# Anchoring, Towing and Mooring Equipment

**Amended Rules and Guidance**

Rules for the Survey and Construction of Steel Ships Parts C, CS, and Q
Rules for High Speed Craft
Rules for the Survey and Construction of Inland Waterway Ships
Guidance for the Survey and Construction of Steel Ships Parts C, and CS
Guidance for the Survey and Construction of Inland Waterway Ships

**Reason for Amendment**

In 2016, IACS conducted a complete review of IACS Unified Requirement A1, A2 (UR A1 and UR A2) as well as IACS Recommendation No.10 (Rec.10) related to towing and mooring equipment, and the Society has already incorporated the latest revisions of these into its Rules for the Survey and Construction of Steel Ships.

Subsequently, the IMO also reviewed its regulations related to towing and mooring equipment (including mooring lines) and amendments to SOLAS Chapter II-1 Regulation 3-8 and the related MSC.1/Circular 1175 Rev.1 were adopted as Resolution MSC.474(102) at the 102$^{nd}$ session of the IMO Maritime Safety Committee (MSC) in 2020.

In order to harmonise the amendments made to the IMO circular such as the definitions of $MBL_{sd}$ and other terms, IACS amended the aforementioned URs and Recommendation and revised versions were adopted as IACS UR A1(Rev.7), UR A2(Rev.5) and IACS Rec. No.10(Rev.4). In addition to the above, as part of the comprehensive review of the ClassNK Rules and Guidance, the format of the Society's requirements was also reviewed to clarify their relationship with relevant URs and Recommendations, and to make their format as similar as possible to the one used by IACS.

Accordingly, relevant requirements were amended based upon IACS UR A1(Rev.7), UR A2(Rev.5) and IACS Rec. No.10(Rev.4) and the results of the aforementioned review.

**Outline of Amendment**

(1) Amended the calculation formulae for equipment numbers to include the effects of funnels.
(2) Amended the strength assessment methods for the supporting hull structures of mooring winches from ones based on gross scantling calculations to ones based on net scantling calculations.
(3) Amended the corrosion additions for the supporting hull structures of towing and mooring equipment
(4) Amended the ship condition to be used for calculations of the required minimum breaking loads of mooring lines to being the ballast condition regardless of ship type.
(5) Amended the calculation formulae for the required number of mooring lines corresponding to adjusted $MBL_{sd}$.

"Rules for the survey and construction of steel ships" has been partly amended as follows:

# Part C HULL CONSTRUCTION AND EQUIPMENT

## Chapter 27 EQUIPMENT

Title of Section 27.1 has been amended as follows.

### 27.1 Anchors~~,~~ and Chain Cables ~~and Mooring Ropes~~

Paragraph 27.1.1 has been amended as follows.

**27.1.1 General***

**1** All ships~~, according to their equipment numbers,~~ are to be provided with anchors~~,~~ and chain cables ~~and mooring ropes which are not less than that given in **Table C27.1**, and **Table C27.2** or **27.1.5**~~ specified in this chapter. ~~In the case of anchoring equipment for ships in deep and unsheltered waters, the Society may require special consideration be given to such equipment.~~ All ships are to be provided with suitable appliances for handling anchors and lines.

**2** Anchors~~,~~ and chain cables ~~and mooring ropes~~ for ships having equipment numbers ~~not more than 50 or~~ more than 16,000 are to be as determined by the Society.

~~**3** Two of the anchors given in **Table C27.1** are to be connected to their cables and be positioned on board ready for use.~~

~~**4** Anchors, chain cables, wire ropes and fibre ropes used for mooring lines are to be in compliance with the requirements in **Chapter 2, 3.1** of **Chapter 3, Chapters 4** and **5, Part L**, respectively.~~

**3** The anchoring equipment subject to the requirements specified in this chapter is based on the following conditions of intended use. The Society, however, may require special consideration be given to anchoring equipment intended for use in deep and unsheltered waters.

(1) The anchoring equipment required herewith is intended for temporary mooring of a ship within a harbour or sheltered area when the ship is awaiting berth, tide, etc. The equipment is, therefore, not designed to hold a ship off fully exposed coasts in rough weather or to stop a ship which is moving or drifting.

(2) The anchoring equipment required herewith is designed to hold a ship in good holding ground conditions so as to avoid dragging of the anchor. In poor holding ground conditions, the holding power of the anchors is significantly reduced.

(3) Anchoring equipment is used under the environmental condition that an assumed maximum current speed of 2.5 *m/s*, a maximum wind speed of 25 *m/s* and a minimum scope of chain cable of 6, the scope being the ratio between the paid-out length of the chain and water depth. However, for ships with a ship length $L_2$ (as defined in **27.1.2-1**) greater than 135 *m*, the required anchoring equipment may alternatively be considered applicable to a maximum current speed of 1.54 *m/s*, a maximum wind speed of 11 *m/s* and waves with maximum significant height of 2 *m*.

(4) It is assumed that under normal circumstances a ship uses only one bow anchor and chain cable at a time.

**4** Sheltered waters are generally calm stretches of water (e.g. harbours, estuaries, roadsteads, bays, lagoons) where the wind force does not exceed 6 on the Beaufort scale.

Paragraph 27.1.2 has been amended as follows.

**27.1.2 Equipment Numbers***

~~**1** Equipment number is the value obtained from the following formula:~~

~~$W^{\frac{2}{3}} + 2.0hB + 0.1A$~~

~~Where:~~

~~$W$: Full load displacement ($t$)~~

~~$h$ and $A$: Values specified in the following **(1)**, **(2)** and **(3)**~~

~~(1) $h$ is the value obtained from the following formula:~~

~~$f + h'$~~

~~$f$: Vertical distance ($m$), at the midship, from the designed maximum load line to the top of the uppermost continuous deck beam at side~~

~~$h'$: Height ($m$) from the uppermost continuous deck to the top of uppermost superstructure or deckhouse having a breadth greater than $B$/4~~

~~In the calculation of $h$', sheer and trim may be ignored. Where a deckhouse having a breadth greater than $B$/4 is located above a deckhouse with a breadth of $B$/4 or less, the narrow deckhouse may be ignored.~~

~~(2) $A$ is the value obtained from the following formula:~~

~~$fL_S + \Sigma h'' l$~~

~~$f$: Value specified in **(1)**~~

~~$L_S$: Length ($m$) of ship specified in **2.1.2, Part A** or 0.97 *times* the length of ship on the designed maximum load line, whichever is smaller. The fore end of $L_S$ is the perpendicular to the designed maximum load draught at the forward side of the stem, and the aft end of $L_S$ is the perpendicular to the designed maximum load draught at a distance $L_S$ aft of the fore end of $L_S$.~~

~~$\Sigma h'' l$: Sum of the products of the height $h''$ ($m$) and length $l$ ($m$) of superstructures, deckhouses or trunks which are located above the uppermost continuous deck within $L_S$ and also have a breadth greater than $B$/4 and a height greater than 1.5$m$~~

~~(3) In the application of **(1)** and **(2)**, screens and bulwarks more than 1.5$m$ in height are to be regarded as parts of superstructures or deckhouses.~~

**1** The equipment number (EN) is the value obtained from the following formula:

$$W^{\frac{2}{3}} + 2.0\left(hB + S_{fun}\right) + 0.1A$$

$W$: Full load displacement ($t$)

$B$: Breadth of ship ($m$) (See **2.1.4, Part A of the Rules**)

$h$: Effective height ($m$) defined as follows: $h = a + \sum h_i$

$a$: Vertical distance ($m$), at the midship, from the designed maximum load line to the top of the uppermost continuous deck beam at side

$h_i$: Height ($m$) at the centreline of each tier of deckhouses having a breadth greater than $B$/4; for the lowest tier $h_1$ is to be measured at the centreline from the upper deck or from the notional deck line where there is local discontinuity in the upper deck (See **Fig. C27.1**)

$S_{fun}$: Effective front projected area of the funnel ($m^2$) defined as follows: $S_{fun} = A_{FS} - S_{shield}$

$A_{FS}$: Front projected area of the funnel ($m^2$) calculated between the upper deck at the centreline (or the notional deck line where there is local discontinuity in the upper deck) and the effective height $h_F$. The value for $A_{FS}$ is to be taken as zero if the funnel breadth is $B$/4 or less at all elevations along the funnel's height.

$h_F$: Effective height of the funnel ($m$) measured from the upper deck at the centreline (or the notional deck line where there is local discontinuity in the upper deck) and the top of the

funnel. The top of the funnel may be taken at the level where the funnel breadth reaches $B$/4.

$S_{shield}$: Section of the front projected area $A_{FS}$ ($m^2$) which is shielded by all deckhouses having breadth greater than $B$/4. To determine $S_{shield}$, the deckhouse breadth is assumed $B$ for all deckhouses having breadth greater than $B$/4 (See **Fig. C27.2)**

$A$: Side projected area ($m^2$) of the hull, superstructures, deckhouses and funnels above the designed maximum load line which are within the length of the ship $L_2$ and also have a breadth greater than $B$/4. The side projected area of the funnel is to be considered in $A$ when $A_{FS}$ is greater than zero. In such cases, the side projected area of the funnel is to be calculated between the upper deck at the centreline (or the notional deck line where there is local discontinuity in the upper deck) and the effective height $h_F$.

$L_2$: Length ($m$) of ship specified in **2.1.2, Part A of the Rules** or 0.97 *times* the length of ship on the designed maximum load line, whichever is smaller. The fore end of $L_2$ is the perpendicular to the designed maximum load draught at the forward side of the stem, and the aft end of $L_2$ is the perpendicular to the designed maximum load draught at a distance $L_2$ aft of the fore end of $L_2$.

Fig. C27.1 Effective Height

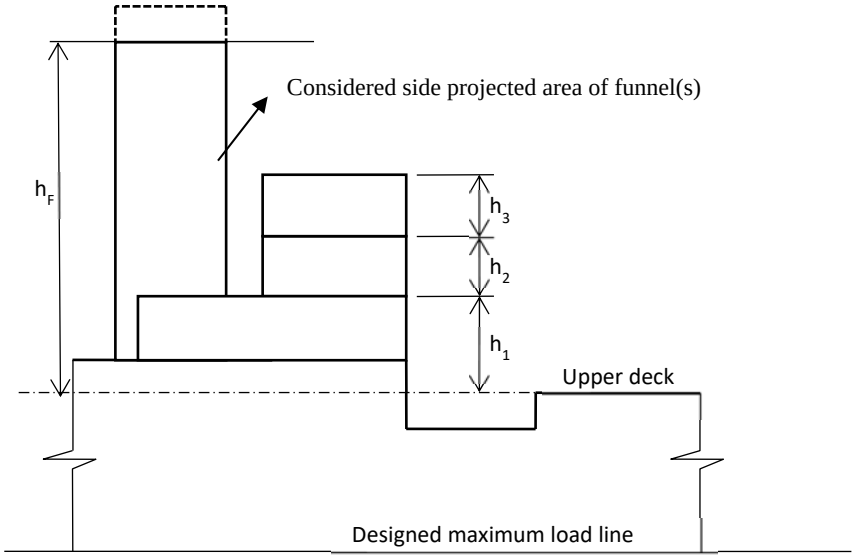
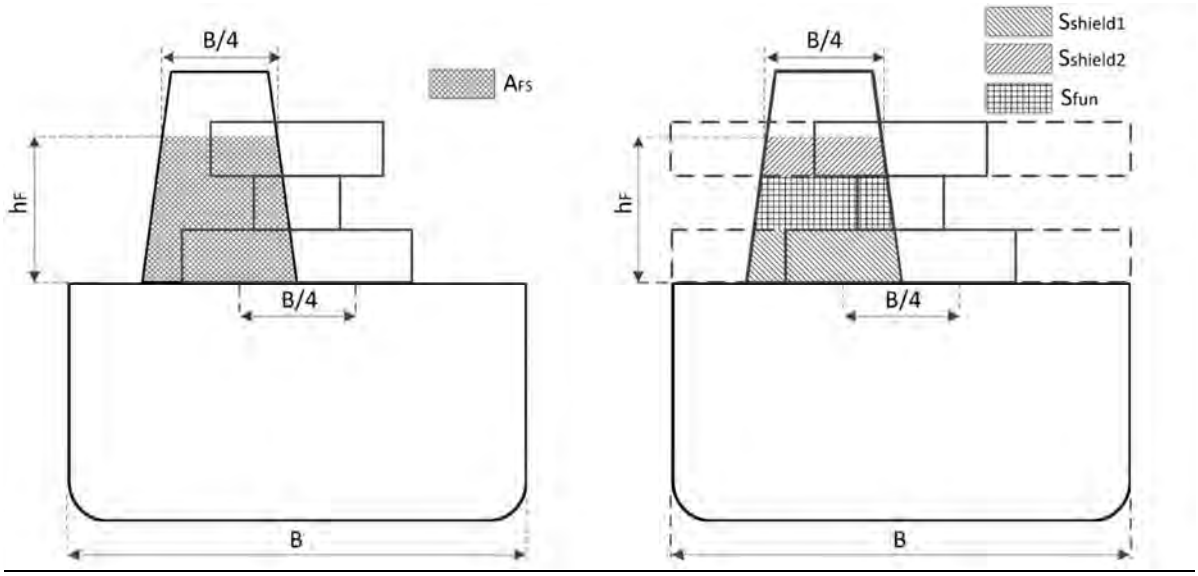
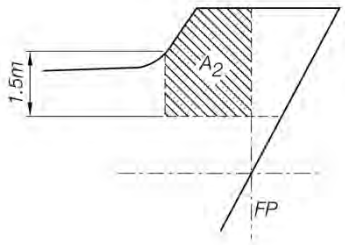


Fig. C27.2 Front Projected Area of Funnel




**2** Screens or bulwarks 1.5 *m* or more in height are to be regarded as parts of deckhouses 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 in **Fig. C27.3** as $A_2$ is to be included in *A*.

Fig. C27.3 Effective Areas for Screens, Bulwarks, etc.




**3** When several funnels are fitted on the ship, the above parameters are to be taken as follows:

$h_F$: Effective height of the funnel (*m*) measured from the upper deck at the centreline (or the notional deck line where there is local discontinuity in the upper deck) and the top of the highest funnel. The top of the highest funnel may be taken at the level where the sum of each funnel breadth reaches *B*/4.

$A_{FS}$: Sum of the front projected area of each funnel ($m^2$), calculated between the upper deck at the centreline (or the notional deck line where there is local discontinuity in the upper deck) and the effective height $h_F$. The value for $A_{FS}$ is to be taken as zero if the sum of each funnel breadth is *B*/4 or less at all elevations along the funnel's height.

*A*: Side projected area ($m^2$) of the hull, superstructures, deckhouses and funnels above the designed maximum load line which are within the length of the ship $L_2$. The total side projected area of the funnel is to be considered in the side projected area of the ship (*A*) when $A_{FS}$ is greater than zero. The shielding effect of funnels in transverse direction may be considered in the total side projected area (i.e. when the side projected areas of two or more funnels fully or partially overlap), the overlapped area needs only to be counted once.

**~~2~~4** Notwithstanding **1**, for tugs, the equipment number ~~for tugs~~ is to be obtained from the following

formula:

$$W^{\frac{2}{3}} + 2.0(\not{f}aB + \sum \not{h}\not{b}h_i b_i) + 0.1A$$

$W$, $\not{f}$ $a$, $h_i$ and $A$: As specified in **1** above

~~$\sum h'' b$: Sum of the products of the height $h''$ ($m$) and the breadth $b$($m$) of each superstructure and deckhouse which have a breadth greater than $B/4$ and are located above the uppermost continuous deck~~

$b_i$: Breadth ($m$) of the widest superstructure or deckhouse of each tier having a breadth greater than $B$/4

Paragraph 27.1.3 has been amended as follows.

**27.1.3 Anchors**

**1** All ships are to be provided with the anchors which are not less than that given in **Table C27.1** according to their equipment number.

**2** Two of the anchors given in **Table C27.1** are to be connected to their cables and be positioned on board ready for use.

**3** Anchors are to comply with the requirements in **Chapter 2, Part L of the Rules.**

~~**1**~~**4** The mass of individual anchors may vary by ±7 % of the mass given in **Table C27.1**, provided that the total mass of anchors is not less than that obtained from multiplying the mass per anchor given in the table by the number installed on board. However, where approval by the Society is obtained, anchors which are increased in mass by more than 7 % may be used.

~~**2**~~**5** Where stocked anchors are used, the mass, excluding the stock, is not to be less than 0.80 *times* the mass shown in the table for ordinary stockless anchors.

~~**3**~~**6** Where high holding power anchors are used, the mass of each anchor may be 0.75 *times* the mass shown in the table for ordinary stockless anchors.

~~**4**~~**7** Where super high holding power anchors are used, the mass of each anchor may be 0.5 *times* the mass required for ordinary stockless anchors. However, super high holding power anchor mass is not to exceed 1,500 *kg*.

Paragraph 27.1.4 has been amended as follows.

**27.1.4 Chain Cables***

**1** All ships are to be provided with chain cables which are not less than that given in **Table C27.1** according to their equipment number.

**2** Chain cables for anchors are to be stud link chains of Grade 1, 2 or 3 as specified in **3.1** of **Chapter 3, Part L of the Rules**. However, Grade 1 chains made of Class 1 chain bars (*KSBC*31) are not to be used in association with high holding power anchors.

Paragraph 27.1.5 has been deleted.

~~**27.1.5 Mooring Lines***~~

Paragraph 27.1.6 has been deleted.

~~**27.1.6 Tow Lines**~~

Paragraphs 27.1.7 and 27.1.8 have been renumbered to Paragraphs 27.1.5 and 27.1.6.

**27.1.~~7~~5 Chain Lockers***

(-1 to -8 are omitted.)

Paragraph 27.1.8 has been renumbered to Paragraph 27.1.6, and has been amended as follows.

**27.1.~~8~~6 Supporting Hull Structures of Anchor Windlasses and Chain Stoppers**

**1** The supporting hull structures of anchor windlasses and chain stoppers are to be sufficient to accommodate operating loads and sea loads

(1) Operating loads are to be taken as not less than the following:
   (a) For chain stoppers, 80 % of the chain cable breaking load
   (b) For windlasses, where no chain stopper is fitted or a chain stopper is attached to the windlass, 80 % of the chain cable breaking load
   (c) For windlasses, where chain stoppers are fitted but not attached to the windlass, 45 % of the chain cable breaking load

(2) Sea loads are to be taken according to **2.1.6, Section 4, Chapter 11, Part 1 of Part CSR-B&T of the Rules**

**2** The permissible stresses for supporting hull structures of windlasses and chain stoppers~~, based on gross thicknesses,~~ are not to be greater than the following permissible values:

~~(1) Normal stress: 1.00 $R_{eH}$~~

~~(2) Shear stress: 0.60 $R_{eH}$~~

(1) For strength assessment by means of beam theory or grillage analysis:
   (a) Normal stress: 1.00 $R_{eH}$
   (b) Shear stress: 0.60 $R_{eH}$
   $R_{eH}$: The specified minimum yield stress of the material

(2) For strength assessment by means of finite element analysis:
   (a) Von Mises stress: 1.00 $R_{eH}$

(3) Normal stress referred to in **(1)** above 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 are to be considered.

**3** For strength assessments of supporting hull structures, beam theory or finite element analysis using net scantlings is to be applied as appropriate. Where finite element analysis is used, the provisions of **27.2.3-5** are to be applied. In addition, the total corrosion addition is to be 2.0 *mm*.

Title of Section 27.2 has been amended as follows.

## 27.2 Towing and Mooring ~~Fittings~~Arranagement

Paragraph 27.2.1 has been amended as follows.

**27.2.1 General***

**1** The requirements in **27.2** apply to shipboard fittings used for towing and mooring operations associated with the normal operation of the ship~~, and~~ as well as their supporting hull structures. ~~With respect to this requirement, towing is limited to the following:~~

~~(1) Normal towing: towing operations necessary for manoeuvring in ports and sheltered waters associated with the normal operation of the ship~~

~~(2) Other towing: emergency towing by another ship or a tug.~~

~~**2** Ships are to be adequately provided with shipboard fittings.~~

~~**3** Shipboard fittings are to comply with the requirements of **27.2.2** and **27.2.3** respectively.~~

~~**4** When the shipboard fittings are not selected from industry standards deemed appropriate by the Society, the corrosion additions specified in **27.2.4** are to be applied to shipboard fittings and their supporting structures such as foundations.~~

~~**5** When the shipboard fittings are not selected from industry standards deemed appropriate by~~

~~the Society, the wear down allowances specified in 27.2.5 are to be applied to shipboard fittings.~~

~~**6** The scantlings of supporting hull structures are to be built at least with the gross scantlings obtained by adding the corrosion addition specified in 27.2.4 to the net scantlings obtained by applying the criteria specified in this section.~~

~~**7** The scantlings of supporting hull structures are to be in accordance with the relevant chapters or sections in addition to this section.~~

**2** Ships are to be adequately provided with shipboard fittings which are selected from industry standards deemed appropriate by the Society. The "shipboard fittings" referred to in **27.2** are bollards, bitts, fairleads, stand rollers, chocks used for normal mooring of the ship and other similar components used for normal or other towing of the ship. Other components such as capstans, winches, etc. are not included. Any welds, bolts or equivalent devices connecting shipboard fittings to their supporting structures are considered to be part of the shipboard fitting if selected in accordance with industry standards deemed appropriate by the Society.

**3** The definitions of terms which appear in this section are as follows.

(1) Maximum towing load

"Maximum towing load" is the largest load that can be assumed or intended in normal towing such as static bollard pull

(2) Safe Towing Load (*TOW*)

"Safe Towing Load" (*TOW*) is the safe load limit of shipboard fittings used for towing purpose. However, it does not represent the actual strength of shipboard fittings and their supporting hull structures

(3) Safe Working Load (*SWL*)

"Safe Working Load" (*SWL*) is the safe load limit of shipboard fittings used for mooring purpose. However, it does not represent the actual strength of shipboard fittings and their supporting hull structures

(4) Line Design Break Force (*LDBF*)

"Line Design Break Force" (*LDBF*) is the minimum force that a new, dry, spliced, mooring line will break at. This is for all synthetic cordage materials.

(5) Ship Design Minimum Breaking Load ($MBL_{sd}$)

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

(6) Ships intended to be regularly moored to jetty-type piers

Ships intended to be regularly moored to jetty-type piers are oil tankers, chemical tankers or gas carriers which are assumed to be moored to jetty-type piers.

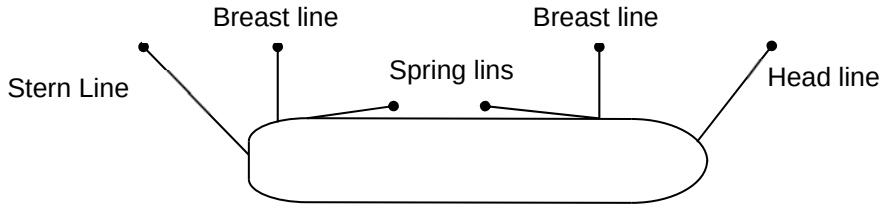
(7) Breast lines, head lines, stern lines and spring lines are defined as follows. (See **Fig. C27.4**)

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

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

(c) Head/Stern line: A mooring line that is oriented between the longitudinal and transverse directions, restraining the ship in the off-berth direction as well as in either the fore or aft direction. The amount of restraint in these directions depends on their relative line angles.

Fig. C27.4 Sample Arrangement of Mooring Lines




(8) Maximum wind speed $v_w$ and acceptable wind speed $v_w^*$
Wind speed is considered representative of a 30 *second* mean speed from any direction and at a height of 10 *m* above the ground

(9) Current speed for maximum current speed
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 currents.

(10) Ship nominal capacity condition
"Ship nominal capacity condition" is the theoretical condition in which the maximum possible amount of deck cargoes (in their respective positions) is included in the ship arrangement. For container ships, the nominal capacity condition represents the theoretical condition in which the maximum possible number of containers (in their respective positions) is included in the ship arrangement.

(11) Supporting hull structure
Supporting hull structures are the parts of the ship structure on or in which shipboard fittings are attached and which are directly subjected to the forces acting on such fittings.

(12) Sheltered waters
Sheltered waters are generally calm stretches of water (e.g. harbours, estuaries, roadsteads, bays, lagoons) where the wind force does not exceed 6 on the Beaufort scale,.

(13) Towing
For the application of this section, towing means the towing operations specified in the following **(a)** and **(b)** but not including **(c)**.

(a) Normal towing means towing operations necessary for manoeuvring in ports and sheltered waters associated with the normal operation of the ships.

(b) Other towing means towing by another ship or a tug (e.g. such as to assist the ship in cases of emergency) but does not include the towing specified in **27.3**.

(c) Towing services not covered by this section are as follows.

i) Escort towing: A towing service for laden oil tankers or LNG carriers, particularly as required in specific estuaries. Its main purpose is to control the ship in cases of propulsion or steering system failure.

ii) Canal transit towing: A towing service for ships transiting canals (e.g. the Panama Canal).

iii) Emergency towing for tankers: A towing service to assist tankers in cases of emergency as specified in **27.3**.

Paragraph 27.2.2 has been added as follows.

**27.2.2 Tow Lines**

Where ships are provided with tow lines, it is advised that tow lines are to be in accordance with the following **(1)** and **(2)**.

(1) Wire ropes and fibre ropes used as tow lines are to comply the requirements in **Chapter 4** and

**Chapter 5, Part L of the Rules**, respectively. The specifications of tow lines (e.g. breaking load, length) and the number of tow lines are to be in accordance with **Table C27.1** according to ship equipment number. However, when calculating the equipment number, the effect of deck cargoes at the ship nominal capacity condition is to be considered with respect to the side-projected area *A*.

(2) Fibre ropes used as tow lines are to be not less than 20 mm in diameter in consideration of rope age degradation and wear. Therefore, the line design break force for such ropes is to be in accordance with the following **(a)** or **(b)**:

(a) Polyamide ropes: *LDBF* ≥ 120 % of the minimum breaking load specified in **Table C27.1** according to equipment number,

(b) Other synthetic ropes: *LDBF* ≥ 110 % of the minimum breaking load specified in **Table C27.1** according to equipment number.

Paragraph 27.2.2 has been renumbered to Paragraph 27.2.3, and has been amended as follows.

**27.2.~~2~~3 Towing Fittings***

**1** Strength

The strength of shipboard fittings used for towing operations at the bow, sides and stern as well as their supporting hull structures are to comply with the requirements of **27.2.3**. For fittings intended to be used for both towing and mooring, the requirements of **27.2.6** are to be applied.

~~**1**~~**2** Arrangement

(1) Towing fittings are to be located on stiffeners, girders, or both which are parts 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.

(2) When towing fittings cannot be located as specified in **(1),** appropriate reinforced members are to be provided directly underneath the towing fittings.

~~**2**~~**3** Selection

(1) Towing fittings are to be selected from industry standards deemed appropriate by the Society and are to be at least based on the following loads. However, the increase of the line design break force for synthetic ropes (according to **27.2.2(2))** need not be considered for the loads applied to shipboard fittings and their supporting hull structures.

(a) For normal towing operations, the intended maximum towing load. ~~(e.g. static bollard pull) as indicated on the towing and mooring arrangements plan specified in **27.2.6**~~.

(b) For other towing services, the minimum ~~strength~~ load of the tow line specified in **Table C27.1** according to equipment number ~~determined in **27.1.2**~~.

(c) For fittings intended to be used for both normal and other towing operations, the greater of the loads specified in **(a)** and **(b)**.

(2) When towing fittings are not selected from industry standards deemed appropriate by the Society, the strength of the fitting and of its attachment to the ship are to be in accordance with ~~3~~**4** and ~~4~~**5**. For strength assessments, beam theory or finite element analysis using net scantlings is to be applied as appropriate. At the discretion of the Society, load tests may be accepted as alternatives to strength assessments by calculations.

(3) Towing bitts (double bollards) are to be of sufficient strength to withstand the loads caused by ~~the~~tow lines attached with eye splices.

~~**3**~~**4** ~~Design Load~~ Supporting Hull Structures

(1) Design load for the supporting hull structures of towing fittings are to be as specified in **(~~1~~a)** to **(~~7~~c)** below:

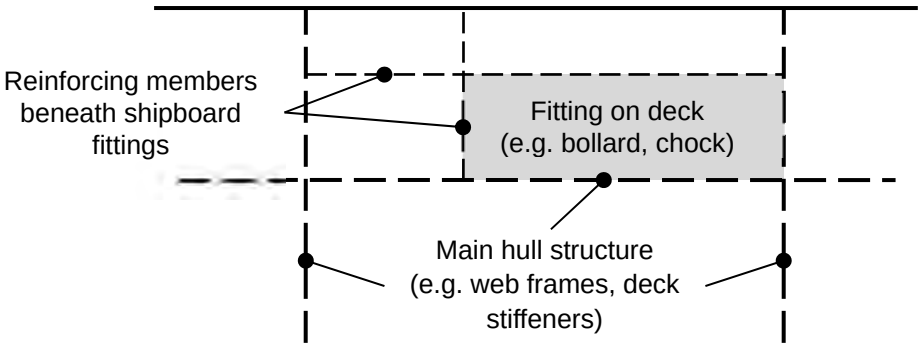
(~~1~~a) For ~~the~~ normal towing operations ~~specified in **27.2.1-1(1)**, the minimum design load is to be~~ 1.25 *times* the intended maximum towing load.

(~~2~~b) For ~~the~~ other towing services ~~specified in 27.2.1.1(2), the minimum design load is to be~~ the breaking ~~strength~~ load of the tow lines specified in **Table C27.1** ~~according to the equipment number determined in 27.1.2~~.

(~~3~~c) For fittings intended to be used for both normal and other towing operations, ~~the minimum design load is to be~~ the greater of the design loads specifies in **(1)** and **(2)**.

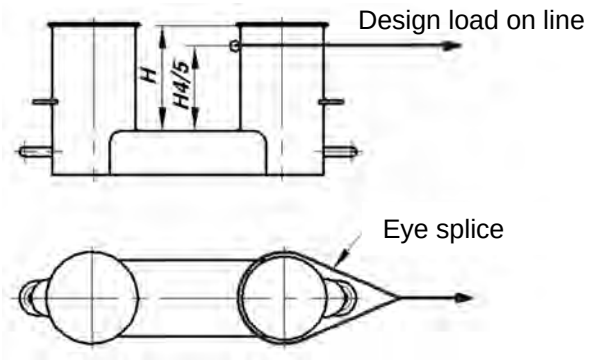
(2) The reinforced members beneath shipboard fittings are to be effectively arranged for any variation of direction (horizontally and vertically) of the towing forces acting upon the shipboard fittings, and the proper alignment of the fittings and their supporting hull structures is to be ensured. (See **Fig. C27.5** for a sample arrangement.)

Fig. C27.5 Sample Arrangement of Shipboard Fittings and Supporting Hull Structures




(~~5~~3) The acting point ~~where~~of the towing force ~~acts~~ on ~~towing~~ shipboard fittings is to be taken ~~as~~ at the attachment point of ~~the~~a tow line or at a change in its direction. For bollards and bitts, the attachment point of the tow line is to be taken as not less than 4/5 of the tube height above the base (see **Fig. C27.~~1~~6**).

Fig. C27.~~1~~6 Acting Point of Towing Force




(4) The design load is to be applied to fittings in all directions that may occur ~~by taking into account~~ in consideration of the arrangements shown in the towing and mooring arrangements plan specified in **27.2.~~6~~9**.

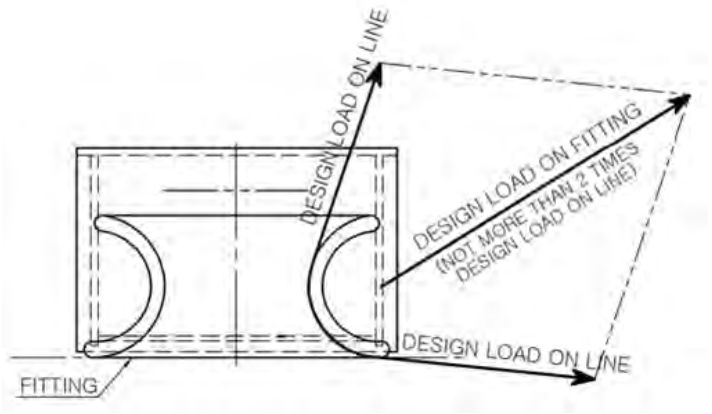
(~~6~~5) Where the tow line is ~~takes a turn at~~ a paid-out through a fitting, the design load is to be equal to the resultant force of the design loads acting on the line, but need~~s~~ not exceed twice the design load on the line. The design load acting on the line is to be the minimum design load specified in **(1)** and **(2)** (see **Fig. C27.~~2~~7**).

~~(7) Notwithstanding the requirements in (1) to (6), when a safe towing load (*TOW*) greater than that determined according to -5 is requested by the applicant, the design load is to be increased~~

~~in accordance with the appropriate *TOW*/design load relationship given by -3 and -5.~~

(6) The strength of supporting hull structures is to be evaluated based on net scantling calculation.

Fig. C27.~~2~~7 Design Load




**~~4~~5** Allowable Stresses

Allowable stresses of supporting hull structures are not to be more than the following:

(1) For strength assessments using beam theory or grillage analysis:
  (a) Normal stress: 100 % of the specified minimum yield ~~point~~ stress of the material
  (b) Shearing stress: 60 % of the specified minimum yield ~~point~~ stress of the material

(2) For strength assessments using finite element analysis:
  (a) ~~Equivalent~~Von Mises stress: 100 % of the specified minimum yield ~~point~~ stress of the material

(3) The normal stress referred to in **(1)** above is the sum of bending stress and axial stress with the corresponding shearing stress acting perpendicular to the normal stress. No stress concentration factors are to be considered.

(4) The followings are recommended to be followed for the strength assessment by means of finite element analysis referred to in **(2) above**.
  (a) The geometry is to be idealized as realistically as possible.
  (b) The ratio of element length to width is not to exceed 3.
  (c) Girders are to be modelled using shell or plane stress elements.
  (d) Symmetric girder flanges may be modelled by beam or truss elements.
  (e) The element height of girder webs is not to exceed one-third of the web height.
  (f) In way of small openings in girder webs the web thickness is to be reduced to a mean thickness over the web height.
  (g) Large openings are to be modelled
  (h) Stiffeners may be modelled by using shell, plane stress, or beam elements.
  (i) Stresses are to be read from the centre of the individual element.
  (j) For shell elements the stresses are to be evaluated at the mid-plane of the element.

**~~5~~6** Safe Towing Load (*TOW*)

(1) For towing fittings used for the normal towing operations ~~specified in 27.2.1-1(1)~~, *TOW* is not to exceed 80 % of the minimum design load specified in ~~-3~~**4(1)(a)**.

(2) For towing fittings used for the other towing operations ~~specified in 27.2.1-1(2)~~, *TOW* is not to exceed 80 % of the minimum design load specified in ~~-3~~**4(~~2~~1)(b)**.

(3) For towing fittings used for both normal and other towing operations, *TOW* is to be the greater of ~~the minimum design loads~~ *TOW* according to **(1)** and **(2)**

~~(4) For fittings intended to be used for both towing and mooring, *SWL* according to 27.2.3-5 is to be marked in addition to *TOW*.~~

(~~5~~4) The *TOW* (in *tonnes*) of each fitting is to be marked by weld beads and paint, or the equivalent, on the fitting.

(5) The towing and mooring arrangements plan specified in **27.2.9** is to define the method of use of tow lines.

Paragraph 27.2.4 has been added as follows.

**27.2.4 Ship Design Minimum Breaking load ($MBL_{sd}$)**

**1** $MBL_{sd}$ is the design load for the selection of mooring lines, mooring fittings and for the design of supporting hull structures.

**2** $MBL_{sd}$ is to be at least not less than minimum breaking load (*MBL*) specified in **27.2.5**. Where the minimum breaking load (*MBL*) is adjusted based on the acceptable wind speed, the number of mooring lines, etc., $MBL_{sd}$ is to be not less than the value *MBL** or *MBL***. $MBL_{sd}$ may be determined in accordance with the method deemed appropriate by the Society.

**3** Where the $MBL_{sd}$ is determined by the widely recognized industry standards or the owner's standard, $MBL_{sd}$ is to be not less than the minimum breaking load (*MBL*) specified in this section.

Paragraph 27.2.5 has been added as follows.

**27.2.5 Mooring Lines**

**1** General

(1) Ships are to be provided with mooring lines of which *LDBF* is more than $MBL_{sd}$.

(2) Wire ropes or synthetic ropes used as mooring lines are to comply with the requirements in **Chapter 4 and Chapter 5, Part L of the Rules**, respectively.

(3) Fibre ropes used for mooring lines are to be not less than 20 *mm* in diameter. For considering rope age degradation and wear, the line design break force for such ropes is to be in accordance with the following **(a)** or **(b)**. However, neither **(a)** nor **(b)** need to be complied with in cases where consideration of rope age degradation and wear is included in the method specified in **27.2.4-3.**

(a) Polyamide ropes: $LDBF \geq 120$ % of $MBL_{sd}$

(b) Other synthetic ropes: $LDBF \geq 110$ % of $MBL_{sd}$

(4) For mooring lines connected with powered winches where the rope is stored on the drum, steel cord wire ropes of suitable flexible construction may be used instead of fibre cord wire ropes subject to the approval by the Society.

(5) The length of individual mooring lines may be reduced by up to 7 % of the lengths required in this section, provided that the actual total length of the stipulated number of mooring lines is not less than the required total length.

**2** The minimum breaking load (*MBL*), the number, the length of mooring lines for ships with equipment numbers of 2,000 or less ($EN \leq 2{,}000$) are to be in accordance with the following **(1)** and **(2).**

(1) The minimum breaking load (*MBL*), the number and the length of mooring lines are to be in accordance with **Table C27.2** according to the equipment number. However, when calculating the equipment number, the effect of deck cargoes at the ship nominal capacity condition is to be considered with respect to the side-projected area *A*.

(2) For ships having the ratio *A to EN* greater than 0.9 ($A/EN > 0.9$), the following number of ropes is to be added to the number required by **Table C27.2** for mooring lines.

Where *A/EN* is greater than 0.9 but 1.1 or less: 1

Where *A/EN* is greater than 1.1 but 1.2 or less: 2

Where *A/EN* is greater than 1.2: 3

**3** The minimum breaking load and the number of mooring lines for ships with an equipment

number greater than 2,000 (EN > 2,000) are to be based on the side-projected area $A_1$. The side-projected area $A_1$ is to be calculated similar to the side-projected area $A$ according to **27.1.2** but in consideration of the following conditions:

(1) The lightest ballast draft is to be considered for the calculation of the side-projected area $A_1$. For ship types having small variation in the draft (e.g. passenger ships, RO-RO ships), the side-projected area $A_1$ may be calculated using the designed maximum load line.

(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* over waterline may be assumed; in other words, 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) For ships that in which cargoes are loaded on deck, the side-projected are $A_1$ is to be the following **(a)** or **(b)**, whichever is the greater.

(a) Side-projected area at the lightest ballast condition.

(b) Side-projected area at the ship nominal capacity condition with cargoes loaded on deck. In such cases, the draft is to be the designed maximum load line.

**4** The mooring lines for ships with an equipment number greater than 2,000 (EN > 2,000) are based on the following environmental conditions:

(1) Maximum current speed: 1.0 *m/s*

(2) Maximum wind speed $v_w$ (*m/s)* as follows.

(a) $v_w = 25.0 - 0.002(A_1 - 2000)$ (*m/s*) for passenger ships, ferries, and car carriers with 2,000 $m^2 < A_1 \leq 4{,}000\ m^2$

(b) $v_w = 21.0$ (*m/s*) for passenger ships, ferries, and car carriers with 4,000 $m^2 > A_1$

(c) $v_w = 25.0$ (*m/s*) for other ships

**5** Minimum breaking load (*MBL*) for ships with an equipment number greater than 2,000 (EN > 2,000) is to be in accordance with the following **(1)** to **(4)**.

(1) Minimum breaking load (*MBL*) is to be taken as follows:

$$MBL = 0.1A_1 + 350\ (kN)$$

$A_1$: Ship side-projected area specified in **3**.

(2) Where the minimum breaking load (*MBL*) exceeds 1,275 *kN*, the maximum wind speed $v_w$ may be decreased in conjunction with an adjustment to the strength of the lines as the acceptable wind speed $v_w^*$ using the following formula but is not to be less than 21 *m/s*:

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

$MBL^*$: The adjusted minimum breaking load of mooring lines (*kN*)

(3) In case that the maximum wind speed is raised up considering the ship's navigation area, the maximum wind speed may be increased in conjunction with an adjustment to the strength of lines (*MBL*). For the calculation of the acceptable wind speed, the formula specified in **(2)** above may be used.

(4) Head lines, stern lines, breast lines or spring lines in the same service are to be of the same characteristics in terms of strength and elasticity. The strength of spring lines is to be the same as that of the head, stern and breast lines.

**6** The number of mooring lines for ships with an equipment number greater than 2,000 (EN > 2,000) is to be in accordance with the following **(1)** to **(4)**.

(1) The total number of head, stern and breast lines is to be obtained from the following formula and rounded to the nearest whole number:

(a) for oil tankers, chemical tankers, bulk carriers and ore carriers

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

(b) for others

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

(2) Notwithstanding the requirement in **(1)**, 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, $MBL^{**}$, is to be taken as follows:

$MBL^{**} = 1.2MBL \cdot n/n^{**} \leq MBL$(*kN*) for an increased number of lines

$MBL^{**} = MBL \cdot n/n^{**}$(*kN*) for a reduced number of lines

$n^{**}$: The increased or decreased total number of head, stern and breast lines

*n*: The number of lines for the considered ship type as calculated by the formulae specified in **(1)** without rounding.

*MBL* : *MBL* specified in **5.(1)** or *MBL****** specified in **5.(2)**

(3) The total number of spring lines is to be taken as not less than the following:

Two lines when the equipment number is less than 5,000 (EN < 5,000)

Four lines when the equipment number is 5,000 or greater (EN ≥ 5,000)

(4) Where 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 number of spring lines is to be taken as follows but rounded up to the nearest even number.

$$n_s^* = MBL \ / MBL^{**} \cdot n_s$$

$n_S$: The number of lines specified in **(3)**

$n_S^*$: The increased or decreased total number of head, stern and breast lines.

*MBL* : *MBL* specified in **5(1)** or *MBL****** specified in **5(2)**

**7** The strength of head, stern and breast lines may be increased in conjunction with an adjustment to the number of lines using the formula specified in **6(2)**.

**8** The length of mooring lines for ships with an equipment number greater than 2,000 (EN > 2,000) is to be taken as not less than 200 *m*.

Paragraph 27.2.3 has been renumbered to Paragraph 27.2.6, and has been amended as follows.

**27.2.~~3~~6 Mooring Fittings***

**1** Strength

The strength of shipboard fittings used for towing operations at the bow, sides and stern as well as their supporting hull structures are to comply with the requirements of **27.2.6**. For fittings intended to be used for both towing and mooring, the requirements of **27.2.3** are to be applied.

**~~1~~2** Arrangement

(1) Mooring fittings, mooring winches and capstans are to be located on stiffeners, girders, or both which are parts of the deck construction so as to facilitate efficient distribution of the mooring load.

(2) When mooring fittings, mooring winches and capstans cannot be located as specified in **(1),** appropriate reinforced members are to be provided directly underneath ~~them~~ the towing fittings.

**~~2~~3** Selection

(1) Mooring fittings are to be selected from industry standards deemed appropriate by the Society and are to be at least based on ~~the minimum breaking strength of mooring line according to 27.1.5.~~$MBL_{sd}$

(2) When mooring fittings are not selected from industry standards deemed appropriate by the Society, the strength of the fitting and of its attachment to the ship are to be in accordance with ~~3~~**4** and ~~4~~**5** For strength assessments, beam theory or finite element analysis using net scantlings is to be applied as appropriate. At the discretion of the Society, load tests may be

accepted as alternatives to strength assessments by calculations.

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

**~~3~~4** ~~Design Load~~Supporting Hull Structure

(1) Design load for supporting hull structures ~~of mooring fittings~~ are to be as specified in **(~~1~~a)** to **(~~7~~c)** below:

(~~1~~a) For supporting hull structures of mooring fittings, ~~T~~the minimum design load is to be 1.15 *times* ~~the breaking strength of the mooring line according to **27.1.5.**~~ $MBL_{sd.}$

(b) For supporting hull structures of mooring winches, the minimum design load is to be 1.25 *times* the intended maximum brake holding load, where the maximum brake holding load is to be assumed to be not less than 80 % of $MBL_{sd.}$

(c) For supporting hull structures of capstans, the minimum design load is to be 1.25 *times* the maximum hauling-in force.

(2) The design load is to be applied to fittings in all directions that may occur ~~by taking into account~~ inconsideration of the arrangements shown in the towing and mooring arrangements plan specified in **27.2.~~6~~9**.

(3) The point where the mooring force acts on mooring fittings is to be taken as the attachment point of the mooring line. For bollards and bitts, the attachment point of the mooring line is to be taken as not less than 4/5 of the tube height above the base. (See **Fig. C27.~~3~~8(a)**) If fins are fitted to the bollard tubes to keep mooring lines as low as possible, the attachment point of the mooring line may be taken as the location of the fins. (See **Fig. C27.~~3~~8(b)**)

(4) Where the mooring line ~~takes a turn at~~ is paid-out through a fitting, the design load is to be equal to the resultant force of design load acting on the line but need~~s~~ not exceed twice the design load acting on the line. The design load acting on the line is to be the minimum design load specified in **(1)**.

~~(5) Notwithstanding the requirements in **(1)** to **(4)**, when a safe working load (*SWL*), greater than that determined according to **-5** is requested by the applicant, the design load is to be increased in accordance with the appropriate *SWL*/design load relationship given by **-3** and **-5.**~~

~~(6) The minimum design load applied to supporting hull structures for mooring 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 **27.1.5.**~~

~~(7) The minimum design load applied to supporting hull structures for capstans is to be 1.25 times the intended maximum hauling-in force.~~

(5) 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, and the proper alignment of the fittings and their supporting hull structures is to be ensured. (See **Fig. C27.5** for a sample arrangement.)

**~~4~~5** Allowable Stresses

Allowable stresses of supporting hull structures are ~~not~~ to be ~~more than the following:~~in accordance with **27.2.3-5**.

~~(1) For strength assessments using beam theory or grillage analysis:~~

~~(a) Normal stress: 100% of the specified minimum yield point of the material~~

~~(b) Shearing stress: 60% of the specified minimum yield point of the material~~

~~(2) For strength assessments using finite element analysis:~~

~~(a) Equivalent stress: 100% of the specified minimum yield point of the material~~

**~~5~~6** Safe Working Load (*SWL*)

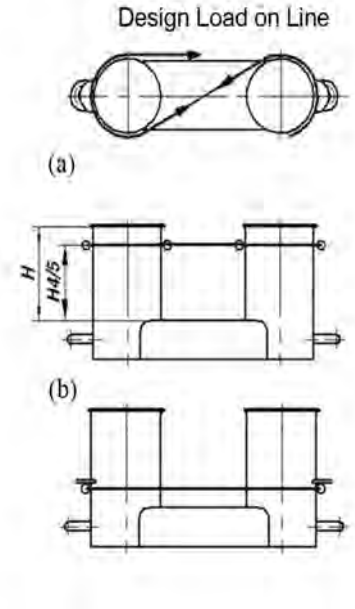
(1) ~~Unless a greater *SWL* is requested by the applicant according to **-3(5),** *SWL*~~ is not to exceed

~~the minimum breaking strength of the mooring line according to **27.1.5**~~*MBL*sd.

(2) The *SWL* (in *tonnes*) of each fitting, excluding mooring winches and capstan, is to be marked by weld beads and paint, or the equivalent, on the fitting. For fittings intended to be used for both towing and mooring, the *TOW* according to **27.2.~~2~~ ~~5~~3** is to be marked in addition to *SWL*.

(3) The towing and mooring arrangements plan specified in **27.2.9** is to define the method of use for mooring lines.

Fig. C27.~~3~~8 Acting Point of Mooring Force




Paragraph 27.2.4 has been renumbered to Paragraph 27.2.7, and has been amended as follows.

**27.2.~~4~~7 Corrosion Additions**

Corrosion additions are to be added to the scantlings of the supporting hull structures ~~specified in **27.2.1-6**~~ and shipboard fittings ~~specified in **27.2.1-4**~~ as ~~follows:~~ following **(1)** to **(3).** However, if the shipboard fittings are selected from industry standards deemed appropriate by the Society and the corrosion additions are considered in the standard, following **(1)** to **(3)** may not be applied.

(1) Supporting hull structures: ~~According to other rules for the surrounding structures~~ total of 2.0 *mm*. (For container carriers, the corrosion additions specified in **32.1.3** may be applied to the supporting hull structures for which scantlings are determined by the net scantling method.)

(2) Pedestals and foundations fitted on decks which are not ~~a part of a~~ shipboard fittings selected ~~according to an~~ from industry standards deemed appropriate by the Society: total of 2.0 *mm*

(3) Shipboard fittings not selected from industry standards deemed appropriate by the Society: total of 2.0 *mm*

Paragraph 27.2.5 has been amended to Paragraph 27.2.8, and has been amended as follows.

**27.2.~~5~~8 Wear Allowances**

In addition to the corrosion additions referred to in **27.2.~~4~~7**, the wear allowances for shipboard fittings not selected industry standards deemed appropriate by the Society are not to be less than 1.0 *mm*, added to surfaces which are intended to regularly contact the line.

Paragraph 27.2.6 has been renumbered to Paragraph 27.2.9, and has been amended as follows.

**27.2.~~6~~9 Towing and Mooring ~~Fitting~~ 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 Master. If not otherwise chosen, *TOW* is to be the load limit for a tow line attached with an eye~~s~~ splice.

**2** Information provided on the plan is to include the following.

(1) Industry standard and referenced number of each towing and mooring fittings.

(2) For each towing and mooring fitting, the location on the ship, the purpose (mooring, normal towing, other towing, etc.), the *SWL* and/or *TOW* ~~and~~ as well as the manner of applying towing or mooring line loads including limiting fleet angles.

(3) An arrangement of mooring lines showing the number of lines. (~~Refer to~~See **Fig. C27.4**)

(4) ~~The minimum breaking load of each mooring line~~The Ship Design Breaking Load ($MBL_{sd}$).

(5) The acceptable environmental conditions ~~as given in **27.1.5**, for the minimum breaking strength of mooring lines~~ for ships with equipment numbers greater than 2,000 (EN > 2,000);

(a) Maximum wind speed or acceptable wind speed,

(b) Maximum current speed.

(6) Condition of use for additional mooring equipment not covered by this chapter.

(~~6~~7) Other information or notes related to the design of shipboard fittings or lines.

Notes of Table C27.1 has been amended as follows.

Table C27.1 Anchors, Chain Cables and Ropes
(Table is omitted.)

Notes:

1 Length of chain cables may include shackles for connection.

2 Tow line is not a condition of Classification, but is listed in this table only for guidance. (ref. **27.~~1.6~~2.2**)

~~3 Values given for anchoring equipment in this table are based on an assumed maximum current speed of 2.5 *m/s*, a maximum wind speed of 25 *m/s* and a minimum scope of chain cable of 6, the scope being the ratio between the paid-out length of the chain and water depth. However, for ships with a ship length $L_2$, as defined in **27.1.2-1**, greater than 135 *m*, alternatively the required anchoring equipment may be considered applicable to a maximum current speed of 1.54 *m/s*, a maximum wind speed of 11 *m/s* and waves with maximum significant height of 2 *m*.~~

# Part CS HULL CONSTRUCTION AND EQUIPMENT OF SMALL SHIPS

## Chapter 23 EQUIPMENT

Title of Section 23.1 has been amended as follows.

### 23.1 Anchors~~,~~ and Chain Cables ~~and Ropes~~

Paragraph 23.1.1 has been amended as follows.

#### 23.1.1 General

**1** All ships~~, according to their equipment numbers,~~ are to be provided with anchors~~,~~ and chain cables~~, ropes, etc.~~ which are not less than that given in **Table CS23.1**~~, and Table CS23.2 or 23.1.5~~ according to their equipment number. All ships are to be provided with suitable appliances for handling anchors and ropes.

**2** Anchors, chain cables, ropes, etc. for ships with having equipment numbers ~~not more than~~ of 50 or ~~more than 1670~~ less (EN≤50) are to be determined by the Society.

**3** ~~Two of t~~The anchors given in **Table CS23.1** are to be connected to their cables and be positioned on board ready for use.

**4** Anchors~~,~~ and chain cables~~, wire ropes and fibre ropes~~ are to ~~be in~~ compli~~ance~~y with the requirements in **Chapter 2** as well as **3.1** ~~of~~in **Chapter 3~~, Chapter 4 and 5~~, Part L of the Rules.**

**5** The anchoring equipment subject to the requirements specified in this chapter is based on the following conditions of intended use. The Society may, however, require special consideration be given to anchoring equipment intended for use in deep and unsheltered waters.

(1) The anchoring equipment required herewith is intended for temporary mooring of a ship within a harbour or sheltered area when the ship is awaiting berth, tide, etc. The equipment is, therefore, not designed to hold a ship off fully exposed coasts in rough weather or to stop a ship which is moving or drifting.

(2) The anchoring equipment required herewith is designed to hold a ship in good holding ground conditions so as to avoid dragging of the anchor. In poor holding ground conditions, the holding power of the anchors is significantly reduced.

(3) Anchoring equipment is used under the environmental condition that an assumed maximum current speed of 2.5 *m/s*, a maximum wind speed of 25 *m/s* and a minimum scope of chain cable of 6, the scope being the ratio between the paid-out length of the chain and water depth.

(4) It is assumed that under normal circumstances a ship uses only one bow anchor and chain cable at a time.

**6** Sheltered waters are generally calm stretches of water (e.g. harbours, estuaries, roadsteads, bays, lagoons) where the wind force does not exceed 6 on the Beaufort scale.

Paragraph 23.1.2 has been amended as follows.

#### 23.1.2 Equipment Numbers*

~~**1** Equipment number is the value obtained from the following formula:~~

~~$W^{\frac{2}{3}} + 2.0hB + 0.1A$~~

~~Where:~~

~~$W$: Full load displacement ($t$)~~

~~$h$ and $A$: Values specified in the following (1), (2) and (3)~~

~~(1) $h$ is the value obtained from the following formula :~~

~~$f + h'$~~

~~$f$ : Vertical distance ($m$), at the midship, from the designed maximum load line to the top of the uppermost continuous deck beam at side~~

~~$h'$: Height ($m$) from the uppermost continuous deck to the top of uppermost superstructures or deckhouses having a breadth greater than $B$/4.~~

~~In the calculation of $h'$, sheer and trim may be ignored. Where a deckhouse having a breadth greater than $B$/4 is located above a deckhouse with a breadth of $B$/4 or less, the narrow deckhouse may be ignored.~~

~~(2) $A$ is the value obtained from the following formula:~~

~~$f L_2 + \Sigma h'' l$~~

~~$f$ : Value specified in (1)~~

~~$L_2$: Length ($m$) of ship specified in 2.1.2, Part A or 0.97 times the length of ship on the designed maximum load line, whichever is smaller. The fore end of $L_2$ is the perpendicular to the designed maximum load draught at the forward side of the stem, and the aft end of $L_2$ is the perpendicular to the designed maximum load draught at a distance $L_2$ aft of the fore end of $L_2$.~~

~~$\Sigma h'' l$ : Sum of the products of the height $h''$ ($m$) and length $l$ ($m$) of superstructures, deckhouses or trunks which are located above the uppermost continuous deck within $L_2$ and also have a breadth greater than $B$/4 and a height greater than 1.5 $m$~~

~~(3) In the application of (1) and (2), screens and bulwarks more than 1.5 $m$ in height are to be regarded as parts of superstructures or deckhouses.~~

**1** The equipment number (EN) is the value obtained from the following formula:

$$W^{\frac{2}{3}} + 2.0(hB + S_{fun}) + 0.1A$$

$W$: Full load displacement ($t$)

$B$: Breadth of ship ($m$) (See **2.1.4, Part A of the Rules**)

$h$: Effective height ($m$) defined as follows: $h = a + \sum h_i$

$a$: Vertical distance ($m$), at the midship, from the designed maximum load line to the top of the uppermost continuous deck beam at side

$h_i$: Height ($m$) at the centreline of each tier of deckhouses having a breadth greater than $B$/4; for the lowest tier $h_1$ is to be measured at the centreline from the upper deck or from the notional deck line where there is local discontinuity in the upper deck (See **Fig. CS23.1**)

$S_{fun}$: Effective front projected area of the funnel ($m^2$) defined as follows: $S_{fun} = A_{FS} - S_{shield}$

$A_{FS}$: Front projected area of the funnel ($m^2$) calculated between the upper deck at the centreline (or the notional deck line where there is local discontinuity in the upper deck) and the effective height $h_F$. The value for $A_{FS}$ is to be taken as zero if the funnel breadth is $B$/4 or less at all elevations along the funnel's height.

$h_F$: Effective height of the funnel ($m$) measured from the upper deck at the centreline (or the notional deck line where there is local discontinuity in the upper deck) and the top of the funnel. The top of the funnel may be taken at the level where the funnel breadth reaches $B$/4.

$S_{shield}$: Section of front projected area $A_{FS}$ ($m^2$) which is shielded by all deckhouses having breadth greater than $B$/4 . To determine $S_{shield}$, the deckhouse breadth is assumed $B$ for all deckhouses having breadth greater than $B$/4. (See **Fig. CS23.2**)

$A$: Side projected area ($m^2$) of the hull, superstructures, deckhouses and funnels above the designed maximum load line which are within the length of the ship $L_2$ and also have a breadth greater than $B$/4. The side projected area of the funnel is to be considered in $A$

when $A_{FS}$ is greater than zero. In such cases, the side projected area of the funnel is to be calculated between the upper deck at the centreline (or the notional deck line where there is local discontinuity in the upper deck) and the effective height $h_F$.

$L_2$: Length (*m*) of ship specified in **2.1.2, Part A of the Rules** or 0.97 *times* the length of ship on the designed maximum load line, whichever is smaller. The fore end of $L_2$ is the perpendicular to the designed maximum load draught at the forward side of the stem, and the aft end of $L_2$ is the perpendicular to the designed maximum load draught at a distance $L_2$ aft of the fore end of $L_2$.

Fig. CS23.1 Effective Height

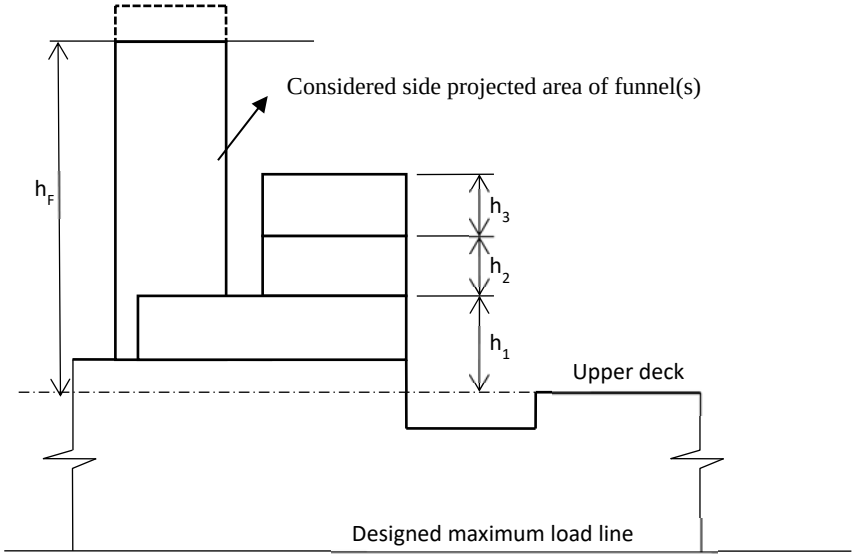
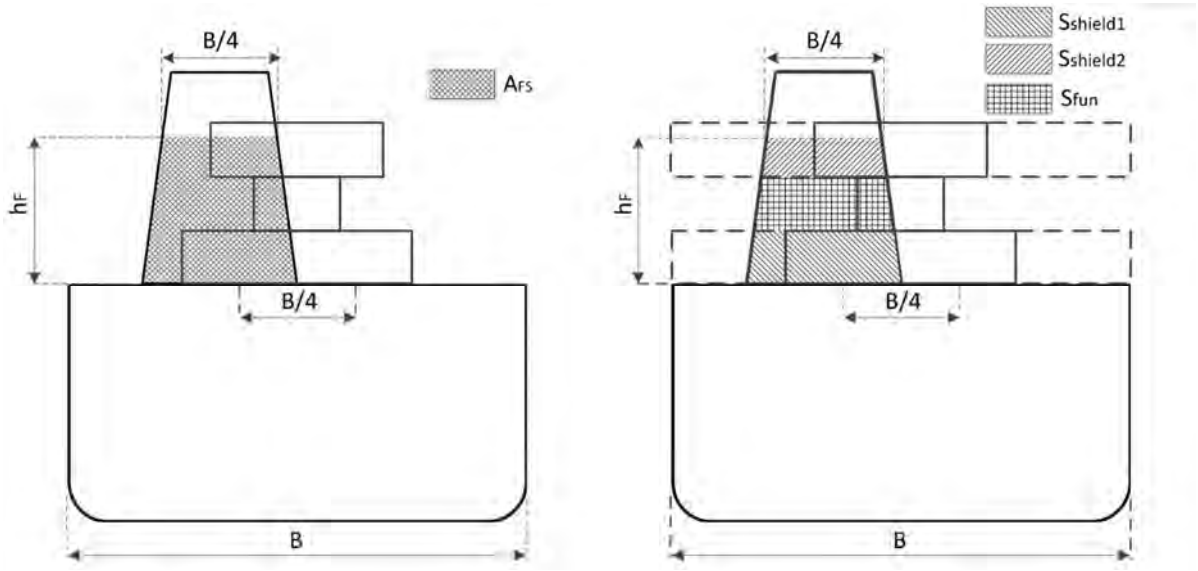


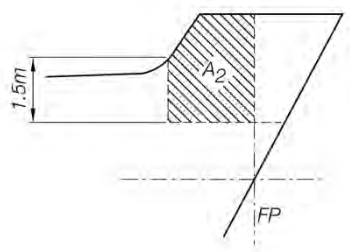

Fig. CS23.2 Front Projected Area of Funnel




**2** Screens or bulwarks 1.5 *m* or more in height are to be regarded as parts of deckhouses 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 $A_2$ in **Fig. CS23.3** is to be included in $A$.

Fig. CS23.3 Effective Area for Screens, Bulwarks, etc.




**3** When several funnels are fitted on the ship, the above parameters are to be taken as follows:

$h_F$: Effective height of the funnel ($m$) measured from the upper deck at the centreline (or the notional deck line where there is local discontinuity in the upper deck) and the top of the highest funnel. The top of the highest funnel may be taken at the level where the sum of each funnel breadth reaches $B/4$.

$A_{FS}$: Sum of the front projected area of each funnel ($m^2$) calculated between the upper deck at the centerline (or the notional deck line where there is local discontinuity in the upper deck) and the effective height $h_F$. The value for $A_{FS}$ is to be taken as zero if the sum of each funnel breadth is $B/4$ or less at all elevations along the funnel's height.

$A$: Side projected area ($m^2$) of the hull, superstructures, deckhouses and funnels above the designed maximum load line which are within the length of the ship $L_2$. The total side projected area of the funnel is to be considered in the side projected area of the ship ($A$) when $A_{FS}$ is greater than zero. The shielding effect of funnels in transverse direction may be considered in the total side projected area (i.e. when the side projected areas of two or more funnels fully or partially overlap), the overlapped area needs only to be counted once.

**~~2~~4** Notwithstanding **1**, ~~for tugs,~~ the equipment number for tugs is to be obtained from the following formula:

$$W^{\frac{2}{3}} + 2.0(\not{f}aB + \sum \not{h}\not{b}h_i b_i) + 0.1A$$

$W$, $a$, $h_i$ and $A$: As specified in **1** above

~~$\sum h'' b$: Sum of the products of the height $h''$ ($m$) and the breadth $b$($m$) of each superstructure and deckhouse which have a breadth greater than $B/4$ and are located above the uppermost continuous deck~~

$b_i$: Breadth ($m$) of the widest superstructure or deckhouse of each tier having a breadth greater than $B/4$

Paragraph 23.1.5 has been deleted.

~~**23.1.5 Tow Lines and Mooring Lines**~~

~~**1** As for wire ropes and fibre ropes used as tow lines and mooring lines, the breaking test load specified in **Chapter 4** or **5, Part L** is not to be less than the breaking load given in **Table CS23.1** and **Table CS23.2** or **3** respectively.~~

~~**2** The number of mooring lines for ships whose equipment numbers do not exceed 2,000 is to be in accordance with **Table CS23.2.** However, for ships having the ratio $A/EN$ above 0.9, the following number of ropes should be added to the number required by **Table CS23.2** for mooring lines.~~

~~Where $A/EN$ is above 0.9 up to 1.1: **1**~~

Where $A/EN$ is above 1.1 up to 1.2: 2

Where $A/EN$ is above 1.2: 3

$EN$: Equipment number

$A$: Value specified in 23.1.2-1(2)

**3** The number and strength of mooring lines for ships whose equipment numbers exceed 2,000 are to be in accordance with the followings (1) to (4).

(1) Minimum breaking strength ($MBL$) is not to be less than that obtained from the following formula:

$MBL = 0.1A_1 + 350$ (kN)

$A_1$: Ship side projected area specified in 5.

(2) Head lines, stern lines, breast lines or spring lines in the same service are to be of the same characteristics in terms of strength and elasticity. The strength of spring lines is to be the same as that of the head, stern and breast lines.

(3) The total number of head, stern and breast lines is to be obtained from the following formula and rounded to the nearest whole number:

(a) for oil tankers, chemical tankers, bulk carriers and ore carriers

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

(b) for others

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

(4) The total number of spring lines is to be taken as not less than:

Two lines when the equipment number < 5,000

Four lines where the equipment number ≧ 5,000

**4** Notwithstanding the requirement in 3, 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, $MBL^*$, is to be taken as:

$MBL^* = 1.2MBL \cdot n/n^* \leq MBL$ (kN) for an increased number of lines

$MBL^* = MBL \cdot n/n^*$ (kN) for a reduced number of lines

$n^*$: The increased or decreased total number of head, stern and breast lines

$n$: The number of lines for the considered ship type as calculated by the formulae specified in 3(3) without rounding.

In the same manner, the strength of head, stern and breast lines may be increased or decreased in conjunction with an adjustment to the number of 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 is to be likewise increased, but rounded up to the nearest even number.

**5** The ship side-projected area $A_1$ is to be obtained from the same formula specified in 23.1.2-1(2). However, following (1) to (4) are to be considered.

(1) For oil tankers, chemical tankers, bulk carriers and ore carriers, the lightest ballast draft is to be considered for the calculation of the side-projected area $A_1$. For other ships, the lightest draft of usual loading conditions is to be considered if the ratio of the freeboard in the lightest draft and the full load condition is equal to or above two.

(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 $m$ over waterline may be assumed; in other word, 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 cargo is to 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 is to be chosen as side-projected area $A_1$.

~~(4) Usual loading conditions mean loading conditions as given by the trim and stability booklet that are to be expected to regularly occur during operation and, in particular, excluding light weight conditions, propeller inspection conditions, etc.~~

~~**6** The mooring lines specified in -**3** and -**4** are based on the following environmental conditions:~~

~~(1) Maximum current speed: 1.0 *m/s*~~

~~(2) Maximum wind speed $v_w$ in *m/s* as followins.~~

~~(a) $v_w = 25.0 - 0.002(A_L - 2000)$ (*m/s*) for passenger ships, ferries, and car carriers with 2,000 $m^2 < A_L \leqq 4{,}000\ m^2$~~

~~(b) $v_w = 21.0$ (*m/s*) for passenger ships, ferries, and car carriers with 4,000 $m^2 > A_L$~~

~~(c) $v_w = 25.0$ (*m/s*) for other ships~~

~~**7** Among the environmental conditions specified in -**6**, the maximum wind speed $v_w$ may be increased and decreased in conjunction with an adjustment to the strength of the lines as the acceptable wind speed $v_w^*$. In this case, the acceptable wind speed $v_w^*$ is to be obtained from the following formula:~~

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

~~*MBL**: The adjusted strength of mooring lines (*kN*)~~

~~However, the maximum wind speed $v_w$ can be decreased where maximum breaking strength, *MBL*, specified in -**3(1)** is more than 1,275 *kN*. The acceptable wind speed $v_w^*$ is to be not less than 21 *m/s*.~~

~~**8** The length of mooring lines for ships whose equipment numbers are less than or equal to 2,000 is to be in accordance with **Table CS23.2**. For ships whose equipment numbers exceed 2,000, the length of mooring lines is to be taken as 200 *m*.~~

~~**9** Application of fibre ropes for tow lines or mooring lines is to be as deemed appropriate by the Society.~~

~~**10** For mooring lines connected with powered winches where the rope is stored on the drum, steel cored wire ropes of suitable flexible construction may be used instead of fibre cored wire ropes subject to the approval by the Society.~~

~~**11** The length of individual mooring lines may be reduced by up to 7% of the lengths given in -**8**, provided that the total length of the stipulated number of mooring lines is not less than that obtained from multiplying the length by the number given in -**2** to -**4**.~~

Paragraph 23.1.6 has been renumbered to Paragraph 23.1.5, and has been amended as follows.

**23.1.6~~6~~5 Chain Lockers**

**1** Chain lockers are to be of capacities and depths adequate to provide an easy direct lead of the cables through the chain pipes and a self-stowing of the cables.

**2** Chain lockers including spurling pipes are to be watertight up to the weather deck and to be provided with a means for drainage.

**3** Chain lockers are to be subdivided by centre~~-~~line screen walls.

**4** Where a means of access is provided, it is to be closed by a substantial cover and secured by closely spaced bolts.

**5** Where a means of access to spurling pipes or cable lockers is located below the weather deck, the access cover and its securing arrangements are to be to the satisfaction of the Society. Butterfly nuts and/or hinged bolts are prohibited as the securing mechanism for the access cover.

**6** Spurling pipes through which anchor cables are led are to be provided with permanently attached closing appliances to minimize water ingress.

**7** The inboard ends of the chain cables are to be secured to the structures by fasteners able to

withstand a force not less than 15 % ~~and~~ but not more than 30 % of the breaking load of the chain cable.

**8** Fasteners are to be provided with a means suitable to permit, in case of emergency, an easy slipping of chain cables to the sea, operable from an accessible position outside the chain locker.

Paragraph 23.1.7 has been renumbered to Paragraph 23.1.6, and has been amended as follows.

**23.1.~~7~~6 Supporting Hull Structures of Anchor Windlasses and Chain Stoppers**

**1** The supporting hull structures of anchor windlasses and chain stoppers are to be sufficient to accommodate operating loads and sea loads

(1) Operating loads are to be taken as not less than the following:
   (a) For chain stoppers, 80 % of the chain cable breaking load
   (b) For windlasses, where no chain stopper is fitted or a chain stopper is attached to the windlass, 80 % of the chain cable breaking load
   (c) For windlasses, where chain stoppers are fitted but not attached to the windlass, 45 % of the chain cable breaking load

(2) Sea loads are to be taken according to **2.1.6, Section 4, Chapter 11, Part 1 of Part CSR-B&T of the Rules**

**2** The permissible stresses for supporting hull structures of windlasses and chain stoppers~~, based on gross thicknesses,~~ are not to be greater than the following permissible values:

~~(1) Normal stress: 1.00 $R_{eH}$~~

~~(2) Shear stress: 0.60 $R_{eH}$~~

~~$R_{eH}$: The specified minimum yield stress of the material~~

(1) For strength assessment by means of beam theory or grillage analysis
   (a) Normal stress: 1.00 $R_{eH}$
   (b) Shear stress: 0.60 $R_{eH}$

   $R_{eH}$: The specified minimum yield stress of the material

(2) For strength assessment by means of finite element analysis
   (a) Von Mises stress: 1.00 $R_{eH}$

(3) The normal stress referred to in **(1)** above is the sum of bending stress and axial stress with the corresponding shearing stress acting perpendicular to the normal stress. No stress concentration factors are to be considered.

**3** For strength assessments of supporting hull structures, beam theory or finite element analysis using net scantlings is to be applied as appropriate. Where finite element analysis is used, the provisions of **23.2.3-5** are to be applied. In addition, the total corrosion addition is to be 2.0 *mm*.

Section 23.2 has been amended as follows.

## 23.2 Towing and Mooring Fittings

### 23.2.1 General

**1** The requirements in **23.2** apply to ships of not less than 500 *gross tonnage*. The requirements in **23.2** apply to shipboard fittings used for towing and mooring operations associated with the normal operation of the ship~~,~~ as well as ~~and~~their supporting hull structures. ~~With respect to this requirement, towing is limited to the following:~~

~~(1) Normal towing: towing operations necessary for manoeuvring in ports and sheltered waters associated with the normal operation of the ship~~

~~(2) Other towing: emergency towing by another ship or a tug.~~

~~**2** Ships are to be adequately provided with shipboard fittings.~~
~~**3** Shipboard fittings are to comply with the requirements of **23.2.2** and **23.2.3** respectively.~~
~~**4** When shipboard fittings are not selected from industry standards deemed appropriate by the Society, the corrosion additions specified in **23.2.4** are to be applied to shipboard fittings and their supporting structures such as foundations.~~
~~**5** When the shipboard fitting is not selected from industry standards deemed appropriate by the Society, the wear down allowances specified in **23.2.5** are to be applied to shipboard fittings.~~
~~**6** The scantlings of supporting hull structures are to be built at least with the gross scantlings obtained by adding the corrosion addition specified in **23.2.4** to the net scantlings obtained by applying the criteria specified in this section.~~
~~**7** The scantlings of supporting hull structures are to be in accordance with the relevant chapters or sections in addition to this section.~~

**2** Ships are to be adequately provided with shipboard fittings which are selected from industry standards deemed appropriate by the Society. The "shipboard fittings" referred to in **23.2** are bollards, bitts, fairleads, stand rollers, chocks used for normal mooring of the ship and other similar components used for normal or other towing of the ship. Other components such as capstans, winches, etc. are not included. Any welds, bolts or equivalent devices connecting shipboard fittings to their supporting structures are considered to be part of the shipboard fitting if selected in accordance with industry standards deemed appropriate by the Society.

**3** The definitions of terms which appear in this section are as follows.

(1) Maximum towing load

"Maximum towing load" is the largest load that can be assumed or intended in normal towing such as static bollard pull.

(2) Safe Towing Load (*TOW*)

"Safe Towing Load" (*TOW*) is the safe load limit of shipboard fittings used for towing purpose. However, it does not represent the actual strength of shipboard fittings and their supporting hull structures.

(3) Safe Working Load (*SWL*)

"Safe Working Load" (*SWL*) is the safe load limit of shipboard fittings used for mooring purpose. However, it does not represent the actual strength of shipboard fittings and their supporting hull structures.

(4) Line Design Break Force (*LDBF*)

"Line Design Break Force" (*LDBF*) is the minimum force that a new, dry, spliced, mooring line will break at. This is the cases for all synthetic cordage materials.

(5) Ship Design Minimum Breaking Load ($MBL_{sd}$)

"Ship Design Minimum Breaking Load" ($MBL_{sd}$) is 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 services.

(6) Ships intended to be regularly moored to jetty-type piers

Ships intended to be regularly moored to jetty-type piers are oil tankers, chemical tankers or gas carriers which are assumed to be moored to jetty-type piers.

(7) Breast lines, head lines, stern lines and spring lines are defined as follows. (See **Fig. CS23.4**)

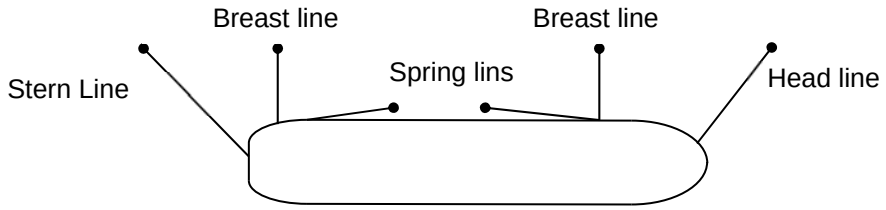
(a) Breast line: A mooring line that is deployed perpendicular to the ship, restraining the ship in the off-berth direction.

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

(c) Head/Stern line: A mooring line that is oriented between the longitudinal and transverse directions, restraining the ship in the off-berth direction as well as in either the fore or aft

direction. The amount of restraint in these directions depends on their relative line angles.

Fig. CS23.4 Sample Arrangement of Mooring Lines




(8) Wind speed for maximum wind speed $v_{w}$ and acceptable wind speed $v_{w}^{*}$
Wind speed is considered representative of a 30 *second* mean speed from any direction and at a height of 10 *m* above the ground

(9) Current speed for maximum current speed
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 currents.

(10) Ship nominal capacity condition
The ship nominal capacity condition is defined as the theoretical condition in which the maximum possible amount of deck cargoes (in their respective positions) is included in the ship arrangement. For container ships the nominal capacity condition represents the theoretical condition in which the maximum possible number of containers (in their respective positions) is included in the ship arrangement.

(11) Supporting hull structures
Supporting hull structures are the parts of the ship structure on or in which shipboard fittings are placed and which are directly subjected to the forces acting on shipboard fittings.

(12) Sheltered waters
Sheltered waters are generally calm stretches of water (e.g. harbours, estuaries, roadsteads, bays, lagoons) where the wind force does not exceed 6 on the Beaufort scale.

(13) Towing
For the application of this section, towing means the towing operations specified in the following **(a)** and **(b)** but not including **(c)**.

(a) Normal towing means towing operations necessary for manoeuvring in ports and sheltered waters associated with the normal operation of the ships

(b) Other towing means towing by another ship or a tug (e.g. such as to assist the ship in cases of emergency)

(c) Towing services not covered by this section are as follows.

i) Escort towing: A towing service for laden oil tankers or LNG carriers, particularly as required in specific estuaries. Its main purpose is to control the ship in cases of propulsion or steering system failure.

ii) Canal transit towing: A towing service for ships transiting canals (e.g. the Panama Canal).

**23.2.2 Tow Lines**

Where ships are provided with tow lines, it is advised that such two lines are to be in accordance with the following **(1)** and **(2)**.

(1) Wire ropes and fibre ropes used as tow lines are to be comply with the requirements in **Chapter 4** and **Chapter 5, Part L of the Rules**, respectively. The specifications of tow lines (e.g. breaking load, length) and the number of tow lines are to be in accordance with **Table CS23.1**

according to ship equipment numbers. However, when calculating the equipment number, the effect of deck cargoes at the ship nominal capacity condition is to be considered with respect to the side-projected area *A*.

(2) Fibre ropes used as tow lines are to be not less than 20 *mm* in diameter in consideration of rope age degradation and wear. Therefore, the line design break force for such ropes is to be in accordance with the following **(a)** or **(b)**:

(a) Polyamide ropes: *LDBF* ≥ 120 % of the minimum breaking load specified in **Table C23.1** according to equipment number.

(b) Other synthetic ropes: *LDBF* ≥ 110 % of the minimum breaking load specified in **Table C23.1** according to equipment number.

### 23.2.~~2~~3 Towing Fittings

**1** Strength

The strength of shipboard fittings used for towing operations at the bow, sides and stern as well as their supporting hull structures are to comply with the requirements of **23.2.3**. For fittings intended to be used for both towing and mooring, the requirements of **23.2.6** are to be applied.

**~~1~~2** Arrangement

(1) Towing fittings are to be located on stiffeners, girders, or both ~~which~~that are part~~s~~ 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.

(2) When towing fittings cannot be located as specified in **(1)**, appropriate reinforced members are to be provided directly underneath the towing fittings.

**~~2~~3** Selection

(1) Towing fittings are to be selected from industry standards deemed appropriate by the Society and are to be at least based on the following loads. However, the increase of the line design break force for synthetic ropes (according to **23.2.2-2)** need not be considered for the loads applied to shipboard fittings and their supporting hull structures.

(a) For normal towing operations, the intended maximum towing load. ~~(e.g., static bollard pull) as indicated on the towing and mooring arrangements plan specified in 23.2.6~~

(b) For other towing services, the minimum breaking strength of the tow line specified in **Table CS23.1** according to the equipment number ~~determined in 23.1.2~~.

(c) For fittings intended to be used for both normal and other towing operations, the greater of the loads according to **(a)** and **(b)**.

(2) When towing fittings are not selected from industry standards deemed appropriate by the Society, the strength of the fitting and of its attachment to the ship are to be in accordance with ~~3~~**4** and ~~4~~**5**. For strength assessments, beam theory or finite element analysis using net scantlings is to be applied as appropriate. At the discretion of the Society, load tests may be accepted as alternatives to strength assessments by calculations.

(3) Towing bitts (double bollards) are to be of sufficient strength to withstand the loads caused by the tow line attached with an eye splice.

**~~3~~4** ~~Design Load~~Supporting Hull Structures

(1)Design load for the supporting hull structures are to be as specified in **(~~1~~a)** to **(~~7~~c)** below:

(~~1~~a) For ~~the~~ normal towing operations ~~specified in 23.2.1-1(1), the minimum design load is to be~~ 1.25 *times* the intended maximum towing load.

(~~2~~b) For ~~the~~ other towing services ~~specified in 23.2.1-1(2), the minimum design load is to be~~ the breaking load of the tow line specified in **Table CS23.1** ~~according to the equipment number determined in 23.1.2~~.

(~~3~~c) For fittings intended to be used for both normal and other towing operations, ~~the minimum design load is to be~~ the greater of the design loads specifie~~d~~s in **(1)** and **(2)**.

(2) 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, and the proper alignment of the fittings and their supporting hull structures is to be ensured. (See **Fig. CS23.5** for a sample arrangement.)

(~~5~~3) The acting point ~~where~~ of the towing force ~~acts~~ on towing fittings is to be taken as the attachment point of ~~the~~e tow line or at a change in its direction. For bollards and bitts, the attachment point of the tow line is to be taken as not less than 4/5 of the tube height above the base. (See **Fig. CS23.~~1~~6**)

(4) The design load is to be applied to fittings in all directions that may occur ~~by~~ in consideration of the arrangements shown in the towing and mooring arrangements plan specified in **23.2.~~6~~9**.

(~~6~~5) Where the tow line ~~takes a turn at~~ is paid-out through a fitting, the design load is to be equal to the resultant force of the design loads acting on the line but need~~s~~ not exceed twice the design load acting on the line. The design load acting on the line is to be the minimum design load specified in **(1)** and **(2)**. (~~s~~See **Fig. CS23.~~2~~7**)

~~(7) Notwithstanding the requirements in **(1)** to **(6)**, when a safe towing load (*TOW*) greater than that determined according to **-5** is requested by the applicant, the design load is to be increased in accordance with the appropriate *TOW*/design load relationship given by **-3** and **-5.**~~

(6) The strength of supporting hull structures is to be evaluated based on net scantling calculation.

Fig. CS23.5 Sample Arrangement of Shipboard Fittings and Supporting Hull Structures

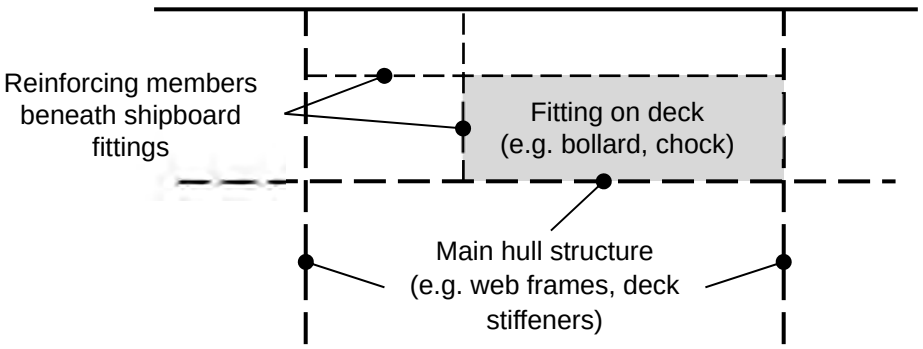



Fig. CS23.~~1~~6 Acting Point of Towing Force

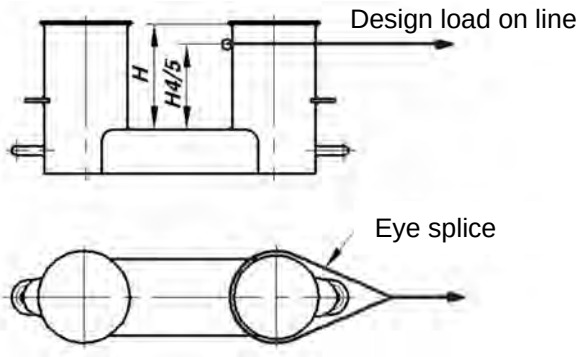
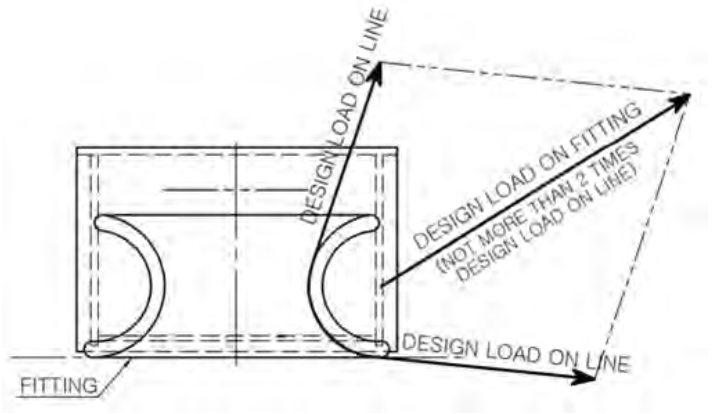


Fig. CS23.~~2~~7 Design Load




~~4~~**5** Allowable Stresses

Allowable stresses of supporting hull structures are not to be more than the following:

(1) For strength assessments using beam theory or grillage analysis:

(a) Normal stress: 100 % of the specified minimum yield ~~point~~ stress of the material

(b) Shearing stress: 60 % of the specified minimum yield ~~point~~ stress of the material

(2) For strength assessments using finite element analysis:

(a) ~~Equivalent~~Von Mises stress: 100 % of the specified minimum yield ~~point~~ stress of the material

(3) The normal stress referred to in **(1)** above is the sum of bending stress and axial stress with the corresponding shearing stress acting perpendicular to the normal stress. No stress concentration factors are to be considered.

(4) The followings are recommended to be followed for the strength assessment by means of finite element analysis referred to in **(2) above**.

(a) The geometry is to be idealized as realistically as possible.

(b) The ratio of element length to width is not to exceed 3.

(c) Girders are to be modelled using shell or plane stress elements.

(d) Symmetric girder flanges may be modelled by beam or truss elements.

(e) The element height of girder webs is not to exceed one-third of the web height.

(f) In way of small openings in girder webs the web thickness is to be reduced to a mean thickness over the web height.

(g) Large openings are to be modelled

(h) Stiffeners may be modelled by using shell, plane stress, or beam elements.

(i) Stresses are to be read from the centre of the individual element.

(j) For shell elements the stresses are to be evaluated at the mid-plane of the element.

~~5~~**6** Safe Towing Load (*TOW*)

(1) For towing fittings used for the normal towing operations ~~specified in 23.2.1-1(1)~~, *TOW* is not to exceed 80 % of the minimum design load specified in ~~-3~~**4(1)(a)**.

(2) For towing fittings used for the other towing operations ~~specified in 23.2.1-1(2)~~, *TOW* is not to exceed 80 % of the minimum design load specified in ~~-3~~**4(~~2~~1)(b)**.

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

~~(4) For fittings intended to be used for both towing and mooring, *SWL* according to 23.2.3-5 is to be marked in addition to *TOW*.~~

(~~5~~4) The *TOW* (in *tonnes*) of each fitting is to be marked by weld beads and paint, or the equivalent, on the fitting.

(5) The towing and mooring arrangements plan specified in **23.2.9** is to define the method of use

of tow lines.

**23.2.4 Ship Design Minimum Breaking load ($MBL_{sd}$)**

**1** $MBL_{sd}$ is the design load for the selection of mooring lines, mooring fittings and for the design of supporting hull structures

**2** $MBL_{sd}$ is to be at least not less than minimum breaking load (MBL) specified in **23.2.5**. Where the minimum breaking load is adjusted based on the acceptable wind speed, the number of mooring lines, etc., $MBL_{sd}$ is to be not less than the value *MBL** or *MBL***. $MBL_{sd}$ may be determined in accordance with a method deemed appropriate by the Society.

**3** Where the $MBL_{sd}$ is determined by the widely recognized industry standards or the owner's standard, $MBL_{sd}$ is to be not less than the minimum breaking load specified in this section.

**23.2.5 Mooring Lines**

**1** General

(1) Ships are to be provided with mooring lines of which *LDBF* is more than $MBL_{sd}$.

(2) Wire ropes or synthetic ropes used as mooring lines are to comply with the requirements in **Chapter 4** and **Chapter 5, Part L of the Rules,** respectively.

(3) Fibre ropes used for mooring lines are to be not less than 20 *mm* in diameter. For considering rope age degradation and wear, the line design break force for such ropes is to be in accordance with the following **(a)** or **(b)**. However, neither **(a)** nor **(b)** need to be complied with in cases where consideration of rope age degradation and wear is included in the method specified in **23.2.4-3.**

(a) Polyamide ropes: $LDBF \geq 120$ % of $MBL_{sd}$

(b) Other synthetic ropes: $LDBF \geq 110$ % of $MBL_{sd}$

(4) For mooring lines connected with powered winches where the rope is stored on the drum, steel cord wire ropes of suitable flexible construction may be used instead of fibre cord wire ropes subject to the approval by the Society.

(5) The length of individual mooring lines may be reduced by up to 7 % of the lengths required in this section, provided that the actual total length of the stipulated number of mooring lines is not less than the required total length required.

**2** The minimum breaking load (*MBL*), the number, the length of mooring lines for ships with equipment numbers of 2,000 or less ($EN \leq 2{,}000$) are to be in accordance with the following **(1)** and **(2)**.

(1) The minimum breaking load (*MBL*), the number and the length of mooring lines are to be in accordance with **Table CS23.2** according to the equipment number. However, when calculating the equipment number, the effect of deck cargoes at the ship nominal capacity condition is to be considered with respect to the side-projected area *A*.

(2) For ships having the ratio *A to EN* greater than 0.9 ($A/EN > 0.9$), the following number of ropes are to be added to the number required by **Table CS23.2** for mooring lines.

Where *A/EN* ~~is above~~ is greater than 0.9 ~~up to~~ but is 1.1 or less: 1

Where *A/EN* ~~is above~~ is greater than 1.1 ~~up to~~ but is 1.2 or less: 2

Where *A/EN* ~~is above~~ is greater than 1.2: 3

**3** The minimum breaking load and the number of mooring lines for ships with an equipment number greater than 2,000 ($EN > 2{,}000$) are to be in accordance with **Chapter 27, Part C of the Rules**.

**23.2.~~3~~6 Mooring Fittings**

**1** Strength

The strength of shipboard fittings used for towing operations at the bow, sides and stern as well as their supporting hull structures are to comply with the requirements of **23.2.6**. For fittings intended to be used for both towing and mooring, the requirements of **23.2.3** are to be applied.

**~~1~~2** Arrangement

(1) Mooring fittings, mooring winches and capstans are to be located on stiffeners, girders, or both which are parts of the deck construction so as to facilitate efficient distribution of the mooring loads.

(2) When mooring fittings, mooring winches and capstans cannot be located as specified in **(1),** appropriate reinforced members are to be provided directly underneath ~~them~~the towing fittings.

**~~2~~3** Selection

(1) Mooring fittings are to be selected from industry standards deemed appropriate by the Society and are to be at least based on ~~the minimum breaking strength of mooring line according to 23.1.5.~~*MBL*$_{sd}$

(2) When mooring fittings are not selected from industry standards deemed appropriate by the Society, the strength of the fitting and of its attachment to the ship are to be in accordance with ~~-3~~4 and ~~-4~~5**.** For strength assessments, beam theory or finite element analysis using net scantlings is to be applied as appropriate. At the discretion of the Society, load tests may be accepted as alternatives to strength assessments by calculations.

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

**~~3~~4** ~~Design Load~~Supporting Hull Structure

(1) Design load for supporting hull structures ~~of mooring fittings~~ are to be as specified in **(~~1~~a)** to **(~~7~~c)** below:

(~~1~~a) For supporting hull structures of mooring fittings, ~~T~~the minimum design load is to be 1.15 *times* ~~the breaking strength of the mooring line according to 23.1.5.~~ *MBL*$_{sd}$

(b) For supporting hull structures of mooring winches, 1.25 *times* the intended maximum brake holding load, where the maximum brake holding load is assumed to be not less than 80 % of *MBL*$_{sd}$

(c) For supporting hull structures of capstans, 1.25 *times* the maximum hauling-in force

(2) The design load is to be applied to fittings in all directions that may occur ~~by~~ in consideration of the arrangements shown in the towing and mooring arrangements plan specified in **23.2.~~6~~9**.

(3) The point where the mooring force acts on mooring fittings is to be taken as the attachment point of the mooring line. For bollards and bitts, the attachment point of the mooring line is to be taken as not less than 4/5 of the tube height above the base. (See **Fig. CS23.~~3~~8(a)**) If fins are fitted to the bollard tubes to keep the mooring lines as low as possible, the attachment point of the mooring line may be taken as the location of the fins. (See **Fig. CS23.~~3~~8(b)**)

(4) Where the mooring line ~~takes a turn at~~ is paid-out through a fitting, the design load is to be equal to the resultant force of the design load acting on the line but need not exceed twice the design load acting on the line. The design load acting on the line is to be the minimum design load specified in **(1)**.

~~(5) Notwithstanding the requirements in (1) to (4), when a safe working load (*SWL*), greater than that determined according to -5 is requested by the applicant, the design load is to be increased in accordance with the appropriate *SWL*/design load relationship given by -3 and -5.~~

~~(6) The minimum design load applied to supporting hull structures for mooring 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 23.1.5.~~

~~(7) The minimum design load applied to supporting hull structures for capstans is to be 1.25 times the intended maximum hauling-in force.~~

(5) 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, and the proper alignment of the fittings and their supporting hull structures is to be ensured. (See **Fig. CS23.5** for a sample arrangement.)

**~~4~~5** Allowable Stresses

Allowable stresses of supporting hull structures are ~~not~~ to be ~~more than the following:~~in accordance with **23.2.3-5**.

~~(1) For strength assessments using beam theory or grillage analysis:~~

~~(a) Normal stress: 100% of the specified minimum yield point of the material~~

~~(b) Shearing stress: 60% of the specified minimum yield point of the material~~

~~(2) For strength assessments using finite element analysis:~~

~~(a) Equivalent stress: 100% of the specified minimum yield point of the material~~

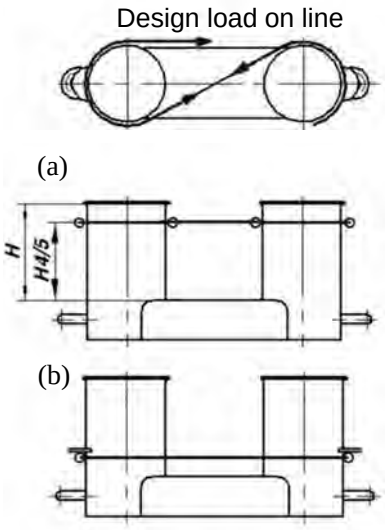
**~~5~~6** Safe Working Load (*SWL*)

(1) ~~Unless a greater *SWL* is requested by the applicant according to 3(5),~~ *SWL* is not to exceed ~~the minimum breaking strength of the mooring line according to **23.1.5**~~$MBL_{sd}$.

(2) The *SWL* (in *tonnes*) of each fitting, excluding mooring winches and capstan, is to be marked by weld beads and paint, or the equivalent, on the fitting. For fittings intended to be used for both towing and mooring, *TOW* according to **23.2.~~2-5.(5)~~3** is to be marked in addition to *SWL*.

(3) The towing and mooring arrangements plan specified in **23.2.9** is to define the method of use of mooring lines.

Fig. CS23.~~3~~8 Acting Point of Mooring Force




**23.2.4~~7~~ Corrosion Additions**

Corrosion additions are to be added to the scantlings of the supporting hull structures ~~specified in **23.2.1-6**~~ and shipboard fittings ~~specified in **23.2.1-4**~~ as follows:

(1) Supporting hull structures: ~~According to other rules for the surrounding structures~~total of 2.0 *mm*.

(2) Pedestals and foundations fitted on decks which are not ~~a part of a~~ shipboard fittings ~~according to~~ selected from industry standards deemed appropriate by the Society: total of 2.0 *mm*

(3) Shipboard fittings not selected from industry standards deemed appropriate by the Society: total of 2.0 *mm*

**23.2.5~~8~~ Wear Allowances**

In addition to the corrosion additions referred to in **23.2.4~~7~~**, the wear allowances for shipboard fittings not selected from industry standards deemed appropriate by the Society are not to be less than

1.0 *mm*, added to surfaces which are intended to regularly contact the line.

**23.2.~~6~~9 Towing and Mooring ~~Fitting~~ Arrangement 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 Master. If not otherwise chosen, *TOW* is to be the load limit for a tow line attached with an eye splice.

**2** Information provided on the plan is to include~~:~~ the followings;

(1) Industry standard and referenced number of each towing and mooring fittings;

(2) For each towing and mooring fitting, the location on the ship, the purpose (mooring, normal towing, other towing etc.), the *SWL* and/or *TOW* ~~and~~as well as the manner of applying towing or mooring line loads including limiting fleet angles.;

(3) An arrangement of mooring lines showing the number of lines.; (See **Fig. CS23.4**)

(4) ~~The minimum breaking load of each mooring line~~The Ship Design Breaking Load $MBL_{sd}$);

(5) The acceptable environmental conditions ~~as given in **23.1.5**, for the minimum breaking strength of mooring lines~~ for ships with equipment numbers greater than 2,000 ~~:~~(EN > 2,000):

(a) Maximum wind speed or acceptable wind speed,

(b) Maximum current speed.

(6) Condition of use for additional mooring equipment not covered by this chapter;

(~~6~~7) Other information or notes related to the design of shipboard fittings or lines.

Table CS23.1 Anchors, Chain Cables and Ropes
(Table is omitted.)

Notes:

1 Length of chain cables may include shackles for connection.

~~2 Values given for anchoring equipment in this table are based on an assumed maximum current speed of 2.5 *m/s*, a maximum wind speed of 25 *m/s* and a minimum scope of chain cable of 6, the scope being the ratio between the paid-out length of the chain and water depth.~~

# Part Q STEEL BARGES

## Chapter 19 EQUIPMENT

### 19.1 Anchors, Chain Cables and Ropes

Paragraph 19.1.5 has been amended as follows.

**19.1.5 Mooring Lines**

~~**1** As for wire ropes and fibre ropes used as mooring lines, the breaking test load specified in **Chapter 4** or **5, Part L** is not to be less than the breaking load given in **Table Q19.2** or **-3** respectively.~~

~~**2**~~**1** The number of mooring lines for barges ~~whose~~with equipment numbers ~~do not exceed~~of 2,000 of less (EN ≤ 2,000) is to be in accordance with **Table Q19.2.** However, for barges having ~~the~~ at ratio of $A \neq$ to *EN* ~~above~~ that is greater than 0.9 (*A/EN* > 0.9), the following number of ropes ~~should~~ is to be added to the number required by **Table Q19.2** for mooring lines.

Where $A/EN$ is ~~above~~ greater than 0.9 ~~upto~~ but 1.1 or less: 1
Where $A/EN$ is ~~above~~ greater than 1.1 ~~upto~~ but 1.2 or less: 2
Where $A/EN$ is ~~above~~ greater than 1.2: 3
$EN$: Equipment number
$A$: Value specified in **19.1.3(2)**

~~**3**~~**2** The number and strength of mooring lines for barges ~~whose~~ with equipment numbers ~~exceed~~ greater than 2,000 (EN > 2,000) are to be in accordance with ~~the following **(1) to (4).**~~ **Chapter 27, Part C of the Rules**.

~~(1) Minimum breaking strength (*MBL*) is not to be less than that obtained from the following formula:~~

~~$MBL = 0.1A_1 + 350$ (*kN*)~~

~~$A_1$: Barge side projected area specified in **-5.**~~

~~(2) Head lines, stern lines, breast lines or spring lines in the same service are to be of the same characteristics in terms of strength and elasticity. The strength of spring lines is to be the same as that of the head, stern and breast lines.~~

~~(3) The total number of head, stern and breast lines is to be obtained from the following formula and rounded to the nearest whole number:~~

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

~~(4) The total number of spring lines is to be not less than two.~~

~~**4** Notwithstanding the requirement in **-3**, 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, $MBL^*$, is to be taken as:~~

~~$MBL^* = 1.2MBL \cdot n/n^* \leq MBL$ (*kN*) for an increased number of lines~~

~~$MBL^* = MBL \cdot n/n^*$ (*kN*) for a reduced number of lines~~

~~$n^*$: The increased or decreased total number of head, stern and breast lines~~

~~$n$: The number of lines calculated by the formulae specified in **-3(3)** without rounding.~~

~~In the same manner, the strength of head, stern and breast lines may be increased or decreased in conjunction with an adjustment to the number of 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 is to be likewise increased, but rounded up to the nearest even number.~~

~~**5** The barge side projected area $A_1$ is to be obtained from the same formula specified in **19.1.3(2).**~~

However, following (1) to (4) are to be considered.

(1) The lightest draft of usual loading conditions is to be considered if the ratio of the freeboard in the lightest draft and the full load condition is equal to or above two.

(2) Wind shielding of the pier can be considered for the calculation of the side-projected area $A_L$ unless the barge is intended to be regularly moored to jetty-type piers. A height of the pier surface of 3 *m* over waterline may be assumed; in other word, 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 $A_L$.

(3) Deck cargo is to be included for the determination of side-projected area $A_L$. Deck cargo may not need to be considered if a usual light draft condition without cargo on deck generates a larger side-projected area $A_L$ than the full load condition with cargo on deck. The larger of both side-projected areas is to be chosen as side-projected area $A_L$.

(4) Usual loading conditions mean loading conditions as given by the trim and stability booklet that are to be expected to regularly occur during operation and, in particular, excluding light weight conditions, propeller inspection conditions, etc.

**6** The mooring lines specified in -**3** and -**4** are based on the following environmental conditions:

(1) Maximum current speed: 1.0 *m/s*

(2) Maximum wind speed $v_w$: 25.0 *m/s*

**7** Among the environmental conditions specified in -**6**, the maximum wind speed $v_w$ may be increased and decreased in conjunction with an adjustment to the strength of the lines as the acceptable wind speed $v_w^*$. In this case, the acceptable wind speed $v_w^*$ is to be obtained from the following formula:

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

*MBL**: The adjusted strength of mooring lines (*kN*)

However, the maximum wind speed $v_w$ can be decreased where maximum breaking strength, *MBL*, specified in -**3(1)** is more than 1,275 *kN*. The acceptable wind speed $v_w^*$ is to be not less than 21 *m/s*.

**8** The length of mooring lines for barges whose equipment numbers are less than or equal to 2,000 is to be in accordance with **Table Q19.2**. For barges whose equipment numbers exceed 2,000, the length of mooring lines is to be taken as 200 *m*.

**9** Application of fibre ropes for mooring lines is to be as deemed appropriate by the Society.

**10**3 For mooring lines connected with powered winches where the rope is stored on the drum, steel cored wire ropes of suitable flexible construction may be used instead of fibre cored wire ropes subject to the approval by the Society.

**11**4 The length of individual mooring lines may be reduced by up to 7 % of the lengths given in -**8**, provided that the actual total length of the stipulated number of mooring lines is not less than that obtained from multiplying the required total length by the number given in -**2**1 or -**3**2.

"Rules for high speed craft" has been partly amended as follows:

# Part 7 EQUIPMENT AND PAINTING

## Chapter 1 EQUIPMENT

### 1.1 Anchors, Chain Cables and Ropes

Paragraph 1.1.7 has been amended as follows.

**1.1.7 Supporting Hull Structures of Anchor Windlasses and Chain Stoppers**

**1** The supporting hull structures of anchor windlasses and chain stoppers are to be sufficient to accommodate operating loads and sea loads

(1) Operating loads are to be taken as not less than the following:
   (a) For chain stoppers, 80% of the chain cable breaking load
   (b) For windlasses, where no chain stopper is fitted or a chain stopper is attached to the windlass, 80% of the chain cable breaking load
   (c) For windlasses, where chain stoppers are fitted but not attached to the windlass, 45% of the chain cable breaking load

(2) Sea loads are to be taken according to **2.1.6, Section 4, Chapter 11, Part 1 of Part CSR-B&T**

**2** The permissible stresses for supporting hull structures of windlasses and chain stoppers~~, based on gross thicknesses,~~ are not to be greater than the following permissible values:

~~(1) Normal stress: 1.00 $R_{eH}$~~

~~(2) Shear stress: 0.60 $R_{eH}$~~

~~$R_{eH}$: The specified minimum yield stress of the material~~

(1) For strength assessment by means of beam theory or grillage analysis:
   (a) Normal stress: 1.00 $R_{eH}$
   (b) Shear stress: 0.60 $R_{eH}$

   $R_{eH}$: The specified minimum yield stress of the material

(2) For strength assessments using finite element analysis:
   (a) Von Mises stress: 1.00 $R_{eH}$

(3) The normal stress referred to in **(1)** above is the sum of bending stress and axial stress with the corresponding shearing stress acting perpendicular to the normal stress. No stress concentration factors are to be considered.

(4) The followings are recommended to be followed for the strength assessment by means of finite element analysis referred to in **(2) above**.
   (a) The geometry is to be idealized as realistically as possible.
   (b) The ratio of element length to width is not to exceed 3.
   (c) Girders are to be modelled using shell or plane stress elements.
   (d) Symmetric girder flanges may be modelled by beam or truss elements.
   (e) The element height of girder webs is not to exceed one-third of the web height.
   (f) In way of small openings in girder webs the web thickness is to be reduced to a mean thickness over the web height.
   (g) Large openings are to be modelled
   (h) Stiffeners may be modelled by using shell, plane stress, or beam elements.
   (i) Stresses are to be read from the centre of the individual element.
   (j) For shell elements the stresses are to be evaluated at the mid-plane of the element.

**3** For strength assessments of supporting hull structures, beam theory or finite element analysis using net scantlings is to be applied as appropriate. In addition, the scantlings of supporting hull structure are to be built at least with the gross scantling obtained by adding the corrosion addition 2.0 *mm* to net scantlings obtained by the criteria specified in this section.

"Rules for the survey and construction of inland waterway ships" has been partly amended as follows:

# Part 4 HULL CONSTRUCTION AND EQUIPMENT OF TUGS AND PUSHERS

## Chapter 16 EQUIPMENT

### 16.1 Anchors, Chain Cables and Ropes

Paragraph 16.1.5 has been amended as follows.

**16.1.5 Mooring Lines***

~~**1** As for wire ropes and hemp ropes used as mooring lines, the breaking test load specified in **Chapter 4 or 5, Part L of Rules for the Survey and Construction of Steel Ships** is not to be less than the breaking load given in **Table 4.16.1** respectively.~~

~~**2**~~**1** For ships having the ratio of *A* specified in **16.1.2-1(2)** to equipment number (*A/EN*) above 0.9, the following number of mooring lines is to be added to the number required by **Table 4.16.1** for mooring lines.

Where *A/EN* is above 0.9 up to 1.1: 1
Where *A/EN* is above 1.1 up to 1.2: 2
Where *A/EN* is above 1.2: 3

~~**3**~~**2** Application of synthetic fibre ropes for mooring lines is to be as deemed appropriate by the Society.

~~**4**~~**3** For mooring lines connected with powered winches where the rope is stored on the drum, steel cored wire ropes of suitable flexible construction may be used instead of fibre cored wire ropes subject to the approval by the Society.

~~**5**~~**4** The length of individual mooring lines may be reduced by up to 7% of the lengths given in **Table 4.16.1**, provided that the total length of the stipulated number of mooring lines is not less than that obtained from multiplying the length by the number given in **Table 4.16.1**.

Paragraph 16.1.7 has been amended as follows.

**16.1.7 Supporting Hull Structures of Anchor Windlasses and Chain Stoppers**

**1** The supporting hull structures of anchor windlasses and chain stoppers are to be sufficient to accommodate operating loads and sea loads

(1) Operating loads are to be taken as not less than the following:
  (a) For chain stoppers, 80% of the chain cable breaking load
  (b) For windlasses, where no chain stopper is fitted or a chain stopper is attached to the windlass, 80% of the chain cable breaking load
  (c) For windlasses, where chain stoppers are fitted but not attached to the windlass, 45% of the chain cable breaking load

(2) Sea loads are to be taken according to **2.1.6, Section 4, Chapter 11, Part 1 of Part CSR-B&T**

**2** The permissible stresses for supporting hull structures of windlasses and chain stoppers~~, based on gross thicknesses,~~ are not to be greater than the following permissible values:

~~(1) Normal stress: 1.00 $R_{eH}$,~~
~~(2) Shear stress: 0.60 $R_{eH}$~~
~~$R_{eH}$: The specified minimum yield stress of the material~~

(1) For strength assessment by means of beam theory or grillage analysis:
  (a) Normal stress: 1.00 $R_{eH}$
  (b) Shear stress: 0.60 $R_{eH}$
  $R_{eH}$: The specified minimum yield stress of the material
(2) For strength assessments using finite element analysis:
  (a) Von Mises stress: 1.00 $R_{eH}$
(3) The normal stress referred to in **(1)** above is the sum of bending stress and axial stress with the corresponding shearing stress acting perpendicular to the normal stress. No stress concentration factors are to be considered.
(4) The followings are recommended to be followed for the strength assessment by means of finite element analysis referred to in **(2) above**.
  (a) The geometry is to be idealized as realistically as possible.
  (b) The ratio of element length to width is not to exceed 3.
  (c) Girders are to be modelled using shell or plane stress elements.
  (d) Symmetric girder flanges may be modelled by beam or truss elements.
  (e) The element height of girder webs is not to exceed one-third of the web height.
  (f) In way of small openings in girder webs the web thickness is to be reduced to a mean thickness over the web height.
  (g) Large openings are to be modelled
  (h) Stiffeners may be modelled by using shell, plane stress, or beam elements.
  (i) Stresses are to be read from the centre of the individual element.
  (j) For shell elements the stresses are to be evaluated at the mid-plane of the element.

**3** For strength assessments of supporting hull structures, beam theory or finite element analysis using net scantlings is to be applied as appropriate. In addition, the scantlings of supporting hull structure are to be built at least with the gross scantling obtained by adding the corrosion addition 2.0 *mm* to net scantlings obtained by the criteria specified in this section.

# Part 5 HULL CONSTRUCTION AND EQUIPMENT OF BARGES

## Chapter 14 EQUIPMENT

### 14.1 Anchors, Chain Cables and Ropes

Paragraph 14.1.5 has been amended as follows.

**14.1.5 Tow Lines and Mooring Lines***

~~**1** As for wire ropes and fibre ropes used as tow lines and mooring lines, the breaking test load specified in **Chapter 4** or **5, Part L** is not to be less than the breaking load given in **Table 5.14.1,** and **Table 5.14.2** or **14.1.5-3** respectively.~~

~~**2**~~**1** The number of mooring lines for ships whose equipment numbers do not exceed 2,000 are to be in accordance with **Table 5.14.2.** However, for ships having the ratio *A/EN* above 0.9, the following number of ropes should be added to the number required by **Table 5.14.2** for mooring lines.

Where $A/EN$ is above 0.9 up to 1.1 : 1
Where $A/EN$ is above 1.1 up to 1.2 : 2
Where $A/EN$ is above 1.2 : 3
$EN$ : Equipment number
$A$ : Value specified in **14.1.3(2)**

~~**3**~~**2** The number and strength of mooring lines whose equipment numbers exceed 2,000 are to be in accordance with ~~the following **(1)** to **(4);**~~ **Chapter 27, Part C of the Rules.**

~~(1) Minimum breaking strength (*MBL*) is not to be less than that obtained from the following formula:~~

~~$MBL = 0.1A_1 + 350$ (*kN*)~~

~~$A_1$: Ship side-projected area specified in **5.**~~

~~(2) Head lines, stern lines, breast lines or spring lines in the same service are to be of the same characteristics in terms of strength and elasticity. The strength of spring lines is to be the same as that of the head, stern and breast lines.~~

~~(3) The total number of head, stern and breast lines is to be obtained from the following formula and rounded to the nearest whole number:~~

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

~~(4) The total number of spring lines is to be not less than two.~~

~~**4** Notwithstanding the requirement in **3**, 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, $MBL^*$, is to be taken as:~~

~~$MBL^* = 1.2MBL \cdot n/n^* \leq MBL$ (*kN*) for an increased number of lines~~

~~$MBL^* = MBL \cdot n/n^*$ (*kN*) for a reduced number of lines~~

~~$n^*$: The increased or decreased total number of head, stern and breast lines~~

~~$n$ : The number of lines for the considered ship type as calculated by the formulae specified in **3(3)** without rounding.~~

~~In the same manner, the strength of head, stern and breast lines may be increased or decreased in conjunction with an adjustment to the number of 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 is to be likewise increased, but rounded up to the nearest even number.~~

~~**5** The ship side-projected area $A_L$ is to be obtained from the same formula specified in **14.1.3(2)**. However, following **(1)** to **(3)** are to be considered.~~

~~(1) The lightest draft of usual loading conditions is to be considered if the ratio of the freeboard in the lightest draft and the full load condition is equal to or above two.~~

~~(2) Wind shielding of the pier can be considered for the calculation of the side-projected area $A_L$ 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; in other word, 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 $A_L$.~~

~~(3) Deck cargo is to be included for the determination of side-projected area $A_L$. Deck cargo may not need to be considered if a usual light draft condition without cargo on deck generates a larger side-projected area $A_L$ than the full load condition with cargo on deck. The larger of both side-projected areas is to be chosen as side-projected area $A_L$.~~

~~**6** The mooring lines specified in **-3** and **-4** are based on the following environmental conditions:~~

~~(1) Maximum current speed: 1.0 *m/s*~~

~~(2) Maximum wind speed $v_w$: 25.0 *m/s*~~

~~**7** Among the environmental conditions specified in **-6**, the maximum wind speed $v_w$ may be increased and decreased in conjunction with an adjustment to the strength of the lines as the acceptable wind speed $v_w^*$. In this case, the acceptable wind speed $v_w^*$ is to be obtained from the following formula:~~

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

~~$MBL^*$: The adjusted strength of mooring lines (*kN*)~~

~~However, the maximum wind speed $v_w$ can be decreased where maximum breaking strength, $MBL$, specified in **-3(1)** is more than 1,275 *kN*. The acceptable wind speed $v_w^*$ is to be not less than 21 *m/s*.~~

~~**8** The length of mooring lines for ships whose equipment numbers are less than or equal to 2,000 is to be in accordance with **Table 5.14.2**. For ships whose equipment numbers exceed 2,000, the length of mooring lines is to be taken as 200 *m*.~~

~~**9** Application of fibre ropes for tow lines or mooring lines is to be as deemed appropriate by the Society.~~

~~**10** For mooring lines connected with powered winches where the rope is stored on the drum, steel cored wire ropes of suitable flexible construction may be used instead of fibre cored wire ropes subject to the approval by the Society.~~

~~**11** The length of individual mooring lines may be reduced by up to 7% of the lengths given in **-8**, provided that the total length of the stipulated number of mooring lines is not less than that obtained from multiplying the length by the number given in **-2** or **-3**.~~

Paragraph 14.1.7 has been amended as follows.

### 14.1.7 Supporting Hull Structure of Anchor Windlasses and Chain Stoppers

**1** The supporting hull structures of anchor windlasses and chain stoppers are to be sufficient to accommodate operating loads and sea loads

(1) Operating loads are to be taken as not less than the following:
   (a) For chain stoppers, 80% of the chain cable breaking load
   (b) For windlasses, where no chain stopper is fitted or a chain stopper is attached to the windlass, 80% of the chain cable breaking load
   (c) For windlasses, where chain stoppers are fitted but not attached to the windlass, 45% of the chain cable breaking load

(2) Sea loads are to be taken according to **2.1.6, Section 4, Chapter 11, Part 1 of Part CSR-B&T**

**2** The permissible stresses for supporting hull structures of windlasses and chain stoppers~~, based on gross thicknesses,~~ are not to be greater than the following permissible values:

~~(1) Normal stress: 1.00 $R_{eH}$~~

~~(2) Shear stress: 0.60 $R_{eH}$~~

~~$R_{eH}$: The specified minimum yield stress of the material~~

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

(a) Normal stress: 1.00 $R_{eH}$

(b) Shear stress: 0.60 $R_{eH}$

$R_{eH}$: The specified minimum yield stress of the material

(2) For strength assessments using finite element analysis:

(a) Von Mises stress: 1.00 $R_{eH}$

(3) The normal stress referred to in **(1)** above is the sum of bending stress and axial stress with the corresponding shearing stress acting perpendicular to the normal stress. No stress concentration factors are to be considered.

(4) The followings are recommended to be followed for the strength assessment by means of finite element analysis referred to in **(2) above**.

(a) The geometry is to be idealized as realistically as possible.

(b) The ratio of element length to width is not to exceed 3.

(c) Girders are to be modelled using shell or plane stress elements.

(d) Symmetric girder flanges may be modelled by beam or truss elements.

(e) The element height of girder webs is not to exceed one-third of the web height.

(f) In way of small openings in girder webs the web thickness is to be reduced to a mean thickness over the web height.

(g) Large openings are to be modelled

(h) Stiffeners may be modelled by using shell, plane stress, or beam elements.

(i) Stresses are to be read from the centre of the individual element.

(j) For shell elements the stresses are to be evaluated at the mid-plane of the element.

**3** For strength assessments of supporting hull structures, beam theory or finite element analysis using net scantlings is to be applied as appropriate. In addition, the scantlings of supporting hull structure are to be built at least with the gross scantling obtained by adding the corrosion addition 2.0 *mm* to net scantlings obtained by the criteria specified in this section.

"Guidance for the survey and construction of steel ships" has been partly amended as follows:

# Part C HULL CONSTRUCTION AND EQUIPMENT

## C27 EQUIPMENT

### C27.1 Anchors~~,~~ and Chain Cables ~~and Mooring Ropes~~

#### C27.1.1 General

Sub-paragraph -1 has been amended as follows.

**1** The "~~S~~special consideration" referred to in **27.1.1-~~1~~3, Part C of the Rules** means the evaluation of the design effectiveness of anchors, chain cables and windlasses. For ships for which $L_2$ is not less than 135 *m*, the ~~provisions of~~ following **(1)** to **(4)** may be used for the design or to assess the adequacy of the anchoring equipment. However, the application of these provisions is limited to anchoring operations in water of depths up to 120 *m*, currents up to 1.54 *m*/*s*, winds up to 14 *m*/*s* and waves with significant heights up to 3 *m*. Furthermore, the scope of chain cables, being the ratio between the paid-out length of the chain and water depth, is limited to between 3 and 4.

((1) to (3) are omitted.)

(4) Windlass design and testing as well as chain stopper design are to be in accordance with **Chapter 16, Part D of the Rules**. In addition, windlasses and chain stoppers are to be in accordance with the following **(a)** to **(c)**.

(a) The windlass unit prime mover is to be able to supply ~~for at least 30 minutes~~a continuous duty pull $Z_{cont}$ (in *N*) ~~as given by~~ for at least 30 *minutes*. $Z_{cont}$ is to be obtained as follows:

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

*d*: chain diameter (*mm*) as per **Table C27.1.1-1**

$m_A$: HHP anchor mass (*kg*) as per **Table C27.1.1-1**

(b) As far as practicable for testing purposes, the test speed of the chain cable during hoisting of the anchor and cable is to be measured over 37.5 *m* of the 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* is to be at least 4.5 *m*/*min*.

(c) For the supporting hull structures of anchor windlasses and chain stoppers, reference is made to the provisions ~~of~~ specified in **27.1.~~8~~6, Part C of the Rules**.

Table C27.1.1-1 has been amended as follows.

Table C27.1.1-1 Anchoring Equipment for Ships in Unsheltered Water of Depths up to 120 *m*

| Equipment letter | Equipment number $EN_1$ | | High holding power stockless bower anchors | | Stud link chain cable for bower anchors | | |
|---|---|---|---|---|---|---|---|
| | | | Number | Mass per anchor | Length | Diameter | |
| | | | | | | Grade 2 | Grade 3 |
| | ~~Over~~ Equal to or greater than | ~~Up to~~ Less than | | *kg* | *m* | *mm* | *mm* |
| - | - | 1790 | 2 | 14150 | 1017.5 | 105 | 84 |
| *DG*2 | 1790 | 1930 | 2 | 14400 | 990 | 105 | 84 |
| *DG*3 | 1930 | 2080 | 2 | 14800 | 990 | 105 | 84 |
| *DG*4 | 2080 | 2230 | 2 | 15200 | 990 | 105 | 84 |
| *DG*5 | 2230 | 2380 | 2 | 15600 | 990 | 105 | 84 |
| *DH*1 | 2380 | 2530 | 2 | 16000 | 990 | 105 | 84 |
| *DH*2 | 2530 | 2700 | 2 | 16300 | 990 | 105 | 84 |
| *DH*3 | 2700 | 2870 | 2 | 16700 | 990 | 105 | 84 |
| *DH*4 | 2870 | 3040 | 2 | 17000 | 990 | 105 | 84 |
| *DH*5 | 3040 | 3210 | 2 | 17600 | 990 | 105 | 84 |
| *DJ*1 | 3210 | 3400 | 2 | 18000 | 990 | 105 | 84 |
| *DJ*2 | 3400 | 3600 | 2 | 18300 | 990 | 10~~5~~6 | 84 |
| *DJ*3 | 3600 | 3800 | 2 | 19000 | 990 | 107 | 8~~7~~5 |
| *DJ*4 | 3800 | 4000 | 2 | 19700 | 962.5 | 10~~7~~8 | 87 |
| *DJ*5 | 4000 | 4200 | 2 | 20300 | 962.5 | 111 | 90 |
| *DK*1 | 4200 | 4400 | 2 | 21100 | 962.5 | 114 | 92 |
| *DK*2 | 4400 | 4600 | 2 | 22000 | 962.5 | 117 | 95 |
| *DK*3 | 4600 | 4800 | 2 | 22900 | 962.5 | ~~120~~119 | 97 |
| *DK*4 | 4800 | 5000 | 2 | 23500 | 962.5 | 12~~4~~2 | 99 |
| *DK*5 | 5000 | 5200 | 2 | 24000 | 935 | 12~~7~~5 | 102 |
| *DL*1 | 5200 | 5500 | 2 | 24500 | 907.5 | ~~132~~130 | 10~~7~~5 |
| *DL*2 | 5500 | 5800 | 2 | 25000 | 907.5 | 13~~2~~3 | 107 |
| *DL*3 | 5800 | 6100 | 2 | 25500 | 880 | 137 | 111 |
| *DL*4 | 6100 | 6500 | 2 | 25700 | 880 | 14~~2~~0 | 11~~4~~3 |
| *DL*5 | 6500 | 6900 | 2 | 26000 | 852.5 | 14~~2~~3 | 11~~7~~5 |
| *DM*1 | 6900 | 7400 | 2 | 26500 | 852.5 | 147 | 11~~7~~8 |
| *DM*2 | 7400 | 7900 | 2 | 27000 | 825 | 152 | 12~~2~~1 |
| *DM*3 | 7900 | 8400 | 2 | 27500 | 825 | 154 | 12~~7~~3 |
| *DM*4 | 8400 | 8900 | 2 | 28000 | 797.5 | 158 | 127 |
| *DM*5 | 8900 | 9400 | 2 | 28900 | 770 | 162 | 132 |
| *DN*1 | 9400 | 10000 | 2 | 29400 | 770 | | 13~~7~~5 |
| *DN*2 | 10000 | 10700 | 2 | 29900 | 770 | | 1~~4~~239 |
| *DN*3 | 10700 | 11500 | 2 | 30600 | 770 | | 14~~2~~3 |
| *DN*4 | 11500 | 12400 | 2 | 31500 | 770 | | 147 |
| *DN*5 | 12400 | 13400 | 2 | 33200 | 770 | | 152 |
| *DO*1 | 13400 | 14600 | 2 | 35000 | 770 | | 157 |
| - | 14600 | - | 2 | 38000 | 770 | | 162 |

Paragraph C27.1.2 has been amended as follows.

**C27.1.2 Equipment Numbers**

(-1 is omitted.)

~~**2 Structures to be included in the second term (2.0*hB*) of the formula in 27.1.2, Part C of the Rules**~~

~~(1) The following items are to be included in the calculation of $h'$.~~

~~(a) Superstructures~~

~~(b) Deckhouses having a breadth greater than *B*/4~~

~~(c) Screens or bulwarks higher than 1.5 *m* in continuation with the deckhouse, the total breadth of which exceeds *B*/4 (*See* **C27.1.2-4**)~~

~~(2) The structures specified in (1) above are to be divided at each deck into upper and lower structures, the breadths of which are to be measured as individual tiers. (*See* **C27.1.2-4**)~~

~~**3**~~**2** Measurement of breadth of structures for second term of the formula in **27.1.2, Part C of the Rules**

(1) Structures are to be treated as separated above and below by a deck level. A continuous superstructure or deckhouse situated on one tier is to be treated as a single structure irrespective of the mode of variation of their breadth and height, continuous or discontinuous, and the breadth is to be the largest one as shown in **Fig. C27.1.2-1**.

(2) As for detached independent deckhouses on one tier, breadths of respective deckhouses are to be measured separately to determine whether they ~~should~~are to be included or not. (*See* **Fig. C27.1.2-2**)

(3) Where a deckhouse having a breadth greater than *B*/4 is above a deckhouse with a breadth of *B*/4 or less, the narrow deckhouse may be ignored. (*See* **Fig. C27.1.2-3**)

(4) When calculating *h*, sheer and trim are to be ignored. (*See* **Fig. C27.1.2-4**)

~~**4 Measurement of heights ($h'$) of structures**~~

~~(1) $h'$ is to be the height at the centreline of the hull and is to be measured as shown in **Fig. C27.1.2-3.**~~

~~(2) Where there are detached structures, $h'$ is to be determined for respective structures independently and the maximum value is to be taken as the height. (*See* **Fig. C27.1.2-4**)~~

~~(3) Where the tween deck height varies longitudinally, $h'$ is to be the maximum value measured from the uppermost continuous deck in the longitudinal section along the ship's centreline. (*See* **Fig. C27.1.2-5**)~~

**3** Side projected area *A* may be in accordance with following **(1)** and **(2)**.

(1) The area of deck camber may disregarded when determining side projected area *A*.

(2) Side projected area *A* may be calculated using following formula.

(a) *A* is the value obtained from the following formula:

$aL_2 + \sum h''l$

$\Sigma h''l$: Sum of the products of the height $h''$ (*m*) and length $l$ (*m*) of superstructures, deckhouses, trunks or funnels which are located above the uppermost continuous deck within $L_2$ and also have a breadth greater than *B*/4 and a height greater than 1.5 *m*

(b) Structures are to be treated as separated above and below by a deck level. A continuous superstructure or deckhouse situated on one tier is to be treated as a single structure irrespective of the mode of variation of their breadth and height, continuous or discontinuous. The length of the single structure is to be the value at the largest point. However, if the height is not more than 1.5 *m*, the part of the single structure is to be ignored. (See **Fig. C27.1.2-5**)

(c) $h''$ is the height (*m*) at the centreline of each tier of deckhouses having a breadth greater than *B*/4.

~~**5**~~**4** Structures to be included in the third term ~~(0.1 A)~~ of the formula in **27.1.2, Part C of the Rules**

(1) The following items ~~are to be included in $\sum h''l$.~~ may be excluded from ship side projected area A:

~~(a) Superstructures~~

~~(b) Deckhouses and trunks having breadths exceeding $B$/4 and heights exceeding 1.5 $m$ (*See* 4 above as to measurement of breadth)~~

~~(c) Screens and bulwarks higher than 1.5 $m$ in continuation with superstructures or deckhouses having a breadth exceeding $B$/4 (*See* **C27.1.2-7** as to measurement of length)~~

~~Notes:~~

~~The following items may be excluded from the calculation of $\sum h''l$:~~

(a) portions outside the fore and aft ends of $L$

(b) derrick posts, ventilators, etc. in continuation with superstructures or deckhouses

~~- hatch coamings and hatch covers~~

~~- funnels~~

(c) cargoes loaded on decks ~~(In the case of calculating equipment numbers for the selection of tow lines and mooring lines, deck cargoes (as given by the Loading Manual) is to be included in the calculations. of $\sum h''l$)~~

~~(2) The structures specified in (1) above are to be divided at each deck into upper and lower structures, and the values of $\sum h''l$ are to be calculated for individual tiers.~~

~~**6** Measurement of length of structures~~

~~(1) A continuous superstructure or deckhouse situated on one tier is to be treated as a single superstructure or deckhouse even when its breadth and/or height vary discontinuously. The length is to be the maximum extreme length of the structure. Where the structure varies in height and has a deckhouse not more than 1.5 $m$ in height at the ends and/or midpoint of the structure, such portions are to be neglected. (*See* **Fig. C27.1.2-6**)~~

~~(2) Bulwarks in continuation with superstructures or deckhouses are to be treated in the same manner as (1) above. (*See* **Fig. C27.1.2-7**)~~

~~**7** Measurement of height ($h''$) of structures~~

~~(1) The height of structures ($h''$) covering the ship's centreline, such as superstructures, deckhouse, etc. is to be the tween deck height of respective tiers of structure at the centreline.~~

~~(2) Where the tween deck height varies longitudinally, $h''$ is to be determined as shown in **Fig. C27.1.2-8.**~~

~~(3) The height of structures not covering the ship's centreline is to be measured at the side facing the centreline.~~

~~**8** Where structures stand side by side~~

~~(1) Where two or more deckhouses stand side by side transversely, $h''l$ may be the projected area on the plane of longitudinal section. (*See* **Fig. C27.1.2-9**)~~

~~(2) Screens and bulwark are to be treated in the same manner as (1) above.~~

~~**9** Calculation of $h''l$ of pressurised LPG tank~~

~~The $h''l$ of the upper portions of LPG tanks above the upper deck which is included into $h''l$ according to **C27.1.2-7** is to be the projected area on the longitudinal section along the ship's centreline.~~

Fig. C27.1.2-1

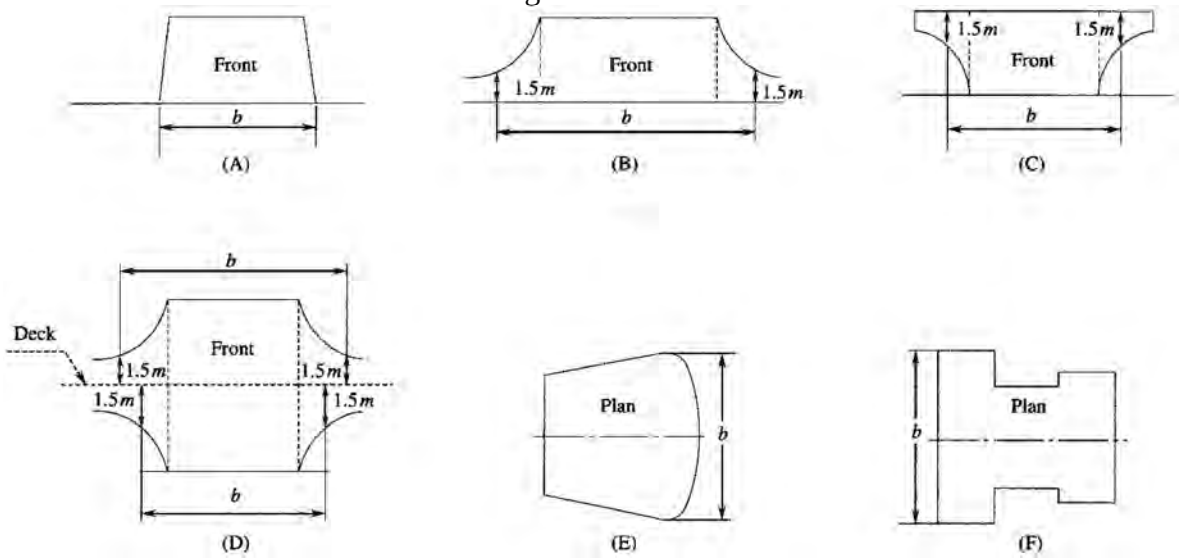
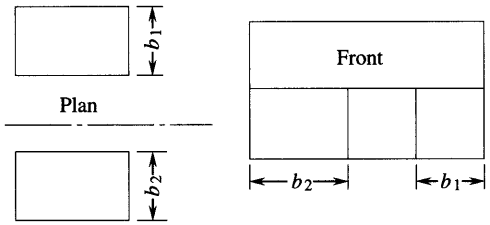


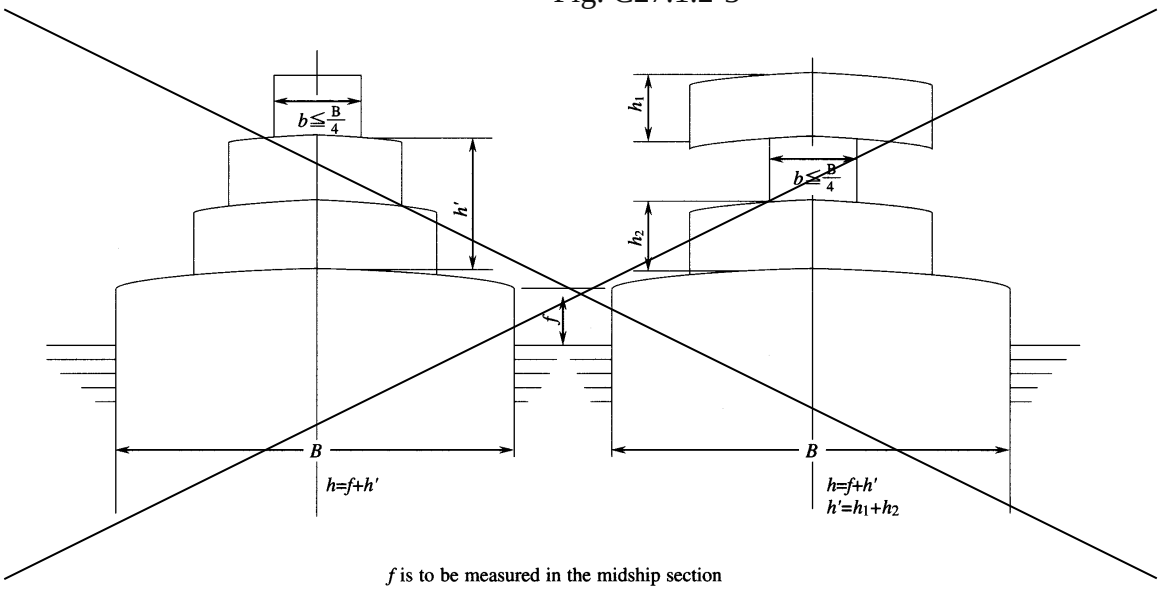

Fig. C27.1.2-2




Note:
If both $b_1$ and $b_2$ are less than $B/4$, they are not to be included (irrespective of the sum $b_1+b_2$)

Fig.C27.1.2-3 has been amended as follows.

Fig. C27.1.2-3




*f* is to be measured in the midship section

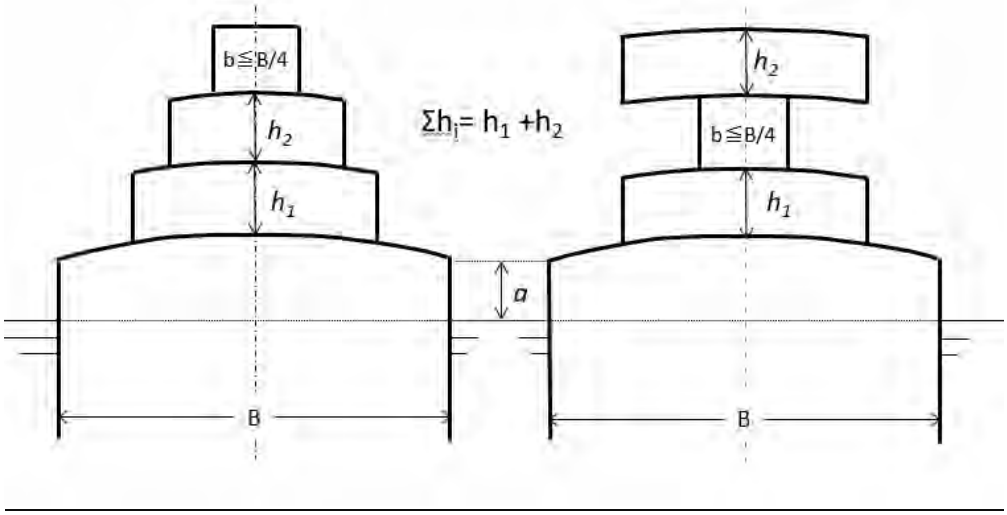
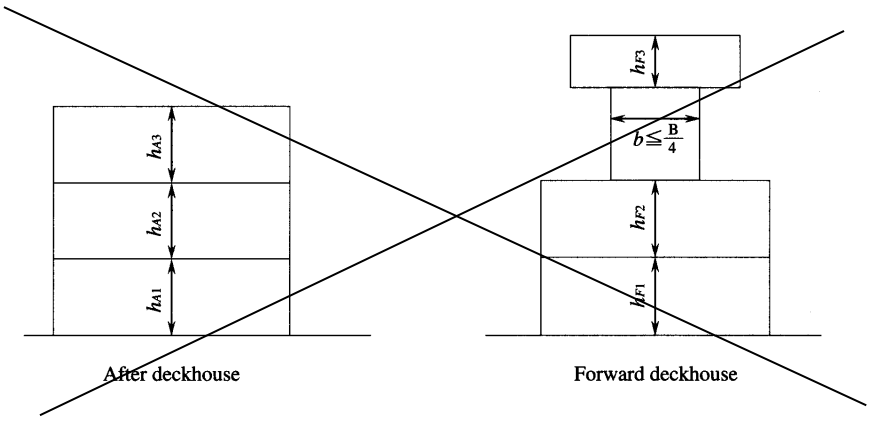


Fig. C27.1.2-4 has been deleted, Fig. C27.1.2-5 and Fig. C27.1.2-6 have been renumbered to Fig. C27.1.2-4 and Fig. C27.1.2-5.

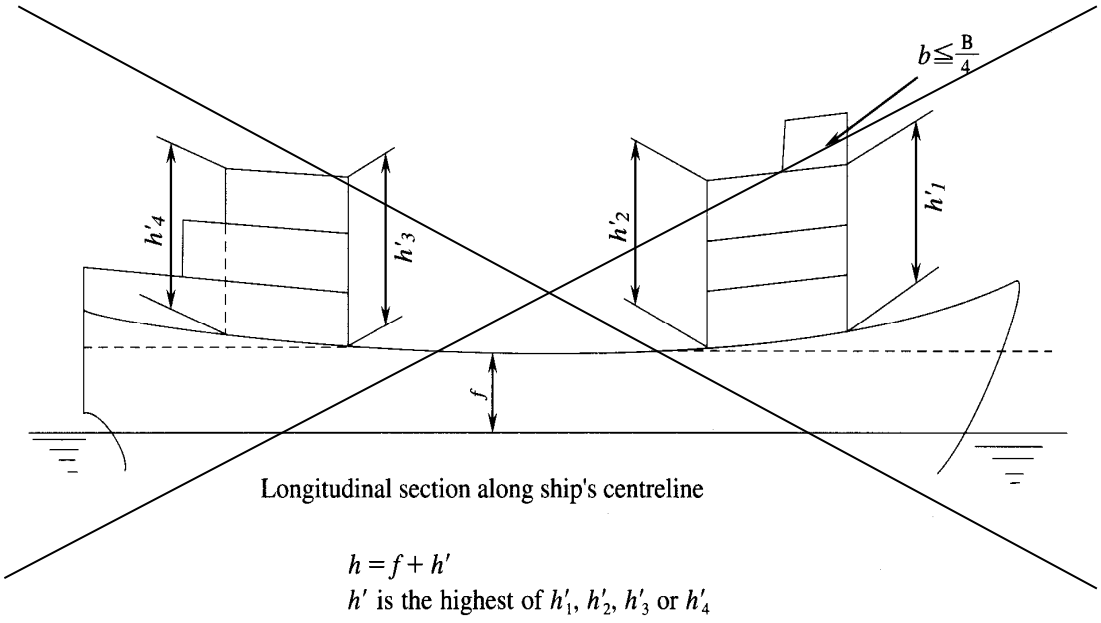
~~Fig. C27.1.2-4~~




$h'$ is to be $(h_{A1} + h_{A2} + h_{A3})$ or $(h_{F1} + h_{F2} + h_{F3})$, whichever is greater

Fig. C27.1.2-4 has been amended as follows.

Fig. C27.1.2-~~5~~4




Longitudinal section along ship's centreline

$h = f + h'$

$h'$ is the highest of $h'_1$, $h'_2$, $h'_3$ or $h'_4$

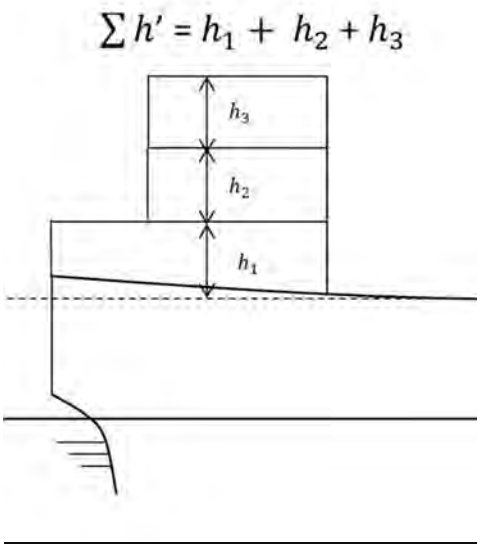


Fig. C27.1.2-~~6~~5

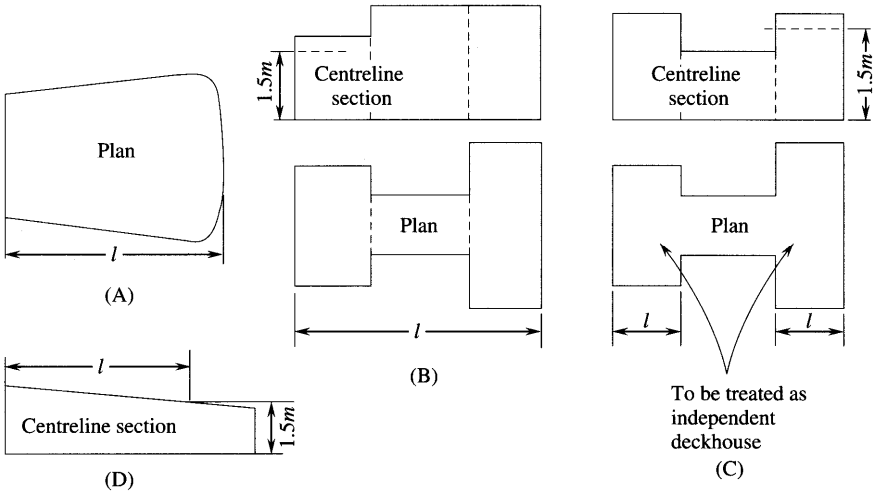

Plan
l
(A)
1.5m
Centreline section
Plan
l
(B)
Centreline section
1.5m
Plan
l
l
To be treated as independent deckhouse
(C)
l
Centreline section
1.5m
(D)

Fig. C27.1.2-7 has been deleted.

~~Fig. C27.1.2-7~~

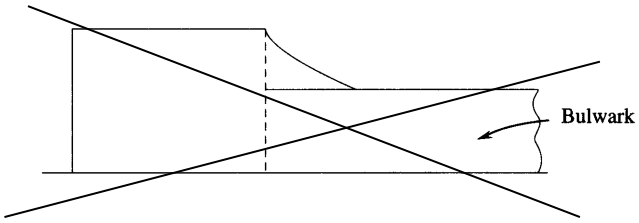



Fig. C27.1.2-8 has been deleted.

~~Fig. C27.1.2-8~~

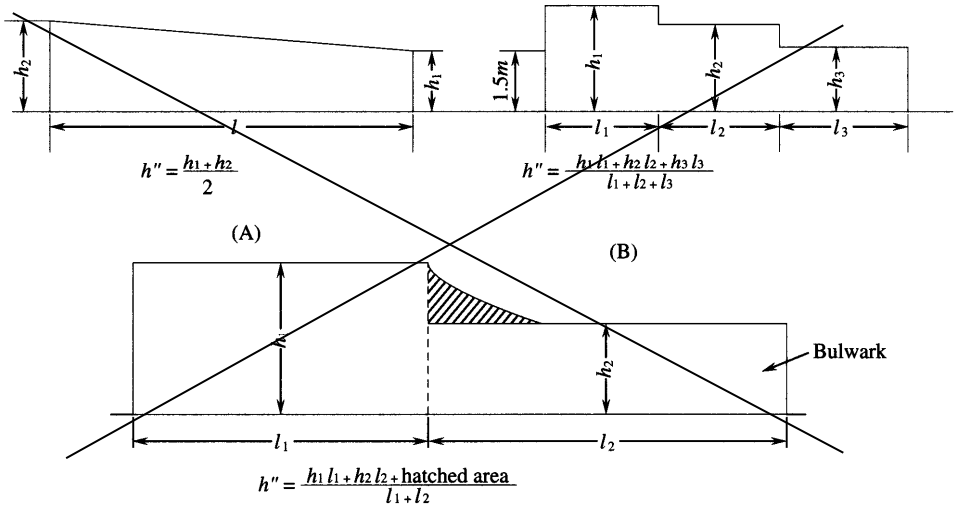
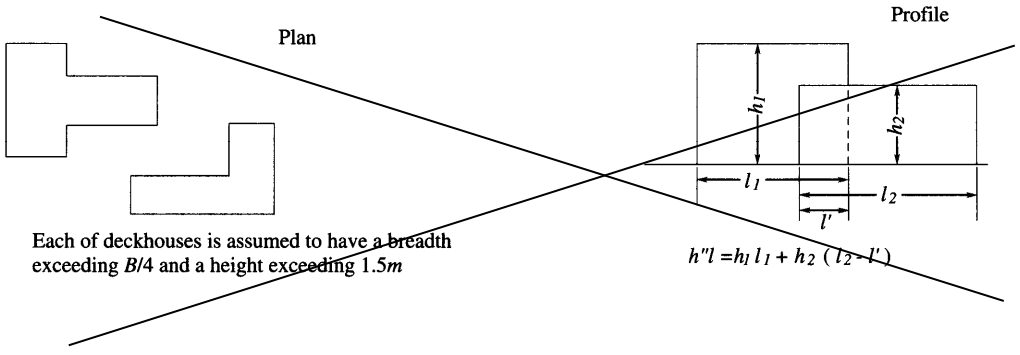



Fig. C27.1.2-9 has been deleted.

~~Fig. C27.1.2-9~~



Paragraph C27.1.4 has been deleted.

**~~C27.1.4 Chain Cables~~**

~~Wire ropes may be used in place of chain cables on ships with less than 40 *m* in length as long as the following (1) to (3) are satisfied.~~

~~(1) The length of the wire rope is to be equal to 1.5 times the corresponding tabular length of chain cable specified in **Table C27.1, Part C of the Rules** and its strength is to be equal to that of a Grade 1 chain cable as specified in **Table L3.5, Part L of the Rules**.~~

~~(2) A short length of chain cable is to be fitted between the wire rope and anchor having a length of 12.5 *m* or the distance between anchor in its stowed position and the winch, whichever is less.~~

~~(3) All surfaces coming into contact with the wire rope need to be rounded with a radius of not less than 10 times the wire rope diameter (including stem).~~

Paragraph C27.1.5 has been deleted.

**~~C27.1.5 Mooring Lines~~**

~~**1** With respect to the provisions of **27.1.5-2, Part C of the Rules**, deck cargo as given by the Loading Manual is to be included for the determination of side-projected area $A_1$.~~

~~**2** Fibre ropes used for tow lines or mooring lines are to be not less than 20 *mm* in diameter. The minimum breaking strength specified in **27.1.5, Part C of the Rules** is to be increased by 20% for polyamide ropes and by 10% for other synthetic ropes to account for any strength loss due to aging and wear, etc.~~

~~**3** For synthetic fibre ropes, it is recommended to use lines which have a reduced risk of recoil (snap-back) to mitigate the risk of injuries or fatalities in the cases where the lines may break.~~

~~**4** "Breast line", "head line", "stern line" and "spring line" referred to in **27.1.5, Part C of the Rules** are defined as follows.~~

~~(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.~~

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

~~**5** "The ship is intended to be regularly moored to jetty-type piers" referred to in **27.1.5-5(2), Part C of the Rules** means oil tankers, chemical tankers or gas carriers which are assumed to be moored to jetty-type piers.~~

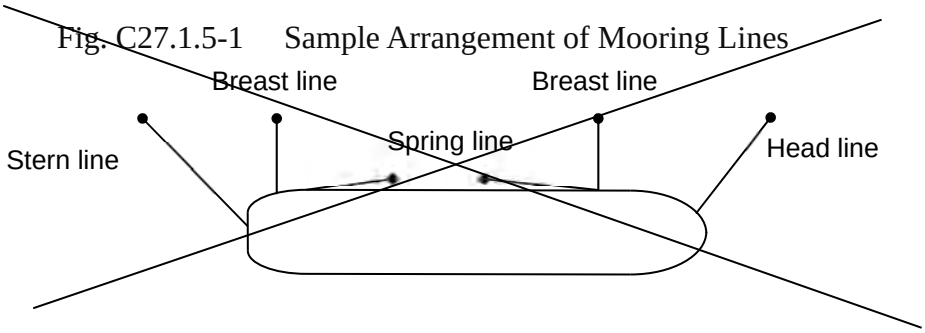
~~**6** Maximum wind speed, acceptable wind speed and maximum current speed referred to in **27.1.5, Part C of the Rules** are based on the following (1) to (2).~~

~~(1) 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.~~

~~(2) 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 currents.~~

Fig.C27.1.5-1 has been deleted.

Fig. C27.1.5-1 Sample Arrangement of Mooring Lines




Paragraph C27.1.7 has been renumbered to Paragraph C27.1.5, and has been amended as follows.

**C27.1.~~7~~5 Chain Lockers**

The wording "the access cover and its securing arrangements to the satisfaction of the Society" in **27.1.~~7~~5-5, Part C of the Rules** means those which are in accordance with *JIS* F 2304, *JIS* F 2329, or *ISO* 5894:1999 or their equivalent.

## C27.2 Towing and Mooring Fittings

Paragraph C27.2.1 has been amended as follows.

### C27.2.1 General

~~**1** "Shipboard fittings" referred to in **27.2.1-1, Part C of the Rules** mean bollards, bitts, fairleads, stand rollers, chocks used for normal mooring of the ship and other similar components used for normal or other towing of the ship. Other components such as capstans, winches, etc. are not included. Any weld, bolt or equivalent device connecting a shipboard fitting to its supporting structure is to be considered to be part of the shipboard fitting if selected in accordance with an industry standard deemed appropriate by the Society.~~

~~**2** "Supporting hull structures" referred to in **27.2.1-1, Part C of the Rules** means the parts of the ship structure on/in which the shipboard fitting is placed and which is directly subjected to the forces exerted on the shipboard fitting. The supporting hull structures of capstans, winches, etc. used for normal or other towing and mooring operations mentioned above is included.~~

~~**3** **27.2.1-1, Part C of the Rules** is not applicable to the design and construction of shipboard fittings and supporting hull structures used for the following types of special towing service:~~

~~(1) 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 propulsion or steering systems.~~

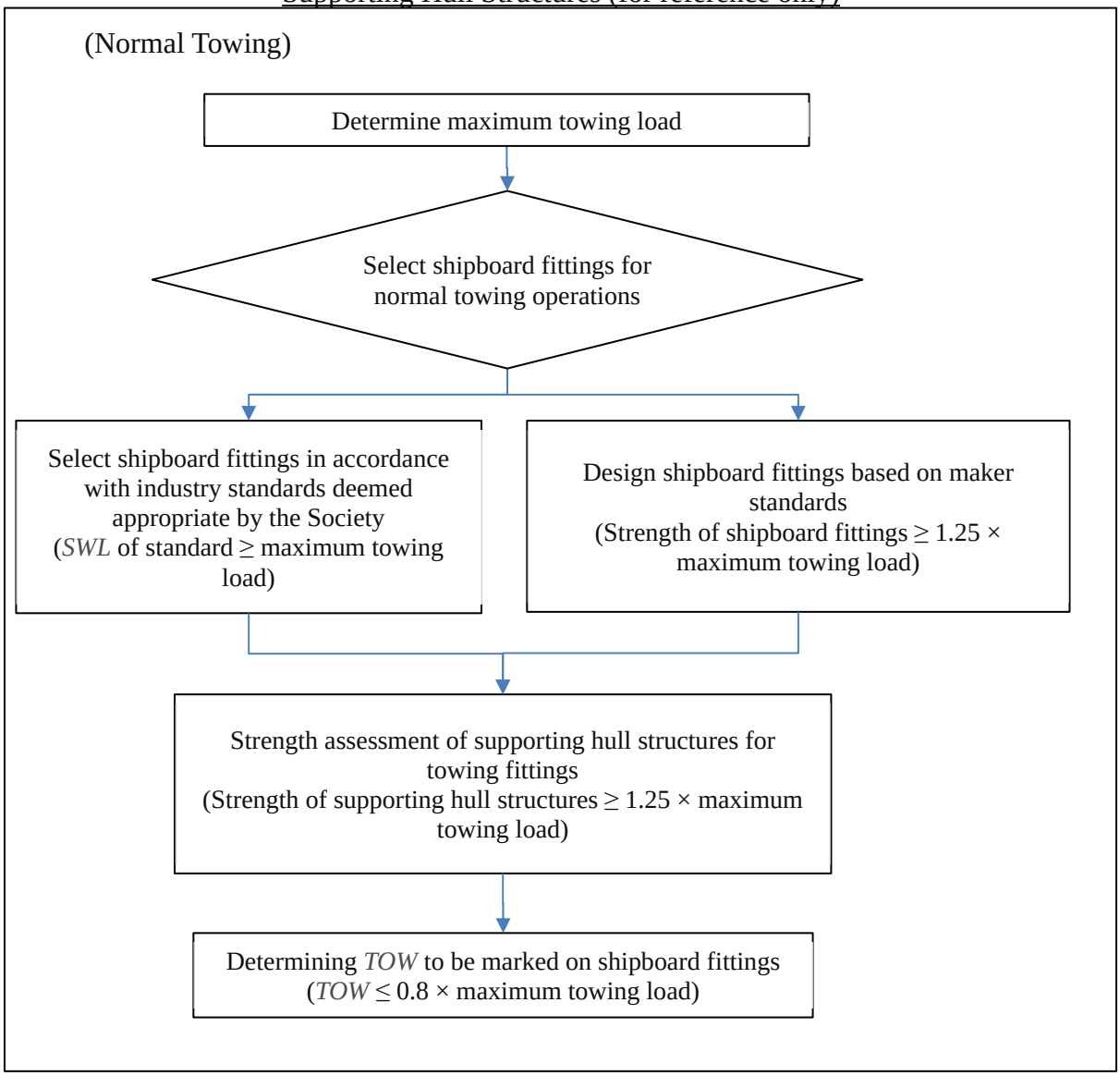
~~(2) Canal transit towing: Towing service for ships transiting canals~~

~~(3) Emergency towing for tankers: Towing service to assist tankers in the cases of emergency referred to in **27.3, Part C of the Rules**.~~

~~**4** "Sheltered waters" referred to in **27.2.1-1, Part C of the Rules** means water area specified in **3.5.2, Section 4, Chapter 1, Part 1 of Part CSR-B&T**.~~

With respect to the provisions of **27.2, Part C of the Rules**, the flow charts shown in **Fig. C27.2.1-1** and **Fig. C27.2.1-2** are standard methods for the design processes of tow lines, mooring lines, shipboard fittings and their supporting hull structures.

Fig. C27.2.1-1 Standard Design and Selection Process for Tow Lines, Towing Arrangements and Supporting Hull Structures (for reference only)



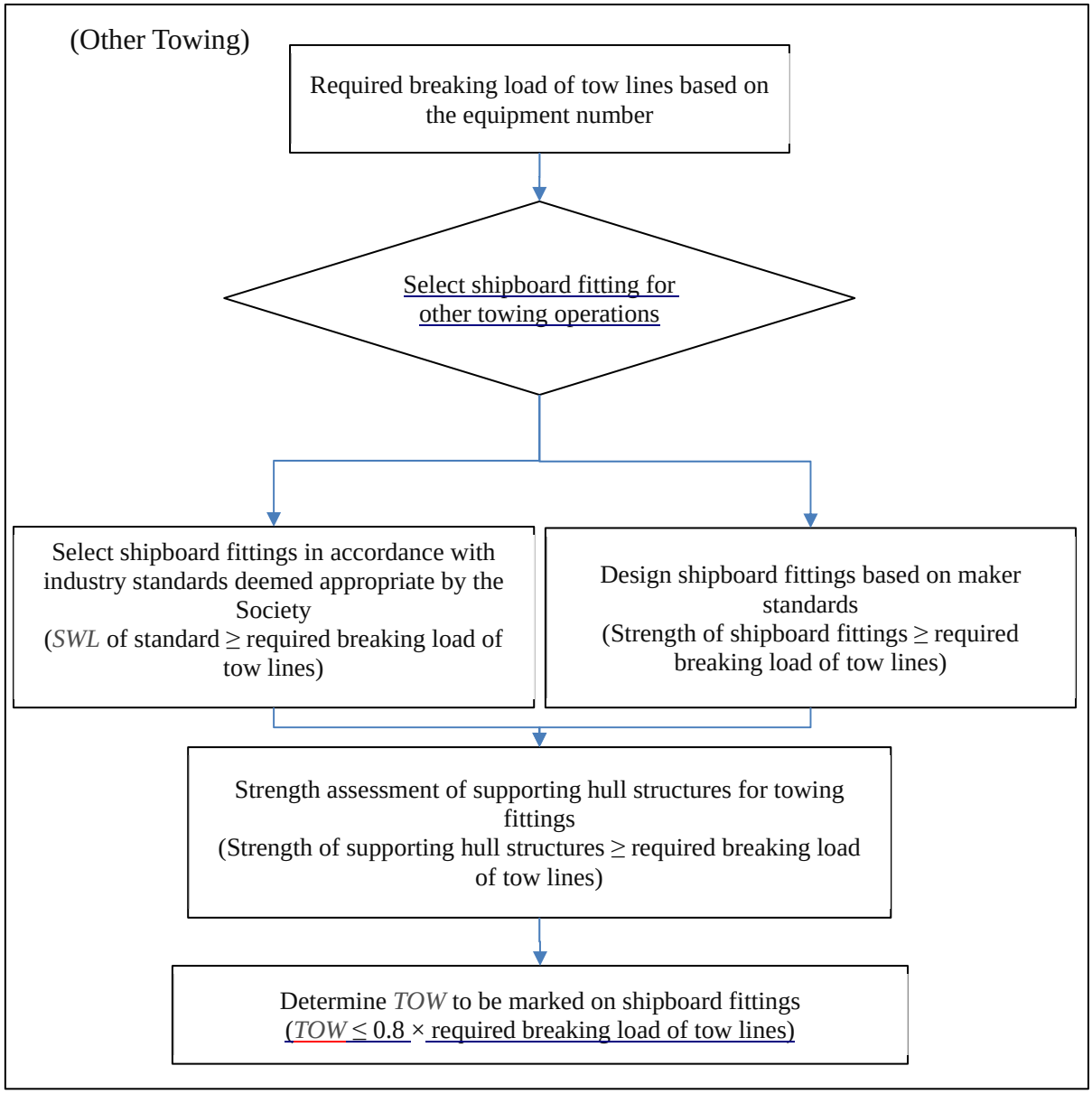
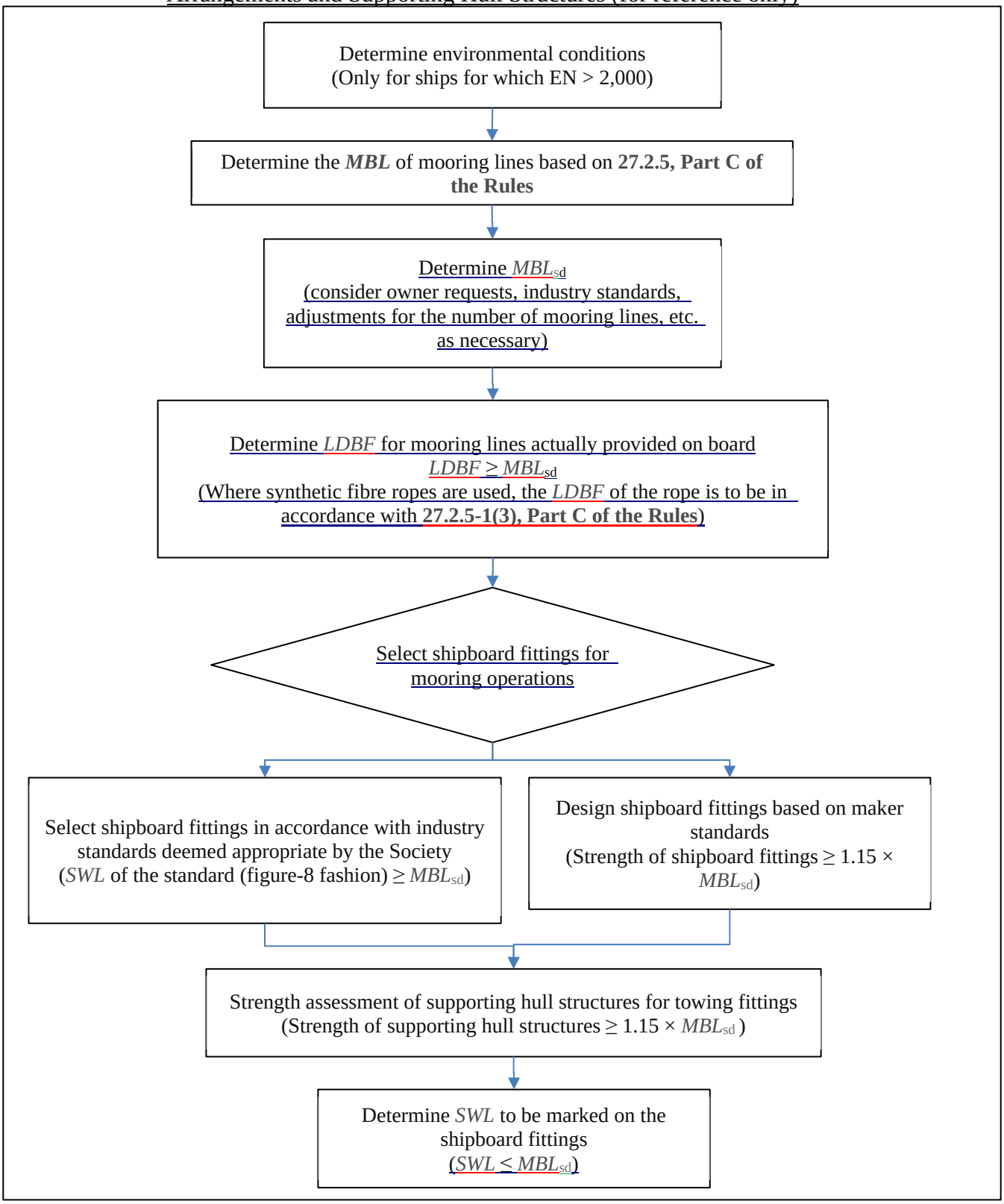

(Other Towing)
Required breaking load of tow lines based on the equipment number
Select shipboard fitting for other towing operations
Select shipboard fittings in accordance with industry standards deemed appropriate by the Society
(*SWL* of standard ≥ required breaking load of tow lines)
Design shipboard fittings based on maker standards
(Strength of shipboard fittings ≥ required breaking load of tow lines)
Strength assessment of supporting hull structures for towing fittings
(Strength of supporting hull structures ≥ required breaking load of tow lines)
Determine *TOW* to be marked on shipboard fittings
(*TOW* ≤ 0.8 × required breaking load of tow lines)

Fig. C27.2.1-2 Standard Design and Selection Process for Mooring Lines, Mooring Arrangements and Supporting Hull Structures (for reference only)



Paragraph C27.2.2 has been renumbered to Paragraph C27.2.3, and has been amended as follows.

**C27.2.~~2~~3 Towing Fittings**

~~**1** With respect to the provisions of **27.2.2, Part C of the Rules**, the increase of the minimum breaking strengths of fibre ropes according to **C27.1.5-2** need not to be taken into account for loads applied to shipboard fittings and supporting hull structures.~~

~~**2** With respect to the provisions of **27.2.2-1, Part C of the Rules**, the arrangements of towing fittings and their supporting hull structures refer to **Fig C27.2.2-1**~~

~~**3**~~**1** "Industry standards deemed appropriate by the Society" as prescribed in **27.2.~~2~~3-~~2~~3(1), Part C of the Rules**, means international standards or national standards such as *ISO*, *JIS F*, etc.

~~**4** With respect to the provisions of **27.2.2-2(1)(b), Part C of the Rules**, side projected area including that of deck cargoes as given by the Loading Manual is to be taken into account for the calculation of equipment numbers.~~

~~**5** With respect to the provisions of **27.2.2-2(2), Part C of the Rules**, strength assessments using finite element analysis are to be in accordance with **C27.2.2-8.**~~

~~**6** "Normal stress" referred to in **27.2.2-4(1), Part C of the Rules** is the sum of bending stress and axial stress with the corresponding shearing stress acting perpendicular to the normal stress.~~

~~**7** With respect to the provisions of **27.2.2-4(1), Part C of the Rules**, stress concentration factors need not be taken into account for strength assessments using beam theory or grillage analysis.~~

~~**8** With respect to the provisions of **27.2.2-4(2), Part C of the Rules**, strength assessments using finite element analysis are to be in accordance with the following **(1) to (10).**~~

~~(1) The geometry is to be idealized as realistically as possible.~~

~~(2) The ratio of element length to width is not to exceed 3.~~

~~(3) Girders are to be modelled using shell or plane stress elements.~~

~~(4) Symmetric girder flanges may be modelled by beam or truss elements.~~

~~(5) The element height of girder webs is not to exceed one-third of the web height.~~

~~(6) In way of small openings in girder webs the web thickness is to be reduced to a mean thickness over the web height.~~

~~(7) Large openings are to be modelled.~~

~~(8) Stiffeners may be modelled by using shell, plane stress, or beam elements.~~

~~(9) Stresses are to be read from the centre of the individual element.~~

~~(10) For shell elements the stresses are to be evaluated at the mid-plane of the element.~~

~~**9**~~**2** The provisions for the *TOW* specified in **27.2.~~2~~3-~~5~~6, Part C of the Rules** are applied for the use ~~with~~ of no more than one line. If not otherwise ~~chosen, for towing bitts (double bollards),~~ specified the *TOW* for towing bitts (double bollards) is the load limit for~~a~~ tow line~~s~~ attached with eye splice~~s~~.

~~**10**~~**3** Towing arrangements are recommended as follows.

(1) Tow lines are to be led through a closed chock. The use of open fairleads with rollers or closed roller fairleads is to be avoided.

(2) It is recommended to provide at least one chock close to centreline of the ship forward and aft. It is beneficial to provide additional chocks on the port and starboard side~~s~~ at the transom and at the bow.

(3) Tow lines are to have a straight lead from the towing bitt or bollard to the chock. Bitts or bollards serving chocks are to be located slightly offset and at a distance of at least 2 *m* away from the chock. (~~Refer to~~ See **Fig. C27.2.~~2~~3-~~2~~1**)

(4) Warping drums are to be positioned not more than 20 *m* away from chocks ~~as far as practicable,~~ measured along the path of the line as far as practicable.

(5) Attention is to be given to the arrangement of the equipment for towing and mooring operations in order to prevent interference of mooring and tow lines as far as practicable.

Fig. C27.2.2-1 has been deleted, Fig. C27.2.2-2 has been renumbered to Fig. C27.2.3-1.

~~Fig. C27.2.2-1 Sample Arrangement of Shipboard Fittings and Supporting Hull Structures~~

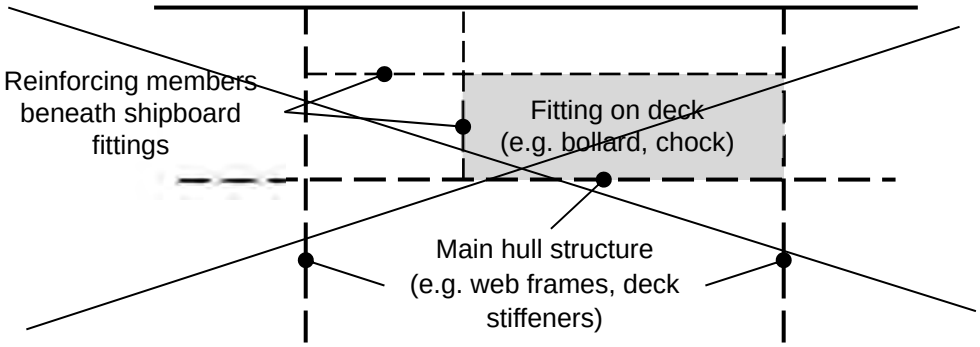
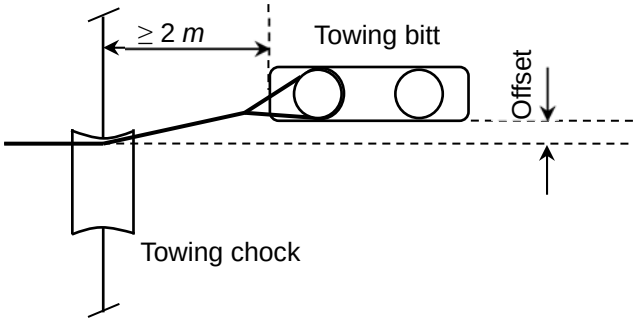



Fig. C27.2.~~2~~3-~~2~~1 Sample Arrangement of Towing Fittings




Paragraph C27.2.3 has been renumbered to Paragraph C27.2.6, and has been amended as follows.

**C27.2.~~3~~6 Mooring Fittings**

~~**1** With respect to the provisions of **27.2.3, Part C of the Rules**, the increase of minimum breaking strength for fibre ropes according to **C27.1.5-2** needs not to be taken into account for the loads applied to shipboard fittings and supporting hull structures.~~

~~**2** With respect to the provisions of **27.2.3-1, Part C of the Rules**, the arrangements of mooring fittings, capstans, winches and their supporting structures refers to **Fig C27.2.2-1.**~~

~~**3**~~**1** The requirements in **27.2, Part C of the Rules** ~~are to~~ also apply to additional mooring fittings ~~and~~ as well as their supporting hull structures. However, ~~"minimum breaking strength of mooring line"~~ $MBL_{sd}$ specified in **27.2.~~3~~6-~~2~~3(1), Part C of the Rules** and ~~"minimum design load"~~$MBL_{sd}$ specified in **27.2.~~3~~6-~~3~~4, Part C of the Rules** may be read as assumed values in consideration of the intended use. This information is to be incorporated into the ~~T~~towing and ~~M~~mooring ~~Fitting A~~arrangement ~~P~~plan specified in **27.2.~~6~~9, Part C of the Rules.**

~~**4**~~**2** The "~~I~~industry standards deemed appropriate by the Society" referred to in **27.2.~~3~~6-2(1), Part C of the Rules** means international standards or national standards such as *ISO*, *JIS F*, etc.

~~**5** With respect to the provisions of **27.2.3-2(2), Part C of the Rules**, strength assessments using finite element analysis are to be in accordance with **C27.2.2-8.**~~

~~**6** "Normal stress" referred to in **27.2.3-4(1), Part C of the Rules** is the sum of bending stress and axial stress with the corresponding shearing stress acting perpendicular to the normal stress.~~

~~**7** With respect to the provisions of **27.2.3-4(1), Part C of the Rules**, stress concentration factors~~

~~need not be taken into account for strength assessments using beam theory or grillage analysis.~~

~~8~~3 The provisions for *SWL* specified in **27.2.~~3~~6-~~5~~6, Part C of the Rules** ~~are to be~~apply~~ied~~ only in cases where no more than one line is used.

~~9~~4 Mooring arrangements are recommended to be as follows.

(1) As far as possible, a sufficient number of mooring winches is to be fitted to allow for all mooring lines to be belayed on winches. If the mooring arrangement is designed such that mooring lines are partly belayed on bitts or bollards, it is to be considered that these lines may not be as effective as the mooring lines belayed on winches. Mooring lines are to have as straight a lead as is practicable from the mooring drum to the fairlead.

(2) At points of changes in direction, sufficiently large radii of the contact surface of a rope on a fitting is to 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.

(3) Attention is to be given to the arrangement of the equipment for mooring operations in order to prevent interference of the mooring lines as far as practicable.

Paragraph C27.2.6 has been renumbered to Paragraph C27.2.9, and has been amended as follows.

**C27.2.~~6~~9 Towing and Mooring ~~Fitting~~ Arrangements Plan**

**1** It is recommended that the information related to safe towing and mooring operation in the ~~T~~towing and ~~M~~mooring ~~FittingA~~arrangement ~~P~~plan specified in **27.2.~~6~~9, Part C of the Rules** is incorporated into the pilot card in order to provide ~~the~~pilots ~~proper~~ with relevant information on harbour ~~/~~ or escort~~ing~~ operations.

**2** With respect to the provisions ~~of~~ specified in **27.2.~~6~~9-2(6), Part C of the Rules**, the design condition related to **27.~~1~~2.5-~~5~~3(2), Part C of the Rules** is to be described in this plan as a note.

# Part CS HULL CONSTRUCTION AND EQUIPMENT OF SMALL SHIPS

CS23 has been added as follows.

## CS23 EQUIPMENT

### CS23.1 Anchors and Chain Cables

#### CS23.1.4 Chain Cables

Wire ropes may be used in place of chain cables on ships less than 40 *m* in length as long as the following **(1)** to **(3)** are satisfied.

(1) The length of the wire rope is to be equal to 1.5 *times* the corresponding length of chain cable specified in **Table CS23.1, Part CS of the Rules** and its strength is to be equal to that of a Grade 1 chain cable as specified in **Table L3.5, Part L of the Rules**.

(2) A short length of chain cable is to be fitted between the wire rope and anchor having a length of 12.5 *m* or the distance between anchor in its stowed position and the winch, whichever is less.

(3) All surfaces coming into contact with the wire rope need to be rounded with a radius of not less than 10 *times* the wire rope diameter (including the stem).

“Guidance for the survey and construction of inland waterway ships” has been partly amended as follows:

# Part 4 HULL CONSTRUCTION AND EQUIPMENT OF TUGS AND PUSHERS

## Chapter 16 EQUIPMENT

### 16.1 Anchors, Chain Cables and Ropes

Paragraph 16.1.5 has been amended as follows.

**16.1.5 Mooring Lines**

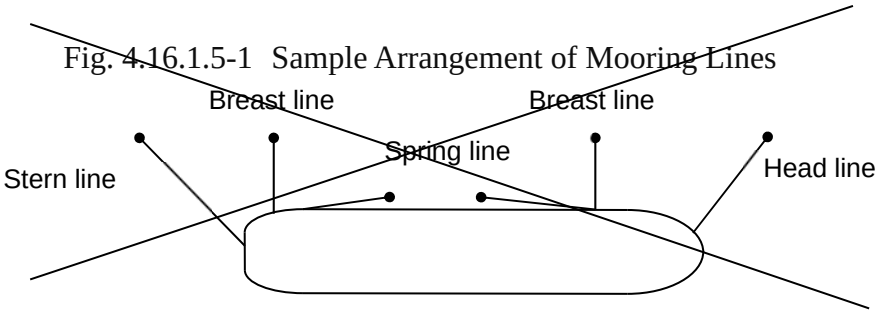
**1** With respect to the provisions of **16.1.5, Part 4 of the Rules**, deck cargo ~~as given by the Loading Manual~~ at the ship nominal condition is to be included for the determination of side-projected area *A*. The ship nominal capacity condition is defined as the theoretical condition in which the maximum possible amount of deck cargoes (in their respective positions) is included in the ship arrangement. For ships carrying containers, the ship nominal capacity condition represents the theoretical condition in which the maximum possible number of containers (in their respective positions) is included in the ship arrangement.

**2** Fibre ropes used for mooring lines are to be not less than 20 *mm* in diameter. The minimum breaking strength specified in **16.1.5, Part 4 of the Rules** is to be increased by 20 % for polyamide ropes and by 10 % for other synthetic ropes to account for any strength loss due to ~~aging~~ rope age degradation and wear, etc.

**3** For synthetic fibre ropes, it is recommended to use lines which have a reduced risk of recoil (snap-back) to mitigate the risk of injuries or fatalities in the cases where the line may break.

Fig.4.16.1.5-1 has been deleted.

Fig. 4.16.1.5-1 Sample Arrangement of Mooring Lines



# Part 5 HULL CONSTRUCTION AND EQUIPMENT OF BARGES

## Chapter 14 EQUIPMENT

### 14.1 Anchors, Chain Cables and Ropes

Paragraph 14.1.5 has been amended as follows.

**14.1.5 Tow Lines and Mooring Lines**

**1** With respect to the provisions of **14.1.5-2, Part 5 of the Rules**, deck cargo ~~as given by the loading manual~~ at the ship nominal capacity condition is to be included for the determination of side-projected area *A*. The ship nominal capacity condition is defined as the theoretical condition in which the maximum possible amount of deck cargoes (in their respective positions) is included in the ship arrangement. For ships carrying containers, the ship nominal capacity condition represents the theoretical condition in which the maximum possible number of containers (in their respective positions) is included in the ship arrangement.

**2** Fibre ropes used for mooring lines are not to be less than 20 *mm* in diameter. For polyamide ropes the minimum breaking strength specified in **14.1.5, Part 5 of the Rules** is to be increased by 20 % and for other synthetic ropes by 10 % to account for any strength loss due to~~, among others, aging~~ rope age degradation and wear, etc.

**3** 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.

~~**4** "Breast line", "head line", "stern line" and "spring line" referred to in **14.1.5, Part 5 of the Rules** are defined as follows.~~

~~(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.~~

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

~~**5** Maximum wind speed, acceptable wind speed and maximum current speed referred to in **14.1.5-6, Part 5 of the Rules** are based on the following **(1)** to **(2)**.~~

~~(1) 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.~~

~~(2) 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 currents.~~

Fig. 5.14.1.5-1 has been deleted.

Fig. 5.14.1.5-1 Sample Arrangement of Mooring Lines