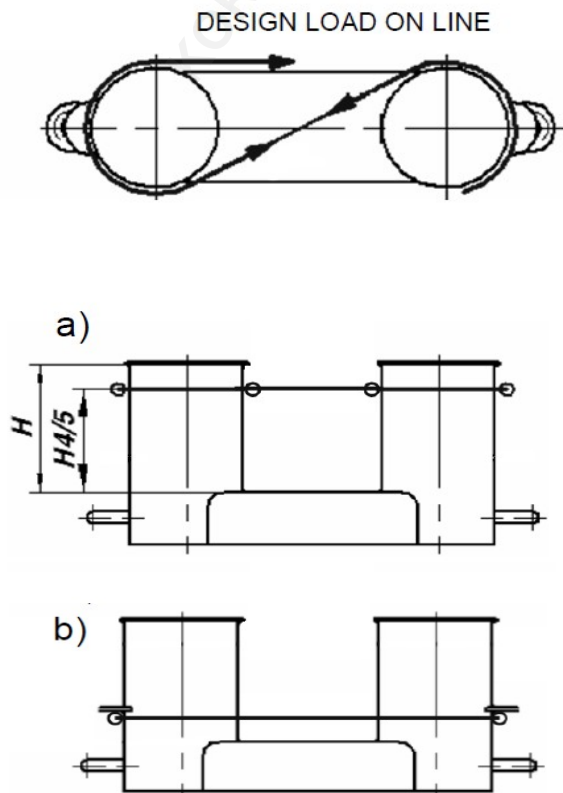
4.4.1 Shipboard fittings may be selected from industry standards accepted by the Administration at least based on the ship design minimum breaking load of the mooring line according to appendix A.

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 ($\pm 10^\circ$).

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 $0.9 < (A/EN) \leq 1.1$,
- two lines where $1.1 < (A/EN) \leq 1.2$,
- three lines where $1.2 < (A/EN)$.

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.

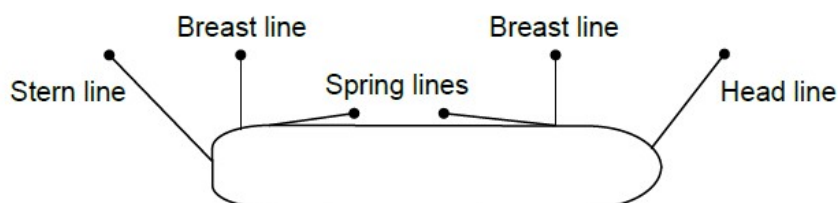
** For ships with EN > 2,000 see section 3 of appendix A.

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:

$$\begin{aligned} v_w &= 25.0 - 0.002 (A_1 - 2,000) \text{ for passenger ships, ferries and car carriers with } 2,000 \text{ m}^2 < A_1 \leq 4,000 \text{ m}^2 \\ &= 21.0 \text{ for passenger ships, ferries and car carriers with } A_1 > 4,000 \text{ m}^2 \\ &= 25.0 \text{ for other ships} \end{aligned}$$

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 ($\pm 10^\circ$) 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:

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

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:

$$MBL_{SD}^* \geq (21/v_w)^2 \cdot MBL_{SD}$$

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:

$$MBL_{SD}^* = (v_w^*/v_w)^2 \cdot MBL_{SD}$$

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:

$$MBL_{SD}^{**} = 1.2 \cdot MBL_{SD} \cdot n/n^{**} \leq MBL_{SD} \text{ for increased number of lines,}$$

$$MBL_{SD}^{**} = MBL_{SD} \cdot n/n^{**} \text{ for reduced number of lines,}$$

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 $EN \geq 5,000$.

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:

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

where:

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

B = Moulded breadth, in metres.

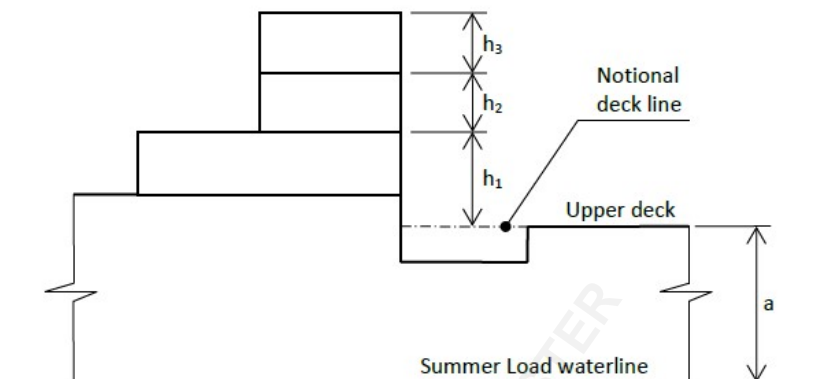
h = Effective height, in metres, from the Summer Load Waterline to the top of the uppermost house; for the lowest tier ' h ' should be measured at centreline from the upper deck or from a notional deck line where there is local discontinuity in the upper deck (see figure below for an example).

$$h = a + \sum h_i$$

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 = 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 $B/4$.

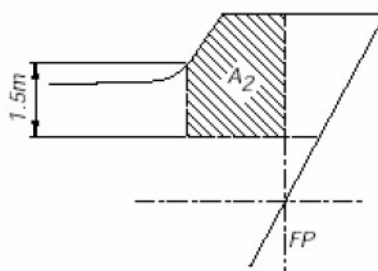


NOTES:

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 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).

