GUIDELINES FOR STATUTORY SURVEYS OF SEA-GOING SHIPS ENGAGED ON NON-INTERNATIONAL VOYAGES

PART THREE LOAD LINES

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Chapter 1 GENERAL

1 General provisions

1.1 For ships to be assigned load lines in accordance with the provisions of this PART, their strength is to comply with the relevant requirements of applicable rules issued by CCS and their intact stability and damage stability is to comply with the requirements of PART FOUR of the Guidelines. Where the freeboards assigned in accordance with the provisions of this PART are different from those decided by the ship's strength, intact stability or damage stability, the largest one is to be assigned.

2 Definitions

2.1 For the purpose of this PART:

(1) *Length*

① The length (*L*) is to be taken as 96% of the total length on a waterline at 85% of the least moulded depth measured from the top of the keel, or as the length from the fore side of the stem to the axis of the rudder stock on that waterline, if that be greater.

② For ships without a rudder stock, the length (*L*) is to be taken as 96% of the waterline at 85% of the least moulded depth.

③ Where the stem contour is concave above the waterline at 85% of the least moulded depth, both the forward terminal of the total length and the fore-side of the stem respectively are to be taken at the vertical projection to that waterline of the aftermost point of the stem contour (above that waterline) (see Figure 2.1).

④ In ships designed with a rake of keel the waterline on which this length is measured is to be parallel to the designed waterline at 85% of the least moulded depth D_{min}, found by drawing a line parallel to the keel line of the vessel (including skeg) tangent to the moulded sheer line of the freeboard deck. The least moulded depth is the vertical distance measured from the top of the keel to the top of the freeboard deck beam at side at the point of tangency (see Figure 2.2).

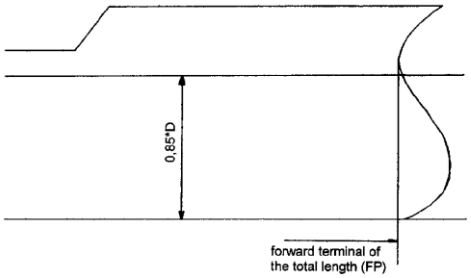


Figure 2.1

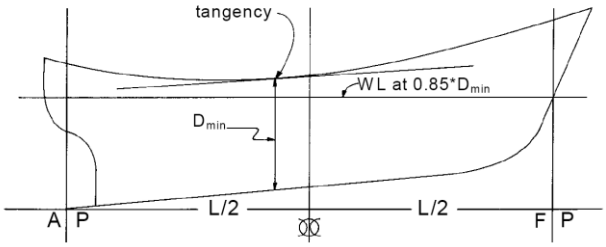


Figure 2.2

(2) *Perpendiculars*. The forward and after perpendiculars are to be taken at the forward and after ends of the length (*L*). The forward perpendicular is to coincide with the foreside of the stem on the waterline on which the length is measured.

(3) *Amidships*. Amidships is at the middle of the length (*L*).

(4) *Breadth*. Unless expressly provided otherwise, the breadth (*B*) is the maximum breadth of the ship, measured amidships to the moulded line of the frame in a ship with a metal shell and to the outer surface of the hull in a ship with a shell of any other material.

(5) *Moulded depth*

① The moulded depth is the vertical distance measured from the top of the keel to the top of the freeboard deck beam at side. In wood and composite ships the distance is measured from the lower edge of the keel rabbet. Where the form at the lower part of the midship section is of a hollow character, or where thick garboards are fitted, the distance is measured from the point where the line of the flat of the bottom continued inwards cuts the side of the keel.

② In ships having rounded gunwales, the moulded depth is to be measured to the point of

intersection of the moulded lines of deck and sides, the lines extending as though the gunwale were of angular design.

③ Where the freeboard deck is stepped and the raised part of the deck extends over the point at which the moulded depth is to be determined, the moulded depth is to be measured to a line of reference extending from the lower part of the deck along a line parallel with the raised part.

(6) *Depth for freeboard (D)*

① The depth for freeboard *(D*) is the moulded depth amidships, plus the freeboard deck thickness at side.

② The depth for freeboard (*D*) in a ship having a rounded gunwale with a radius greater than 4% of the breadth (*B*) or having topsides of unusual form is the depth for freeboard of a ship having a midship section with vertical topsides and with the same round of beam and area of topside section equal to that provided by the actual midship section.

(7) *Block coefficient*

① The block coefficient (C_b) is given by:

$$C_b = \frac{\nabla}{L \cdot B \cdot d_1}$$

where:

∇ — the volume of the moulded displacement of the ship, excluding appendages, in a ship with a metal shell, and is the volume of displacement to the outer surface of the hull in a ship with a shell of any other material, both taken at a moulded draught of *d*1;

d_1 — 85% of the least moulded depth.

② When calculating the block coefficient of a multi-hull craft, the full breadth (*B*) as defined in paragraph (4) is to be used and not the breadth of a single hull.

(8) *Freeboard*. The freeboard assigned is the distance measured vertically downwards amidships from the upper edge of the deck line to the upper edge of the related load line.

(9) *Freeboard deck*.

① The freeboard deck is normally the uppermost complete deck exposed to weather and sea, which has permanent means of closing all openings in the weather part thereof, and below which all openings in the sides of the ship are fitted with permanent means of watertight closing.

② Lower deck as a freeboard deck

At the option of the owner and subject to the approval, a lower deck may be designated as the freeboard deck provided it is a complete and permanent deck continuous in a fore and aft direction at least between the machinery space and peak bulkheads and continuous athwartships.

(a) When this lower deck is stepped the lowest line of the deck and the continuation of that line parallel to the upper part of the deck is taken as the freeboard deck.

(b) When a lower deck is designated as the freeboard deck, that part of the hull which extends above the freeboard deck is treated as a superstructure so far as concerns the application of the conditions of assignment and the calculation of freeboard. It is from this deck that the freeboard is calculated.

(c) When a lower deck is designated as the freeboard deck, such deck as a minimum is to consist of suitably framed stringers at the ship sides and transversely at each watertight bulkhead which extends to the upper deck, within cargo spaces. The width of these stringers is not to be less than can be conveniently fitted having regard to the structure and the operation of the ship. Any arrangement of stringers is to be such that structural requirement can also be met.

③ Discontinuous freeboard deck, stepped freeboard deck.

(a) Where a recess in the freeboard deck extends to the sides of the ship and is in excess of one metre in length, the lowest line of the exposed deck and the continuation of that line parallel to the upper part of the deck is taken as the freeboard deck (see Figure 2.3).

(b) Where a recess in the freeboard deck does not extend to the sides of the ship, the upper part of the deck is taken as the freeboard deck.

(c) Recesses not extending from side to side in a deck below the exposed deck, designated as the freeboard deck, may be disregarded, provided all openings in the weather deck are

fitted with weathertight closing appliances.

(d) Due regard is to be given to the drainage of exposed recesses and to free surface effects on stability.

(e) Provisions of subparagraphs (a) through (d) are not intended to apply to dredgers, hopper barges or other similar types of ships with large open holds, where each case requires individual consideration.

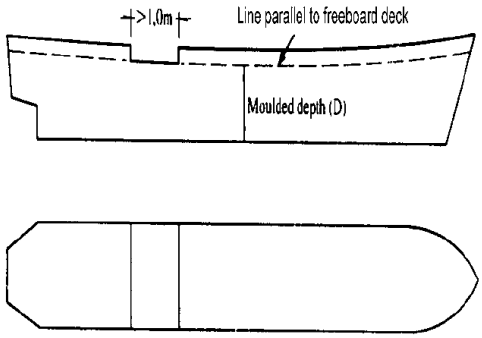


Figure 2.3

(10) *Superstructure*

① A superstructure is a decked structure on the freeboard deck, extending from side to side of the ship or with the side plating not being inboard of the shell plating more than 4% of the breadth (*B*).

② An enclosed superstructure is a superstructure with:

(a) enclosing bulkheads of efficient construction;

(b) access openings, if any, in these bulkheads fitted with doors complying with the requirements of paragraph 2.1 of Chapter 2;

(c) all other openings in sides or ends of the superstructure fitted with efficient weathertight means of closing.

A bridge or poop is not to be regarded as enclosed unless access is provided for the crew starting from any point on the uppermost complete exposed deck or higher to reach machinery and other working spaces inside these superstructures by alternative means which are available at all times when bulkhead openings are closed.

③ The height of a superstructure is the least vertical height measured at side from the top of the superstructure deck beams to the top of the freeboard deck beams.

④ The length of a superstructure (*S*) is the mean length of the part of the superstructure which lies within the length (*L*).

⑤ Bridge. A bridge is a superstructure which does not extend to either the forward or after perpendicular.

⑥ Poop. A poop is a superstructure which extends from the after perpendicular forward to a point which is aft of the forward perpendicular. The poop may originate from a point aft of the aft perpendicular.

⑦ Forecastle. A forecastle is a superstructure which extends from the forward perpendicular aft to a point which is forward of the after perpendicular. The forecastle may originate from a point forward of the forward perpendicular.

⑧ Full superstructure. A full superstructure is a superstructure which, as a minimum, extends from the forward to the after perpendicular.

⑨ Raised quarterdeck. A raised quarterdeck is a superstructure which extends forward from the after perpendicular, generally has a height less than a normal superstructure, and has an intact front bulkhead (sidescuttles of the non-opening type fitted with efficient deadlights and bolted man hole covers) (see Figure 2.4). Where the forward bulkhead is not intact due to doors and access openings, the superstructure is then to be considered as a poop.

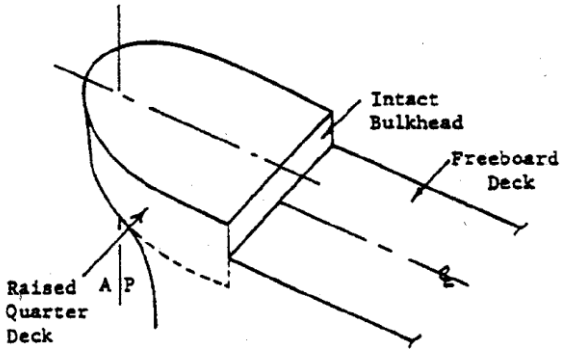


Figure 2.4

(11) *Superstructure deck*. A superstructure deck is a deck forming the upper boundary of a superstructure.
(12) *Flush deck ship*. A flush deck ship is one which has no superstructure on the freeboard deck.
(13) *Weathertight*. Weathertight means that in any sea conditions water will not penetrate into the ship.
(14) *Watertight*. Watertight means capable of preventing the passage of water through the structure in either direction with a proper margin of resistance under the pressure due to the maximum head of water which it might have to sustain.
(15) *Well*. A well is any area on the deck exposed to the weather, where water may be entrapped. Wells are considered to be deck areas bounded on two or more sides by deck structures.

3 Division of voyage areas and seasonal periods

3.1 Voyage areas and seasonal periods for sea-going ships engaged on non-international voyages are as provided in Annex II of the International Convention on Loadlines.

4 Deck line and load line mark

4.1 The deck line and load line mark are to be assigned on each side of a ship.

4.2 The deck line is a horizontal line 300 mm in length and 25 mm in breadth. It is to be marked amidships on each side of the ship, and its upper edge is normally to pass through the point where the continuation outwards of the upper surface of the freeboard deck intersects the outer surface of the shell (as illustrated in Figure 4.1). Where it is difficult to mark as above, the deck line may be placed at an appropriate position amidships on each side of the ship on condition that the freeboard is correspondingly corrected, and this is to be indicated on the Load Line Certificate.

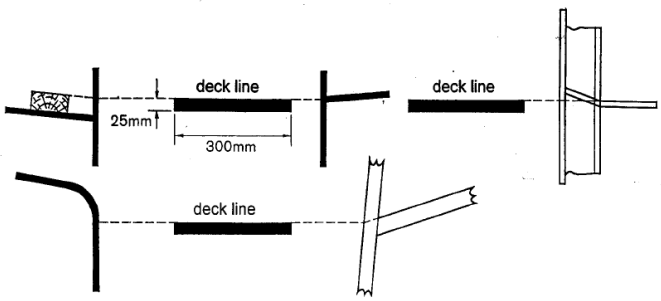


Figure 4.1 Deck Line

4.3 The load line mark is to consist of a ring which is intersected by a horizontal line, the upper edge of which passes through the center of the ring. The center of the ring is to be placed amidships and at a distance equal to the assigned summer freeboard measured vertically below the upper edge of the deck line. For ships surveyed by CCS, the letters “C” and “S” are to be indicated on each side of the load line ring. The letter each is to be 115 mm in height and 75 mm in width (as illustrated in Figure 4.3).

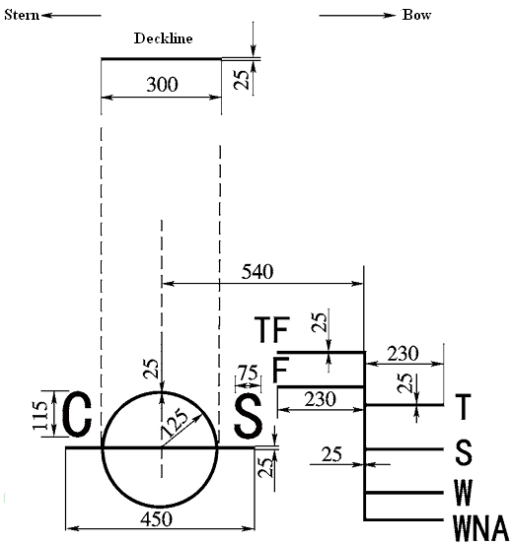


Figure 4.3 Load Line Mark and Lines to be used with This Mark

4.4 The load lines are the load waterlines, which are assigned in accordance with the voyage areas and seasonal periods of the ship voyages, are to be expressed by horizontal lines respectively and forward of the load line ring. All load lines are to be indicated by the upper edge of the corresponding line.
The summer load line is to be indicated by a horizontal line marked "S", the upper edge of which passes through the center of the ring.
The Winter Load Line is to be indicated by a horizontal line marked "W".
The Winter North Atlantic Load Line is to be indicated by a horizontal line marked "WNA".
The Tropical Load Line is to be indicated by a horizontal line marked "T".
The Fresh Water Load Line in summer is to be indicated by a horizontal line marked "F". The difference between the Fresh Water Load Line in summer and the Summer Load Line is the allowance to be made for loading in fresh water at the other load lines.
The Tropical Fresh Water Load Line is to be indicated by a horizontal line marked "TF".

4.5 Where a ship is assigned a greater than minimum freeboard so that the load line is marked at a position corresponding to, or lower than, the lowest seasonal load line assigned at minimum freeboard in accordance with this PART, only the Fresh Water Load Line need be marked.

4.6 For a passenger ship assigned freeboard according to the subdivision requirements of PART FOUR of the Guidelines, the fresh water load line and the subdivision load line P1 are to be marked as illustrated in Figure 4.6. However, if the distance between the fresh water load line and the subdivision load line of a ship is small and thus it is difficult to distinguish between the two load lines if they are marked according to Figure 4.6, the subdivision load line P1 may be marked forward of the vertical line.

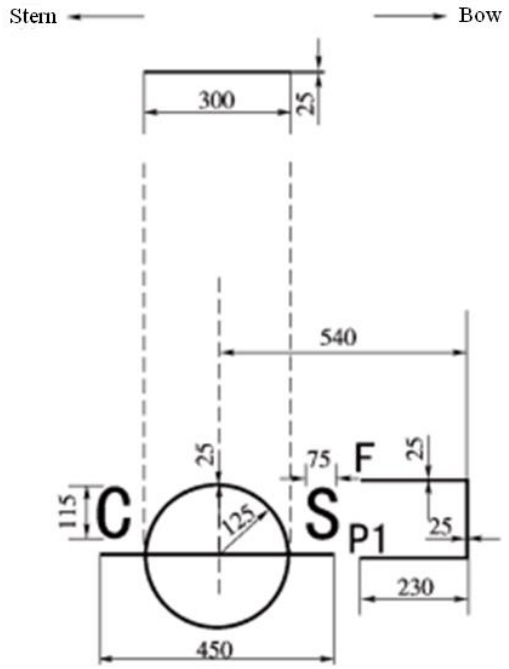


Figure 4.6 Load Line Mark for a Passenger Ship

4.7 Load line marks are to be permanently marked on the sides of the ships. The ring, lines and letters are to be painted in white or yellow on a dark ground or in black on a light ground. The marks are to be plainly visible and, if necessary, special arrangements are to be made for this purpose.

4.8 The Load Line Certificate for Ships at Sea is not to be delivered to the ship until it has been certified that the marks are correctly and permanently indicated on both sides of the ship. Subdivision load lines assigned and marked for passenger ships are also to be recorded in the Load Line Certificate for Ships at Sea.

Chapter 2 CONDITIONS OF ASSIGNMENT OF FREEBOARD

1 General provisions

1.1 For ships assigned freeboard in accordance with Chapters 3 and 4 of this PART, the means for closing openings, discharge arrangements and protection of the crew is to fully comply with the provisions of this Chapter. For small ships, relaxation from these provisions may be granted appropriately subject to agreement, however, the requirements for tightness are not to be relaxed.

2 Means for closing openings and tightness

2.1 Doors of enclosed superstructures

2.1.1 All access openings in bulkheads at ends of enclosed superstructures are to be fitted with doors of steel or other equivalent material, permanently and strongly attached to the bulkhead, and framed, stiffened and fitted so that the whole structure is of equivalent strength to the un-pierced bulkhead and weathertight when closed. The means for securing these doors weathertight is to consist of gaskets and clamping devices or other equivalent means and is to be permanently attached to the bulkhead or to the doors themselves, and the doors are to be so arranged that they can be operated from both sides of the bulkhead.

2.1.2 Except as otherwise provided, the height of the sills of access openings in bulkheads at ends of enclosed superstructures is to be at least 380 mm above the deck.

2.1.3 Unless otherwise permitted, doors are to open outwards to provide additional security against the impact of the sea.

2.1.4 Portable sills are to be avoided. However, in order to facilitate the loading/unloading of heavy spare parts or similar, portable sills may be fitted on the following conditions:
(1) they are to be installed before the ship leaves port; and
(2) they are to be gasketed and fastened by closely spaced through bolts.

2.2 Position of hatchways, doorways and ventilators

2.2.1 Two positions of hatchways, doorways and ventilators are defined as follows:
(1) Position 1 - Upon exposed freeboard and raised quarter decks, and upon exposed superstructure decks situated forward of a point located a quarter of the ship’s length from the forward perpendicular.
(2) Position 2 - Upon exposed superstructure decks situated abaft a quarter of the ship’s length from the forward perpendicular and located at least one standard height of superstructure above the freeboard deck.
Upon exposed superstructure decks situated forward of a point located a quarter of the ship’s length from the forward perpendicular and located at least two standard heights of superstructure above the freeboard deck.

2.3 Cargo and other hatchways

2.3.1 The construction and means for securing the weathertightness of cargo and other hatchways in position 1 and 2 is to be at least equivalent to the requirements of paragraphs 2.4 and 2.5 of this Chapter.

2.4 Hatchways closed by portable covers and secured weathertight by tarpaulins and battening devices

2.4.1 Hatchway coamings

The coamings of hatchways closed by portable covers and secured weathertight by tarpaulins and battening are to be of substantial construction, and their height above the deck is to be at least as follows:

600 mm if in position 1; and
450 mm if in position 2.

2.4.2 Hatch covers

(1) The width of each bearing surface for hatchway covers is to be at least 65 mm.

(2) Where covers are made of wood, the finished thickness is to be at least 60 mm in association with a span of not more than 1.5 m.

(3) Where covers are made of steel, the strength is to be calculated with assumed loads not less than 17.16 kPa on hatchways in position 1, and not less than12.75 kPa on hatchways in position 2, and the product of the maximum stress thus calculated and the factor 4.25 are not to exceed the minimum ultimate strength of the material. They are to be so designed as to limit the deflection to not more than 0.0028 times the span under these loads.

(4) The assumed loads required by 2.4.2(3) of this Chapter may be appropriately reduced for ships of less than 100 m in length. The assumed loads on hatchways in position 1 and position 2 may be reduced to 9.72 kPa and 7.29 kPa respectively for ships of 20 m in length. Values are to be obtained by linear interpolation for ships between 20m and 100m in length.

2.4.3 Portable beams

Where portable beams for supporting hatchway covers are made of steel, the strength is to be calculated with assumed loads not less than 17.16 kPa on hatchways in position 1 and not less than 12.75 kPa on hatchways in position 2, and the product of the maximum stress thus calculated and the factor 5 is not to exceed the minimum ultimate strength of the material. They are to be so designed as to limit the deflection to not more than 0.0022 times the span under these loads. For ships of not more than 100 m in length, the requirements of 2.4.2(4) of this Chapter are to be complied with.

2.4.4 Pontoon covers

(1) Where pontoon covers used in place of portable beams and covers are made of mild steel, the strength is to be calculated in accordance with the requirement of 2.4.2(3) of this Chapter and the product of the maximum stress thus calculated and the factor 5 are not to exceed the minimum ultimate strength of the material. They are to be so designed as to limit the deflection to not more than 0.0022 times the span. Mild steel plating forming the tops of covers is not to be less in thickness than 1% of the spacing of stiffeners or 6 mm if that be greater. For ships of not more than 100 m in length, the requirements of 2.4.2(4) of this Chapter are to be complied with.

(2) The strength and stiffness of covers made of materials other than mild steel is to be equivalent to those of mild steel subject to approval.

2.4.5 Carriers or sockets

Carriers or sockets for portable beams are to be of substantial construction, and are to provide means for the efficient fitting and securing of the beams. Where rolling types of beams are used, the arrangements are to ensure that the beams remain properly in position when the hatchway is closed.

2.4.6 Cleats

Cleats are to be set to fit the taper of the wedges. They are to be at least 65 mm wide and spaced not more than 600 mm from center to center; the cleats along each side or end are not to be more than 150 mm from the hatch corners.

2.4.7 Battens and wedges

Battens and wedges are to be efficient and in good condition. Wedges are to be of tough wood or other equivalent material. They are to have a taper of not more than 1 in 6 and are not to be less than 13 mm thick at the toes.

2.4.8 Tarpaulins

At least two layers of tarpaulin in good condition are to be provided for each hatchway in position 1 or 2. The tarpaulins are to be waterproof and of ample strength. They are to be of a material to be approved.

2.4.9 Securing of hatchway covers

For all hatchways in position 1 or 2, steel bars or other equivalent means are to be provided in order efficiently and independently to secure each section of hatchway covers after the tarpaulins are battened down. Hatchway covers of more than 1.5 m in length are to be secured by at least two such securing appliances.

2.5 Hatchways closed by weathertight covers of steel fitted with gaskets and clamping devices or other equivalent materials

2.5.1 Hatch coamings

At positions 1 and 2 the height above the deck of hatchway coamings fitted with weathertight hatch covers of steel or other equivalent material fitted with gaskets and clamping devices is to be as specified in 2.4.1 of this Chapter. The height of these coamings may be reduced, or the coamings omitted entirely, on condition that it is confirmed that the safety of the ship is not thereby impaired in any sea conditions. Where hatch coamings are provided, they are to be of substantial construction.

2.5.2 Weathertight covers

(1) Where weathertight hatch covers are made of mild steel, the strength is to be calculated with assumed loads not less than 17.16 kPa on hatchways in position 1, and not less than 12.75 kPa on hatchways in position 2, and the product of the maximum stress thus calculated and the factor of 4.25 is not to exceed the minimum ultimate strength of the material. They are to be so designed as to limit the deflection to not more than 0.0028 times the span under these loads. Mild steel plating forming the tops of covers is not to be less in thickness than 1% of the spacing of stiffeners or 6 mm if that be greater. For ships not more than 100 m in length, the requirements of 2.4.2(4) of this Chapter are to be complied with.

(2) The strength and stiffness of covers made of materials other than mild steel is to be equivalent to those of mild steel and subject to approval.

2.5.3 Means for securing weathertightness

The means for securing and maintaining weathertightness is to be subject to approval. The arrangements are to ensure that the tightness can be maintained in any sea conditions, and for this purpose, tests for tightness are to be required at the initial survey, and may be required at renewal and annual surveys or at more frequent intervals.

2.6 Machinery space openings

2.6.1 Machinery space openings in position 1 or 2 are to be properly framed and efficiently enclosed by steel casings of ample strength, and where the casings are not protected by other structures, their strength is to be specially considered. Access openings in such casings are to be fitted with doors complying with the requirements of 2.1.1 of this Chapter, the sills of which are to be at least 600 mm above the deck if in position 1, and at least 380 mm above the deck if in position 2. Other openings in such casings are to be fitted with equivalent covers, permanently attached in their proper positions.

2.6.2 Where machinery casings are not protected by other structures, double doors (i.e. inner and outer doors complying with the requirements of 2.1.1 of this Chapter) are to be required for ships assigned freeboards less than the basic freeboards specified in 1.1.1 of Chapter 3 for type B ships. An inner sill of 230 mm in conjunction with the outer sill of 600 mm is to be provided.

2.6.3 Coamings of any fiddley, funnel or machinery space ventilator in an exposed position on the freeboard deck or superstructure deck are to be as high above the deck as is reasonable and practicable. In general, ventilators necessary to continuously supply the machinery space are to have coamings of sufficient height to comply with the requirements of 2.8.3, without having to fit weathertight closing appliances. Ventilators necessary to continuously supply the emergency generator room, if this is considered buoyant in the stability calculation or protecting opening leading below, are to have coamings of sufficient height to comply with 2.8.3, without having to fit weathertight closing appliances.

2.6.4 Where due to ship size and arrangement this is not practicable, lesser heights for

machinery space and emergency generator room ventilator coamings, fitted with weathertight closing appliances in accordance with 2.8.4, may be permitted in combination with other suitable arrangements to ensure an uninterrupted, adequate supply of ventilation to these spaces.

2.6.5 Fiddley openings are to be fitted with strong covers of steel or other equivalent material permanently attached in their proper positions and capable of being secured weathertight.

2.7 Miscellaneous openings in freeboard and superstructure decks

2.7.1 Manholes and flush scuttles in position 1 or 2 or within superstructures other than enclosed superstructures are to be closed by substantial covers capable of being made watertight. Unless secured by closely spaced bolts, the covers are to be permanently attached.

2.7.2 Openings in freeboard decks other than hatchways, machinery space openings, manholes and flush scuttles are to be protected by an enclosed superstructure, or by a deckhouse or companionway of equivalent strength and weathertightness. Similarly, any such opening in an exposed superstructure deck, in the top of a deckhouse on the freeboard deck which gives access to a space below the freeboard deck or a space within an enclosed superstructure is to be protected by an efficient deckhouse or companionway. Doorways in such companionways or deckhouses that lead or give access to stairways leading below are to be fitted with doors in accordance with 2.1.1. Alternatively, if stairways within a deckhouse are enclosed within properly constructed companionways fitted with doors complying with 2.1.1, the external door need not be weathertight.

2.7.3 Openings in the top of a deckhouse on a raised quarterdeck or superstructure of less than standard height, having a height equal to or greater than the standard quarterdeck height, are to be provided with an acceptable means of closing but need not be protected by an efficient deckhouse or companionway as defined in this paragraph, provided that the height of the deckhouse is at least the standard height of a superstructure. Openings in the top of the deck house on a deck house of less than a standard superstructure height may be treated in a similar manner.

2.7.4 In position 1 the height above the deck of sills to the doorways in companionways is to be at least 600 mm. In position 2 it is to be at least 380 mm.

2.7.5 Where access is provided from the deck above as an alternative to access from the freeboard deck in accordance with 2.1(10)②of Chapter 1, then the height of sills into a bridge or poop is to be 380 mm. The same is to apply to deckhouses on the freeboard deck.

2.7.6 Where access is not provided from above, the height of the sills to doorways in deckhouses on the freeboard deck is to be 600 mm.

2.7.7 Where the closing appliances of access openings in superstructures and deckhouses are not in accordance with 2.1.1, interior deck openings are to be considered exposed (i.e. situated in the open deck).

2.8 Ventilators

2.8.1 Ventilators in position 1 or 2 to spaces below freeboard deck or decks of enclosed superstructures are to have coamings of steel or other equivalent material, substantially constructed and efficiently connected to the deck. Where the coaming of any ventilator exceeds 900 mm in height it is to be specially supported.

2.8.2 Ventilators passing through superstructures other than enclosed superstructures are to have substantially constructed coamings of steel or other equivalent material at the freeboard deck.

2.8.3 Ventilators in position 1 the coamings of which extend to more than 4.5 m above the deck, and in position 2 the coamings of which extend to more than 2.3 m above the deck, normally need not be fitted with closing arrangements unless specifically provided. For the required height of coamings of ventilators on ships in service categories 2 and 3, the required 4.5 m for position 1

may be substituted by two times the standard height of other superstructures as specified in Table 2.2.1 of Chapter 3 of this PART, and the required 2.3 m for position 2 may be substituted by the the standard height of other superstructures as specified in Table 2.2.1 of Chapter 3 of this PART.

2.8.4 Except as provided in 2.8.3 of this Chapter, ventilator openings are to be provided with efficient weathertight closing appliances. In ships of not more than 100 m in length the closing appliances are to be permanently attached; where not so provided in other ships, they are to be conveniently stowed near the ventilators to which they are to be fitted. Ventilators in position 1 are to have coamings of a height of at least 900 mm above the deck; in position 2 the coamings are to be of a height at least 760 mm above the deck.

2.9 Air pipes

2.9.1 Where air pipes to ballast and other tanks extend above the freeboard or superstructure decks, the exposed parts of the pipes are to be of substantial construction; the height from the deck to the point where water may have access below is to be at least 760 mm on the freeboard deck and 450 mm on the superstructure deck. Where these heights may interfere with the working of the ship, a lower height may be approved, provided it is confirmed that the closing arrangements and other circumstances justify a lower height.

2.9.2 Air pipes are to be provided with automatic closing devices.

2.9.3 Pressure-vacuum valves (PV valves) may be accepted on tankers.

2.10 Cargo ports and other similar openings

2.10.1 Cargo ports and other similar openings in the sides of ships below the freeboard deck are to be fitted with doors so designed as to ensure the same watertightness and structural integrity as the surrounding shell plating. Unless otherwise granted by CCS, these openings are to open outwards. The number of such openings is to be the minimum compatible with the design and proper working of the ship.

2.10.2 Unless otherwise permitted by CCS, the lower edge of openings referred to in 2.10.1 is not to be below a line drawn parallel to the freeboard deck at side, which is at its lowest point at least 230 mm above the upper edge of the uppermost load line.

2.10.3 Where it is permitted to arrange cargo ports and other similar openings with their lower edge below the line specified in 2.10.2, additional features are to be fitted to maintain the watertight integrity.

2.10.4 The fitting of a second door of equivalent strength and watertightness is one acceptable arrangement. A leakage detection device is to be provided in the compartment between the two doors. Drainage of this compartment to the bilges, controlled by a readily accessible screw down valve, is to be arranged. The outer door is to open outwards.

2.10.5 Arrangements for bow doors and their inner doors, side doors and stern doors and their securings are to be in compliance with the requirements of CCS or other applicable standards which provide an equivalent level of safety.

2.11 Scuppers, inlets and discharges

2.11.1 General requirements for arrangement of scuppers, inlets and discharges

(1) Discharges led through the shell either from spaces below the freeboard deck or from within superstructures and deckhouses on the freeboard deck fitted with doors complying with the requirements of paragraph 2.1 of this Chapter are to, except as provided in paragraph 2.11.2, be fitted with efficient and accessible means for preventing water from passing inboard. Normally each separate discharge is to have one automatic non-return valve with a positive means of closing it from a position above the freeboard deck. Where the inboard end of the discharge pipe is located at least 0.01L above the Summer Load Line, the discharge may have two automatic non-return valves without positive means of closing. Where that vertical distance exceeds 0.02L, a single

automatic non-return valve without positive means of closing may be accepted. The means for operating the positive action valve is to be readily accessible and provided with an indicator showing whether the valve is open or closed.

(2) One automatic non-return valve and one sluice valve controlled from above the freeboard deck instead of one automatic non-return valve with a positive means of closing from a position above the freeboard deck, is acceptable.

(3) Where two automatic non-return valves are required, the inboard valve is always to be accessible for examination under service conditions (i.e., the inboard valve is to be above the level of the Tropical Load Line). If this is not practicable, the inboard valve need not be located above the Tropical Load Line, provided that a locally controlled sluice valve is fitted between the two automatic non-return valves.

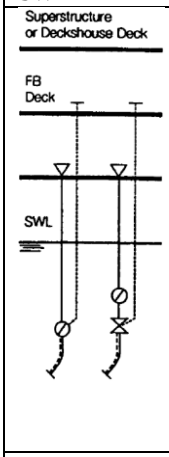
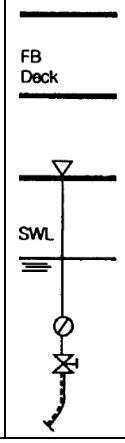
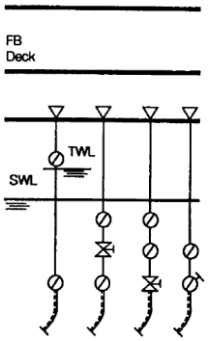
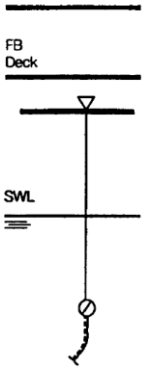
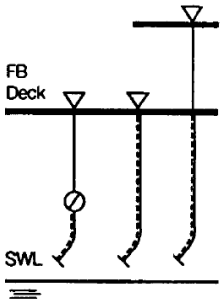
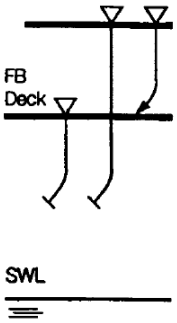
(4) Where sanitary discharges and scuppers lead overboard through the shell in way of machinery spaces, a locally operated positive closing valve at the shell, together with a non-return valve inboard, is acceptable. The controls of the valves are to be in an easily accessible position.

(5) The position of the inboard end of discharges is to be related to the Summer Timber Load Line when a timber freeboard is assigned.

(6) The requirements for non-return valves are applicable only to those discharges which remain open during the normal operation of a ship. For discharges which are to be kept closed at sea, a single screw down valve operated from the deck is acceptable.

(7) Table 2.11.1 provides the acceptable arrangements of scuppers, inlets and discharges.

Acceptable Arrangements of Scuppers, Inlets and Discharges Figure 2.11.1

Discharges coming from enclosed spaces below the freeboard deck or on the freeboard deck				Discharges coming from other spaces	
General requirement: 2.11.1 where inboard end ≤ 0.01 L above SWL	Discharges through machinery space	Alternatives (2.11.1) where inboard end		Outboard end>450 mm below FB deck or ≤ 600 mm above SWL 2.11.4	Otherwise 2.11.5
		>0.01 L above SWL	>0.02 L above SWL		
					

Symbols:

- ∇ inboard end of pipes
- outboard end of pipes
- pipes terminating on the open deck
- non return valve without positive means of closing
- non return valve with positive means of closing controlled locally
- valve controlled locally
- remote control
- normal thickness
- substantial thickness

Note: SWL means summer water line.

2.11.2 Scuppers led through the shell from enclosed superstructures used for the carriage of cargo are to be permitted only where the edge of the freeboard deck is not immersed when the ship heels 5 °either way. In other cases the drainage is to be led inboard.

2.11.3 In manned machinery spaces, main and auxiliary sea inlets and discharges in connection with the operation of machinery may be controlled locally. The controls are to be readily accessible and are to be provided with indicators showing whether the valves are open or closed.

2.11.4 Scuppers and discharge pipes originating at any level and penetrating the shell either more than 450 mm below the freeboard deck or less than 600 mm above the Summer Load Line are to be provided with a non-return valve at the shell. This valve, unless required by 2.11.2, may be omitted if the piping is of substantial thickness (see paragraph 2.11.7 below).

2.11.5 Scuppers leading from superstructures or deckhouses not fitted with doors complying with the requirements of 2.1 of this Chapter are to be led overboard.

2.11.6 All shell fittings and the valves required by 2.11 of this Chapter are to be of steel, bronze or other approved ductile material. Valves of ordinary cast iron or similar material are not acceptable. All pipes to which 2.11 of this Chapter refers are to be of steel or other equivalent material subject to approval.

2.11.7 Scupper and discharge pipes:

(1) For scupper and discharge pipes, where substantial thickness is not required:

① for pipes having an external diameter equal to or less than 155 mm, the thickness is not to be less than 4.5 mm;

② for pipes having an external diameter equal to or more than 230 mm, the thickness is not to be less than 6 mm.

Intermediate sizes are to be determined by linear interpolation.

(2) For scupper and discharge pipes, where substantial thickness is required:

① for pipes having an external diameter equal to or less than 80 mm, the thickness is not to be less than 7 mm;

② for pipes having an external diameter of 180 mm, the thickness is not to be less than 10 mm;

③ for pipes having an external diameter equal to or more than 220 mm, the thickness is not to be less than 12.5 mm.

Intermediate sizes are to be determined by linear interpolation.

2.12 Garbage chutes

2.12.1 Two gate valves controlled from the working deck of the chute instead of the non-return valve with a positive means of closing from a position above the freeboard deck which comply with the following requirements are acceptable:

(1) the lower gate valve is to be controlled from a position above the freeboard deck. An interlock system between the two valves is to be arranged;

(2) the inboard end is to be located above the waterline formed by an 8.5 °heel to port or starboard at a draft corresponding to the assigned summer freeboard, but not less than 1,000 mm above the summer waterline. Where the inboard end exceeds 0.01 L above the summer waterline, valve control from the freeboard deck is not required, provided the inboard gate valve is always accessible under service conditions; and

(3) alternatively, the upper and lower gate valves may be replaced by a hinged weathertight cover at the inboard end of the chute together with a discharge flap. The cover and flap are to be arranged with an interlock so that the discharge flap cannot be operated until the hopper cover is closed.

2.12.2 The entire chute, including the cover, is to be constructed of material of substantial thickness.

2.12.3 The controls for the gate valves and/or hinged covers are to be clearly marked: "Keep closed when not in use".

2.12.4 Where the inboard end of the chute is below the freeboard deck of a passenger ship or the equilibrium waterlines of a cargo ship to which damage stability requirements apply, then:

(1) the inboard end hinged cover/valve is to be watertight;

(2) the valve is to be a screw-down non-return valve fitted in an easily accessible position above the deepest load line; and

(3) the screw-down non-return valve is to be controlled from a position above the bulkhead deck and provided with open/closed indicators. The valve control is to be clearly marked: "Keep closed when not in use".

2.13 Side scuttles, windows and skylights

2.13.1 Side scuttles and windows, together with their glasses, deadlights and storm covers[①], if fitted, are to be of an approved design and substantial construction. Non-metallic frames are not acceptable.

2.13.2 Side scuttles are defined as being round or oval openings with an area not exceeding 0.16 m^2. Round or oval openings having areas exceeding 0.16 m^2 are to be treated as windows.

2.13.3 Windows are defined as being rectangular openings generally, having a radius at each corner relative to the window size and round or oval openings with an area exceeding 0.16 m^2.

2.13.4 Side scuttles to the following spaces are to be fitted with hinged inside deadlights:

(1) spaces below freeboard deck;

(2) spaces within the first tier of enclosed superstructures; and

① Deadlights are fitted to the inside of windows and side scuttles, while storm covers are fitted to the outside of windows, where accessible, and may be hinged or portable.

(3) first tier deckhouses on the freeboard deck protecting openings leading below or considered buoyant in stability calculations.
Deadlights are to be capable of being closed and secured watertight if fitted below the freeboard deck and weathertight if fitted above.

2.13.5 Side scuttles are not to be fitted in such a position that their sills are below a line drawn parallel to the freeboard deck at side and having its lowest point 2.5% of the breadth (B), or 500 mm, whichever is the greatest distance, above the Summer Load Line (or Timber Summer Load Line if assigned).

2.13.6 If the required damage stability calculations indicate that the side scuttles would become immersed at any intermediate stage of flooding or the final equilibrium waterline, they are to be of the non-opening type.

2.13.7 Windows are not be fitted in the following locations:
(1) below the freeboard deck;
(2) in the first tier end bulkheads or sides of enclosed superstructures; or
(3) in first tier deckhouses that are considered buoyant in the stability calculations.

2.13.8 Side scuttles and windows at the side shell in the second tier are to be provided with hinged inside deadlights capable of being closed and secured weathertight if the superstructure protects direct access to an opening leading below or is considered buoyant in the stability calculations.

2.13.9 Side scuttles and windows in side bulkheads set inboard from the side shell in the second tier which protect direct access below to spaces listed in paragraph 2.13.4 are to be provided with either hinged inside deadlights or, where they are accessible, permanently attached external storm covers which are capable of being closed and secured weathertight.

2.13.10 Cabin bulkheads and doors in the second tier and above separating side scuttles and windows from a direct access leading below or the second tier considered buoyant in the stability calculations may be accepted in place of deadlights or storm covers fitted to the side scuttles and windows.

2.13.11 Deckhouses situated on a raised quarter deck or on the deck of a superstructure of less than standard height may be regarded as being in the second tier as far as the requirements for deadlights are concerned, provided that the height of the raised quarter deck or superstructure is equal to or greater than the standard quarter deck height.

2.13.12 Fixed or opening skylights are to have a glass thickness appropriate to their size and position as required for side scuttles and windows. Skylight glasses in any position are to be protected from mechanical damage and, where fitted in position 1 or 2, are to be provided with permanently attached deadlights or storm covers.

2.14 Spurling Pipes and cable lockers

2.14.1 Spurling pipes and cable lockers for ships in unrestricted service are to be watertight up to the deck exposed to weather. Where means of access are provided, they are to be closed by a substantial cover and secured by closely spaced bolts.

2.14.2 Spurling pipes and cable lockers for ships in other service areas are to be watertight up to the freeboard deck, and where means of access are provided in spurling pipes and cable lockers below the freeboard deck, they are to be closed by a substantial cover and secured by closely spaced bolts. Where superstructures are provided, spurling pipes and cable lockers are at least to be watertight from freeboard deck up to the deck exposed to weather, and if means of access are provided in such extended spurling pipes and cable lockers, they are to be closed weathertight.

3 Discharging equipment and protection of the crew

3.1 Freeing ports

3.1.1 Minimum freeing port area

(1) Where bulwarks on the weather portions of freeboard or superstructure decks form wells, ample provision is to be made for rapidly freeing the decks of water and for draining them.

(2) Except as provided in (3) below and 3.1.2, the minimum freeing port area (A) on each side of the ship for each well on the freeboard deck is to be that given by the following formulae in cases where the sheer in way of the well is standard or greater than standard.

The minimum area for each well on superstructure decks is to be one-half of the area given by the following formulae:

where the length of bulwark (l) in the well is 20 m or less:

$$A = 0.7 + 0.035\, l \qquad \text{m}^2$$

where l exceeds 20 m:

$$A = 0.07\, l \qquad \text{m}^2$$

l need in no case be taken as greater than 0.7 L.

If the bulwark is more than 1.2 m in average height, the required area is to be increased by 0.004 m^2 per metre of length of well for each 0.1 m difference in height. If the bulwark is less than 0.9 m in average height, the required area may be decreased by 0.004 m^2 per m of length of well for each 0.1 m difference in height.

(3) In ships with no sheer, the area calculated according to the above (2) is to be increased by 50%. Where the sheer is less than the standard, the percentage is to be obtained by linear interpolation.

(4) On a flush deck ship with a deckhouse amidships having a breadth at least 80% of the beam of the ship and the passageways along the side of the ship not exceeding 1.5 m in width, two wells are formed. Each is to be given the required freeing port area based upon the length of each well.

(5) Where a screen bulkhead is fitted completely across the ship at the forward end of a midship deckhouse, the exposed deck is divided into two wells and there is no limitation on the breadth of the deckhouse.

(6) Wells on raised quarterdecks are to be treated as being on freeboard decks.

(7) Gutter bars greater than 300 mm in height fitted around the weather decks of tankers in way of cargo manifolds and cargo piping are to be treated as bulwarks. Freeing ports are to be arranged in accordance with 3.1 of this Chapter. Closures attached to the freeing ports for use during loading and discharge operations are to be arranged in such a way that jamming cannot occur while at sea.

3.1.2 Where a ship fitted with a trunk does not comply with the requirements of 2.2.4(5) of Chapter 3 or where continuous or substantially continuous hatchway side coamings are fitted between detached superstructures, the minimum area of the freeing port openings is to be calculated from the following table:

Breadth of hatchway or trunk in relation to the breadth of ship	Area of freeing ports in relation to the total area of the bulwarks
40% or less	20%
75% or more	10%

The area of freeing ports at intermediate breadths is to be obtained by linear interpolation.

3.1.3 The effectiveness of the freeing area in bulwarks required by 3.1.1 depends on the free flow area across the deck of a ship.

The free flow area on deck is the net area of gaps between hatchways, and between hatchways and superstructures and deckhouses up to the actual height of the bulwark. The freeing port area in bulwarks is to be assessed in relation to the net free flow area as follows:

(1) If the free flow area is not less than the freeing area calculated from 3.1.2 as if the hatchway coamings were continuous, then the minimum freeing port area calculated from 3.1.1 is to be deemed sufficient.

(2) If the free flow area is equal to, or less than the area calculated from 3.1.1, the minimum freeing area in the bulwarks is to be determined from 3.1.2.

(3) If the free flow area is smaller than the area calculated from 3.1.2, but greater than that calculated from 3.1.1, the minimum freeing area in the bulwark is to be determined from the following formula:

$$F = F_1 + F_2 - f_p \qquad m^2$$

where:

F_1 — the minimum freeing area calculated from 3.1.1;

F_2 — the minimum freeing area calculated from 3.1.2; and

f_p — the total net area of passages and gaps between hatch ends and superstructures or deckhouses up to the actual height of bulwark.

3.1.4 In ships having superstructures on the freeboard deck or superstructure decks, which are open at either or both ends to wells formed by bulwarks on the open decks, adequate provision for freeing the open spaces within the superstructures is to be provided.

The minimum freeing port area on each side of the ship for the open superstructure (A_s) and for the open well (A_w), is to be calculated in accordance with the following procedure:

(1) Determine the total well length (l_t) equal to the sum of the length of the open deck enclosed by bulwarks (l_w) and the length of the common space within the open superstructure (l_s).

(2) To determine A_s:

① calculate the freeing port area (A) required for an open well of length l_t in accordance with 3.1.1 with standard height bulwark assumed;

② multiply by a factor of 1.5 to correct for the absence of sheer, if applicable, in accordance with 3.1.1(3);

③ multiply by the factor (b_o/l_t) to adjust the freeing port area for the breadth (b_o) of the openings in the end bulkhead of the enclosed superstructure;

④ to adjust the freeing port area for that part of the entire length of the well which is enclosed by the open superstructure, multiply by the factor:

$$1 - (l_w / l_t)^2$$

where l_w and l_t are defined in 3.1.4(1);

⑤ to adjust the freeing port area for the distance of the well deck above the freeboard deck, for decks located more than 0.5 h_s above the freeboard deck, multiply by the factor :

$$0.5\ (h_s/h_w)$$

where:

h_w — the distance of the well deck above the freeboard deck;

h_s — one standard superstructure height.

(3) To determine A_w:

① the freeing port area for the open well (A_w) is to be calculated in accordance with (2)①, using l_w to calculate a nominal freeing port area (A'), and then adjusted for the actual height of the bulwark (h_b) by the application of one of the following area corrections, whichever is applicable:

for bulwarks greater than 1.2 m in height:

$$A_c = l_w((h_b - 1.2)/0.10)(0.004) \qquad m^2;$$

for bulwarks less than 0.9 m in height:

$$A_c = l_w((h_b - 0.9)/0.10)(0.004) \qquad m^2;$$

for bulwarks between 1.2 m and 0.9 m in height there is no correction (i.e. $A_c = 0$);

② the corrected freeing port area ($A_w = A' + A_c$) is then to be adjusted for absence of sheer, if applicable, and height above freeboard deck as in paragraphs (2)②and (2)⑤, using h_s and h_w.

(4) The resulting freeing port areas for the open superstructure (A_s) and for the open well (A_w) are to be provided along each side of the open space covered by the open superstructure and each side of the open well, respectively.

(5) The above relationships are summarised by the following equations, assuming l_t, the sum of l_w and l_s, is greater than 20 m:

freeing port area Aw for the open well:

$$A_w = (0.07\ l_w + A_c)(\text{ sheer correction})(0.5\ h_s/\ h_w);$$

freeing port area As for the open superstructure:

$$A_s = (0.07 l_t)(\text{ sheer correction})(b_o/l_t)(1-(l_w/l_t)^2)(0.5 h_s/h_w);$$

where l_t is 20 m or less, the basic freeing port area is $A = 0.7 + 0.035 l_t$ in accordance with 3.1.1.

3.1.5 The lower edges of freeing ports are to be as near the deck as practicable. Two thirds of the

freeing port area required are to be provided in the half of the well nearest the lowest point of the sheer curve. One third of the freeing port area required is to be evenly spread along the remaining length of the well. With zero or little sheer on the exposed freeboard deck or an exposed superstructure deck the freeing port area is to be evenly spread along the length of the well.

3.1.6 All freeing port openings in the bulwarks are to be protected by rails or bars spaced approximately 230 mm apart. If shutters are fitted to freeing ports, ample clearance is to be provided to prevent jamming. Hinges are to have pins or bearings of non-corrodible material. Shutters are not to be fitted with securing appliances.

3.2 Protection of the Crew

3.2.1 The deckhouses used for the accommodation of the crew are to be constructed to an acceptable level of strength.

3.2.2 Guard rails or bulwarks are to be fitted around all exposed decks. The height of the bulwarks or guard rails is to be at least 1 m from the deck, provided that where this height would interfere with the normal operation of the ship, a lesser height may be approved, if it is satisfied that adequate protection is provided.

3.2.3 Guard rails fitted on superstructure and freeboard decks are to have at least three courses. The opening below the lowest course of the guard rails is not to exceed 230 mm. The other courses are not to be more than 380 mm apart. In the case of ships with rounded gunwales the guard rail supports are to be placed on the flat of the deck. In other locations, guardrails with at least two courses are to be fitted. Guard rails are to comply with the following provisions:
(1) fixed, removable or hinged stanchions are to be fitted about 1.5 m apart. Removable or hinged stanchions are to be capable of being locked in the upright position;
(2) at least every third stanchion is to be supported by a bracket or stay;
(3) where necessary for the normal operation of the ship, steel wire ropes may be accepted in lieu of guard rails. Wires are to be made taut by means of turnbuckles; and
(4) where necessary for the normal operation of the ship, chains fitted between two fixed stanchions and/or bulwarks are acceptable in lieu of guard rails.

3.2.4 Satisfactory means for safe passage required by 3.3 (in the form of guard rails, lifelines, gangways or underdeck passages, etc.) is to be provided for the protection of the crew in getting to and from their quarters, the machinery space and any other spaces used in the essential operation of the ship.

3.2.5 Deck cargo carried on any ship is to be so stowed that any opening which is in way of the cargo and which gives access to and from the crew’s quarters, the machinery space and all other parts used in the essential operation of the ship can be closed and secured against water ingress. Protection for the crew in the form of guard rails or lifelines is to be provided above the deck cargo if there is no convenient passage on or below the deck of the ship.

3.2.6 For a pusher tug-barge combination, means of access is to be provided between the pusher tug and the barge ensuring safe passage of crew under any operational conditions.

3.3 Means for safe passage of crew

3.3.1 The safe passage of crew is to be provided by at least one of the means prescribed in table 3.3.1 below:

Acceptable Arrangements of Means for Passage of Crew **Table 3.3.1**

Type of ship	Locations of access in ship	Assigned summer freeboard	Acceptable arrangements according to type of freeboard assigned***			
			Type A	Type B-100	Type B-60	Type B
All ships other than oil tankers*, chemical tankers* and gas carriers*	1.1 **Access to midship quarters** 1.1.1 Between poop and bridge, or 1.1.2 Between poop and deckhouse containing living accommodation or navigating equipment, or both	≤ 3000 mm	(a) (b) (e)	(a) (b) (e)	(a) (b) (c)(i) (e) (f)(i)	(a) (b) (c)(i) (c)(ii) (c)(iv) (d)(i) (d)(ii) (d)(iii) (e) (f)(i) (f)(ii) (f)(iv)
		> 3000 mm	(a) (b) (e)	(a) (b) (e)	(a) (b) (c)(i) (c)(ii) (e) (f)(i) (f)(ii)	
	1.2 **Access to ends** 1.2.1 Between poop and bow (if there is no bridge), 1.2.2 Between bridge and bow, or 1.2.3 Between a deckhouse containing living accommodation or navigating equipment, or both, and bow, or 1.2.4 In the case of a flush deck ship, between crew accommodation and the forward and after ends of ship	≤ 3000 mm	(a) (b) (c)(i) (e) (f)(i)	(a) (b) (c)(i) (c)(ii) (e) (f)(i) (f)(ii)	(a) (b) (c)(i) (c)(ii) (e) (f)(i) (f)(ii)	
		> 3000 mm	(a) (b) (c)(i) (d)(i) (e) (f)(i)	(a) (b) (c)(i) (c)(ii) (d)(i) (d)(ii) (e) (f)(i) (f)(ii)	(a) (b) (c)(i) (c)(ii) (c)(iv) (d)(i) (d)(ii) (d)(iii) (e) (f)(i) (f)(ii) (f)(iv)	
Oil tankers*,chemical tankers* and gas carriers*	2.1 **Access to bow** 2.1.1 Between poop and bow or 2.1.2 Between a deckhouse containing living accommodation or navigating equipment, or both, and bow, or 2.1.3 In the case of a flush deck ship, between crew accommodation and the forward ends of ship	≤ (A_f + H_s)**	(a) (e) (f)(i) (f)(v)			
		> (A_f + H_s)**	(a) (e) (f)(i) (f)(ii)			
	2.2 In the case of a flush deck ship, between crew accommodation and the after end of ship	As required in 1.2.4 for other types of ships				

* Oil tankers, chemical tankers and gas carriers as defined in PART FIVE, Chapter 2, 1.2.1(4) and PART FOUR, Chapter 1, 2.1(6) and (7) respectively.

** A_f : the minimum summer freeboard calculated as type A ship regardless of the type freeboard actually assigned.

H_s: the standard height of superstructure as defined in 2.2.1 of Chapter 3 of this part.

*** Arrangements (a)-(f) are described in 3.3.2 below. Locations (i)-(v) are described in 3.3.3 below.

3.3.2 Acceptable arrangements referred to in Table 3.3.1 are defined as follows:

(a) A well lighted and ventilated under-deck passageway (with a clear opening of at least 0.8 m wide and 2 m high), as close as practicable to the freeboard deck, connecting and providing access to the locations in question.

(b) A permanent and efficiently constructed gangway, fitted at or above the level of the superstructure deck, on or as near as practicable to the centre line of the ship, providing a continuous platform at least 0.6 m in width and a non-slip surface and with guard rails extending

on each side throughout its length. Guard rails are to be at least 1 m high with three courses and constructed as required in 3.2.3. A foot-stop is to be provided.
(c) A permanent walkway at least 0.6 m in width, fitted at freeboard deck level and consisting of two rows of guard rails with stanchions spaced not more than 3 m. The number of courses of rails and their spacing is to be in accordance with 3.2.3. On type B ships, hatchway coamings not less than 0.6 m in height may be accepted as forming one side of the walkway, provided that two rows of guard rails are fitted between the hatchways.
(d) A wire rope lifeline not less than 10 mm in diameter, supported by stanchions not more than 10 m apart, or a single hand rail or wire rope attached to hatch coamings, continued and supported between hatchways.
(e) A permanent gangway that is:

① located at or above the level of the superstructure deck;
② located on or as near as practicable to the centre line of the ship;
③ located so as not to hinder easy access across the working areas of the deck;
④ providing a continuous platform at least 1 m in width;
⑤ constructed of fire resistant and non-slip material;
⑥ fitted with guard rails extending on each side throughout its length; guard rails are to be at least 1 m high with courses as required by 3.2.3 and supported by stanchions spaced not more than 1.5 m apart;
⑦ provided with a foot-stop on each side;
⑧ having openings, with ladders where appropriate, to and from the deck. Openings are not to be more than 40 m apart; and
⑨ having shelters set in way of the gangway at intervals not exceeding 45 m if the length of the exposed deck to be traversed exceeds 70 m. Every such shelter is to be capable of accommodating at least one person and be so constructed as to afford weather protection on the forward, port and starboard sides.

(f) A permanent walkway located at the freeboard deck level, on or as near as practicable to the centre line of the ship, having the same specifications as those for a permanent gangway listed in (e), except for foot-stops. On type B ships (certified for the carriage of liquids in bulk) with a combined height of hatch coaming and fitted hatch cover of not less than 1 m in height, the hatchway coamings may be accepted as forming one side of the walkway, provided that two rows of guard rails are fitted between the hatchways.

3.3.3 Permitted transverse locations for arrangements in paragraphs 3.3.2(c), (d) and (f) above, where appropriate:

(i) at or near the centre line of the ship; or fitted on hatchways at or near the centre line of the ship;
(ii) fitted on each side of the ship;
(iii) fitted on one side of the ship, provision being made for fitting on either side;
(iv) fitted on one side of the ship only;
(v) fitted on each side of the hatchways, as near to the centre line as practicable.

3.3.4 Others
(1) Where wire ropes are fitted, turnbuckles are to be provided to ensure their tautness.
(2) Where necessary for the normal operation of the ship, steel wire ropes may be accepted in lieu of guard rails.
(3) Where necessary for the normal operation of the ship, chains fitted between two fixed stanchions are acceptable in lieu of guard rails.
(4) Where stanchions are fitted, every third stanchion is to be supported by a bracket or stay.
(5) Removable or hinged stanchions are to be capable of being locked in the upright position.
(6) A means of passage over obstructions such as pipes or other fittings of a permanent nature, is to be provided.
(7) Generally, the width of the gangway or deck-level walkway should not exceed 1.5 m.

3.3.5 For tankers less than 100 m in length, the minimum width of the gangway platform or deck-level walkway fitted in accordance with paragraphs 3.3.2(e) or (f) above, respectively, may

be reduced to 0.6 m.

4 Special conditions of assignment for Type A ships

4.1 Machinery casings

4.1.1 Machinery casings on type A ships, as defined in 1.2 of Chapter 3, are to be protected by an enclosed poop or bridge of at least standard height or a deckhouse of equal height and equivalent strength. Machinery casings may, however, be exposed if there are no openings giving direct access from the freeboard deck to the machinery space. A door complying with the requirements of 2.1 of this Chapter is acceptable in the machinery casing, provided that it leads to a space or passageway which is as strongly constructed as the casing and is separated from the stairway to the engine-room by a second weathertight door of steel or other equivalent material. The height of the outer sill above deck is at least to be 600 mm, and the height of the inner sill above deck is at least to be 230 mm.

4.2 Gangway and Access

4.2.1 A fore and aft permanent gangway of substantial construction and ample strength is to be fitted on type A ships at the level of the superstructure deck between the poop and the midship bridge or deckhouse where fitted. Other arrangement such as under-deck passageway is considered an equivalent means of access to carry out the purpose of the gangway. In other places and on type A ships without midship bridges, approved means for protection of crew to reach all spaces needed to be accessed for work on board is to be provided.

4.2.2 Safe and appropriate access from the gangway level is to be available between separate crew accommodations and also between crew accommodations and the machinery space.

4.3 Hatchways

4.3.1 Exposed hatchways on the freeboard and forecastle decks or on the tops of expansion trunks on type A ships are to be provided with efficient watertight covers of steel or other equivalent material.

4.4 Freeing arrangements

4.4.1 Type A ships with bulwarks are to have open rails fitted for at least half the length of the weather deck or other equivalent freeing arrangements. A freeing port area, in the lower part of the bulwarks, of 33% of the total area of the bulwarks, is an acceptable equivalent freeing arrangement. The upper edge of the sheer strake is to be kept as low as practicable.

4.4.2 Where superstructures are connected by trunks, open rails are to be fitted for the whole length of the exposed parts of the freeboard deck.

5 Special provisions for ships in service category 3

5.1 For ships engaged on service category 3, the height above the deck of the means of closing of openings may be determined according to Table 5.1.

Height above the Deck of the Means of Closing of Openings (in mm) Table 5.1

Means of closing of openings	Sills of access openings in enclosed superstructures & deckhouses	Cargo hatch coamings	Other small hatch coamings	Sills of access openings in exposed machinery casings		Sills to the doorways in companio nway	Coamings of ventilators		Air pipes
corresponding paragraphs in this Chapter	2.1.2	2.4.1	2.4.1	2.6.1	2.6.2, 4.1.1	2.7.4	2.8.3	2.8.4	2.9.1
Position 1	250	450	300	300	Outer sill: 300 Inner sill: 150	250	1000 above a deck above the ventilator deck	450	300
Position 2	100	300	150	150	150	100	1000	300	150

5.2 Where approved, for engineering ships solely navigating and operating in ports, the height above the deck of means of closing of openings may be reduced as appropriate if safe operation of such ships will not be impaired, however, the requirements for position 2 in Table 5.1 are at least to be complied with.

6 Special conditions for assigning freeboard of pusher tug-barge combinations

6.1 Length of the combination L_c

Length of the combination L_c is to be measured when a pusher tug and a barge is connected for pushed navigation. The combined length *Lc* is to be taken as the distance, in m, measured on a waterline d_1 at 85% of the least molded depth of the barge (where the lowest point of freeboard deck of the pusher tug is at or above this waterline d_1) or on the design waterline *d* of the combination (where the lowest point of freeboard deck of the pusher tug is below this waterline d_1), from the fore side of the stem of the barge to the after side of the rudder post or stern post of the pusher tug. Where there is no rudder post or stern post, L_c is to be measured to the centerline of the rudder stock of the pusher tug. L_c, however, is not to be taken less than 96% and need not be taken greater than 97% of the total waterline length of the combination measured at 85% of the least molded depth of the barge.

6.2 Where the pusher tug of the combination is acting as a single unit, the freeboard and bow height is not to be less than that provided in this part.

6.3 The freeboard and bow height of the barge is not to be less than the greater of the values calculated below:

Where the barge is acting as a single unit, the freeboard and bow height is not to be less than that provided in this part.

Where the combination is acting as a single unit, the freeboard and bow height is to be assigned according to the requirements in relation to barges in this PART of the Guidelines. For this purpose, the length is to be taken as L_c, the ship width and moulded depth is to be taken as those required for barges, and displacement is to be taken as that required for the combination, according to L_c.

Chapter 3 COMPUTATION FOR FREEBOARD

1 Basic freeboard

1.1 Calculation formula of basic freeboard

1.1.1 Basic freeboard F_o is to be calculated as follows:

$$F_o = KD_1 \quad \text{mm}$$

where: K— coefficient, determined according to 1.2, 1.3 and 1.7 of this chapter;
D_1— depth for freeboard, in m.

1.2 Type A ships

1.2.1 A type A ship is one which:
(1) is designed to carry only liquid cargoes in bulk;
(2) has a high integrity of the exposed deck with only small access openings to cargo compartments, closed by watertight gasketed covers of steel or equivalent material; and
(3) has low permeability of loaded cargo compartments.

1.2.2 *K* values for type A ships are to be obtained from Appendix 1 of this PART.

1.3 Type B ships

1.3.1 All ships which do not come within the provisions regarding type A ships are to be considered as type B ships.

1.3.2 *K* values of type B ships are to be obtained from Appendix 2 of this PART.

1.3.3 For any type B ship over 100 m in length, *K* values may be reduced by not more than 60% of the difference between the tabular values in Appendix 1 and Appendix 2 (this kind of ship is called a B-60 ship), provided that the following conditions are complied with:
(1) the measures provided for the protection of the crew are adequate;
(2) the freeing arrangements are adequate;
(3) the covers in position 1 and 2 comply with the provisions of 2.5 of Chapter 2 and have adequate strength, special care being given to their sealing and se curing arrangements; and
(4) the ship, when loaded in accordance with the requirements of 1.4 of this Chapter, is to be able to withstand the flooding of any compartment or compartments (except for machinery space), with an assumed permeability of 0.7, consequent upon the damage assumptions specified in 1.5 of this Chapter, and is to remain afloat in a satisfactory condition of equilibrium, as specified in 1.6 of this Chapter.

1.3.4 For any type B ship over 100 m in length, *K* values may be reduced. The reduction may be increased up to the total difference between the tabular values in Appendix 1 and Appendix 2 (this kind of ship is called a B-100 ship), provided that the following conditions are complied with:
(1) the requirements in 4.1, 4.2 and 4.4 of Chapter 2;
(2) the requirements of 1.3.3 of this Chapter; and
(3) the requirements of 1.5 (except for 1.5.7) of this Chapter, provided that throughout the length of the ship any one transverse bulkhead will be assumed to be damaged, such that two adjacent fore and aft compartments are to be flooded simultaneously, except that such damage will not apply to the boundary bulkheads of a machinery space.

1.4 Initial condition of loading

1.4.1 Before flooding the ship is loaded to its summer load waterline on an imaginary even keel.

1.4.2 The vertical center of gravity before flooding is to be determined as follows:
(1) Homogeneous cargo is carried;
(2) All cargo compartments, except those referred to under 1.4.2(3) of this Chapter, but including compartments intended to be partially filled, are to be considered fully loaded except that in the case of fluid cargoes each compartment is to be treated as 98% full;
(3) If the ship is intended to operate at its summer load waterline with empty compartments, such

compartments are to be considered empty, provided the height of the centre of gravity so calculated is not less than as calculated under 1.4.2(2) of this Chapter;
(4) 50% of the individual total capacity of all tanks and spaces fitted to contain consumable liquids and stores is allowed for. It is to be assumed that for each type of liquid at least one transverse pair or a single centreline tank has maximum free surface, and the tank or combination of tanks to be taken into account are to be those where the effect of free surfaces is the greatest; in each tank the centre of gravity of the contents is to be taken at the centre of volume of the tank. The remaining tanks are to be assumed either completely empty or completely filled, and the distribution of consumable liquids among these tanks is to be effected so as to obtain the greatest possible height above the keel for the centre of gravity;
(5) At an angle of heel of not more than 5 ° in each compartment containing liquids, as prescribed in 1.4.2(2) of this Chapter, except that in the case of compartments containing consumable fluids, as prescribed in 1.4.2(4) of this Chapter, the maximum free surface effect, is to be taken into account. Alternatively, the actual free surface effects may be used, provided the methods of calculation are acceptable;
(6) Weights are to be calculated on the basis of the following values for specific gravities:

salt water	1.025
fresh water	1.000
oil fuel	0.950
diesel oil	0.900
lubricating oil	0.900

1.5 Damage assumptions

1.5.1 The vertical extent of damage in all cases is assumed to be from the base line upwards without limit.

1.5.2 The transverse extent of damage is equal to B/5 or 11.5 m, whichever is the lesser, measured inboard from the side of the ship perpendicularly to the centreline at the level of the summer load waterline.

1.5.3 If damage of a lesser extent than specified in 1.5.1 and 1.5.2 of this Chapter results in a more severe condition, such lesser extent is to be assumed.

1.5.4 Except where otherwise required by 1.3.4 of this Chapter, the flooding is to be confined to a single compartment between adjacent transverse bulkheads, provided that the inner longitudinal boundary of the compartment is not in a position within the transverse extent of assumed damage. Transverse boundary bulkheads of wing tanks, which do not extend over the full breadth of the ship are to be assumed not to be damaged, provided that they extend beyond the transverse extent of assumed damage prescribed in 1.5.2 of this Chapter.
If in a transverse bulkhead there are steps or recesses of not more than 3 m in length, located within the transverse extent of assumed damage as defined in 1.5.2 of this Chapter, such transverse bulkhead may be considered intact and the adjacent compartment may be floodable singly. If, however, within the transverse extent of assumed damage there is a step or recess of more than 3 m in length in a transverse bulkhead, the two compartments adjacent to this bulkhead are to be considered as flooded. The step formed by the afterpeak bulkhead and the afterpeak tank top is not to be regarded as a step for the purpose of this paragraph.

1.5.5 Where a main transverse bulkhead is located within the transverse extent of assumed damage and is stepped in way of a double bottom or side tank by more than 3 m, the double bottom or side tanks adjacent to the stepped portion of the main transverse bulkhead are to be considered as flooded simultaneously. If this side tank has openings into one or several holds, such as grain feeding holes, such hold or holds are to be considered as flooded simultaneously. Similarly, in a ship designed for the carriage of fluid cargoes, if a side tank has openings into adjacent compartments, such adjacent compartments are to be considered as empty and as being flooded simultaneously. This provision is applicable even where such openings are fitted with closing appliances, except in the case of sluice valves fitted in bulkheads between tanks and where the valves are controlled from the deck. Manhole covers with closely spaced bolts are considered

equivalent to the unpierced bulkhead, except in the case of openings in topside tanks making the topside tanks common to the holds.

1.5.6 The main transverse watertight bulkheads are to be spaced at least $L^{2/3}/3$ or 14.5 m, whichever is the lesser. Where transverse bulkheads are spaced at a lesser distance, one or more of these bulkheads are to be assumed as non-existent.

1.5.7 Damage is to be assumed to occur at any position along the ship length, but the main transverse bulkheads which are to be spaced as required in 1.5.6 are not included, and machinery spaces are also excluded.

1.6 Condition of equilibrium

1.6.1 The final waterline after flooding, taking into account sinkage, heel an trim, is below the lower edge of any opening through which progressive downflooding may take place. Such openings are to include air pipes, ventilators (even if they comply with 2.8.4 of Chapter 2) and openings which are closed by means of weathertight doors (even if they comply with 2.1 of Chapter 2) or hatch covers (even if they comply with 2.5 of Chapter 2) and may exclude those openings closed by means of manhole covers and flush scuttles (which comply with 2.7 of Chapter 2), cargo hatch covers of the type described in 4.3 of Chapter 2, remotely operated sliding watertight doors, and sidescuttles of the non-opening type (which comply with 2.13 of Chapter 2). However, in the case of doors separating a main machinery space from a steering gear compartment, watertight doors may be of a hinged, quick-acting type kept closed at sea whilst not in use, provided also that the lower sill of such doors is above the summer load waterline.

1.6.2 If pipes, ducts or tunnels are situated within the assumed extent of damage penetration as defined in 1.5.2 of this Chapter, arrangements are to be made so that progressive flooding cannot thereby extend to compartments other than those assumed to be floodable in the calculation for each case of damage.

1.6.3 The angle of heel due to unsymmetrical flooding does not exceed 15°. If no part of the deck is immersed, an angle of heel of up to 17° may be accepted.

1.6.4 The metacentric height in the flooded condition is positive.

1.6.5 When any part of the deck outside the compartment assumed flooded in a particular case of damage is immersed, or in any case where the margin of stability in the flooded condition may be considered doubtful, the residual stability is to be investigated. It may be regarded as sufficient if the righting lever curve has a minimum range of 20° beyond the position of equilibrium with a maximum righting lever of at least 0.1 m within this range. The area under the righting lever curve within this range is not to be less than $0.0175\text{m} \cdot \text{rad}$.
The potential hazard presented by protected or unprotected openings which may become temporarily immersed within the range of residual stability is to be considered.

1.6.6 The stability is to be sufficient during intermediate stages of flooding.

1.7 Ships without means of propulsion

1.7.1 A lighter, barge or other ship without independent means of propulsion is to be assigned a freeboard in accordance with the provisions of this Chapter. For barges which meet the requirements of 1.2.1 of this Chapter, *K* values may be obtained from Appendix 1 of this PART.

1.7.2 For barges with cargo on the weather deck, *K* values may be obtained from Appendix 2 of this PART.

1.7.3 However, in the case of barges which are unmanned or other unmanned ships without means of propulsion, the requirements of 3.2 and 4.2 of Chapter 2 and 2.5 of this Chapter are not to apply.

1.7.4 Such unmanned barges or other unmanned ships without means of propulsion which have on the freeboard deck only small access openings closed by watertight gasketed covers of steel or equivalent material may be assigned a freeboard 25% less than those calculated in accordance with this Chapter.

2 Correction to the freeboard

2.1 Freeboard correction for block coefficient

2.1.1 The freeboard correction f_1 for block coefficient is to be calculated as follows:

$$f_1 = 0.6F_o(C_b - 0.68) \quad \text{mm}$$

where: F_o— Basic freeboard, in mm, determined according to 1.1 of this Chapter;
C_b— block coefficient, to be taken not less than 0.68.

2.1-1 Correction for recess in freeboard deck

2.1-1.1 Where a recess is arranged in the freeboard deck, and it does not extend to the sides of the ship, the freeboard calculated without regard to the recess is to be corrected for the consequent loss of buoyancy. The correction is to be equal to the value obtained by dividing the volume of the recess by the waterplane area of the ship at 85% of the least moulded depth (see figure 2.1-1.1).

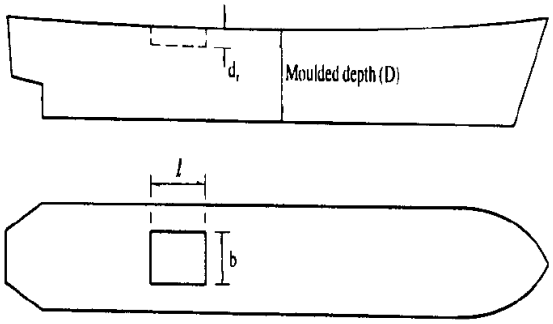


Figure 2.1-1.1

2.1-1.2 The correction is to be an addition to the freeboard obtained after all other corrections have been applied, except bow height correction.

2.1-1.3 Where the freeboard, corrected for lost buoyancy as above, is greater than the minimum geometric freeboard determined on the basis of a moulded depth measured to the bottom of the recess, the latter value may be used.

Correction is the addition to freeboard equal to: $\dfrac{l \times b \times d_r}{WP\ Area\ at\ 0.85D}$

2.2 Freeboard correction for superstructures and trunks

2.2.1 Standard height of superstructure

The standard height of a superstructure is to be as given in Table 2.2.1:

Standard height of superstructure (in m) **Table 2.2.1**

Ship length L (m)	Raised quarterdeck	All other superstructures
$L \leq 30$	0.90	1.80
75	1.20	1.80
$L \geq 125$	1.80	2.30

The standard heights at intermediate lengths of the ship are to be obtained by linear interpolation.

2.2.2 Length of superstructure

(1) Except as provided in 2.2.2(2) of this Chapter, the length of a superstructure (S) is to be the mean length of the parts of the superstructure which lie within the length (L).

(2) Where the end bulkhead of an enclosed superstructure extends in a fair convex curve beyond its intersection with the superstructure sides, the length of the superstructure may be increased on the basis of an equivalent plane bulkhead. This increase is to be two-thirds of the fore and aft

extent of the curvature. The maximum curvature which may be taken into account in determining this increase is one-half the breadth of the superstructure at the point of intersection of the curved end of the superstructure with its side.

2.2.3 Effective length of superstructure

(1) Except as provided for in 2.2.3(2) of this Chapter, the effective length of an enclosed superstructure of standard height is to be its length.

(2) In all cases where an enclosed superstructure of standard height is set-in from the sides of the ship as permitted in 2.1(10) of Chapter 1, the effective length is to be the length modified by the ratio of b/Bs, where: b is the breadth of the superstructure at the middle of its length; and B_s is the breadth of the ship at the middle of the length of the superstructure.

Where a superstructure is set-in for a part of its length, this modification is to be applied only to the set-in part.

(3) Where the height of an enclosed superstructure is less than the standard height, the effective length is to be its length reduced in the ratio of the actual height to the standard height. Where the height exceeds the standard, no increase is to be made to the effective length of the superstructure.

(4) The effective length of a raised quarter deck, if fitted with an intact front bulkhead, is to be its length up to a maximum of 0.6 L. Where the bulkhead is not intact, the raised quarter deck is to be treated as a poop of less than standard height.

(5) Superstructures which are not enclosed are to have no effective length.

2.2.4 Efficient trunks

A trunk or similar structure which does not extend to the sides of the ship is to be regarded as efficient on the following conditions:

(1) the trunk is at least as strong as a superstructure;

(2) the hatchways are in the trunk deck, the hatchway coamings and covers comply with the requirements of 2.2 to 2.5 of Chapter 2 inclusive and the width of the trunk deck stringer provides a satisfactory gangway and sufficient lateral stiffness. However, small access openings with watertight covers may be permitted in the freeboard deck;

(3) a permanent working platform fore and aft fitted with guard rails is provided by the trunk deck, or by detached trunks connected to superstructures by efficient permanent gangways;

(4) ventilators are protected by the trunk, by watertight covers or by other equivalent means;

(5) open rails are fitted on the weather parts of the freeboard deck in way of the trunk for at least half their length or, alternatively, freeing port area in the lower part of the bulwarks, subject to 3.1.3 of Chapter 2, of 33% of the total area of the bulwarks is provided;

(6) the machinery casings are protected by the trunk, by a superstructure of at least standard height, or by a deckhouse of the same height and of equivalent strength;

(7) the breadth of the trunk is at least 60% of the breadth of the ship; and

(8) where there is no superstructure, the length of the trunk is at least 0.6L.

2.2.5 Full length of efficient trunk

(1) The full length of an efficient trunk reduced in the ratio of its mean breadth to B is to be its effective length.

(2) The standard height of a trunk is the standard height of a superstructure other than a raised quarter deck.

(3) Where the height of a trunk is less than the standard height, its effective length is to be reduced in the ratio of the actual to the standard height. Where the height of hatchway coamings on the trunk deck is less than that required under 2.4.1 of Chapter 2, a reduction from the actual height of trunk is to be made which corresponds to the difference between the actual and the required height of coaming.

(4) Where the trunk height is less than standard and the trunk hatch coamings are also of less than standard height, or omitted entirely, the reduction from the actual height of trunk on account of insufficient hatch coaming height is to be taken as the difference between 600 mm and the actual height of coaming, or 600 mm if no hatch coamings are fitted. Reduction in the actual height of trunk is not to be required in cases where only small hatches with less than standard height are fitted in the trunk deck for which the requirement of standard coaming height may not be considered.

(5) Continuous hatchways may be treated as a trunk in the freeboard computation, provided the provisions of this paragraph are complied with in all respects. The trunk deck stringer referred to in the above (2) may be fitted outboard of the trunk side bulkhead in association with the following:

① the stringer so formed is to provide a clear walkway of at least 450 mm in width on each side of the ship;

② the stringer is to be of solid plate, efficiently supported and stiffened;

③ the stringer is to be as high above the freeboard deck as practicable. In the freeboard calculation, the trunk height is to be reduced by at least 600 mm or by the actual difference between the top of the trunk and the stringer, whichever is greater;

④ hatch cover securing appliances are to be accessible from the stringer or walkway; and

⑤ the breadth of the trunk is to be measured between the trunk side bulkheads.

(6) Where the trunk adjoining the superstructures such as poop, bridge or forecastle is included in the calculation of freeboard, openings are not to be arranged in that part of the bulkhead which is common for the trunk and superstructure. A relaxation may be made for small openings such as for piping, cable or manholes with covers attached by means of bolts.

(7) The sides of a trunk included in the calculation of freeboard are to be intact. Side scuttles of the non-opening type and bolted manhole covers may be allowed.

2.2.6 Freeboard correction for efficient superstructures and trunks

Freeboard correction f_2 for efficient superstructures and trunks is to be calculated as follows:

$$f_2 = -C(80 + 4L) \quad \text{mm}$$

where: L— Length of the ship, in m; when L >120m, it is still to be taken as 120 m;

$$C = (1 + \frac{E}{L})\frac{E}{L}$$

where: E— the total effective length of superstructures and trunks, in m. Where the effective length of a forecastle for type B ships is less than $0.07L$, the coefficient C is to be reduced by a value obtained from the following formula:

$$\frac{0.07L - e}{0.7L}$$

where: e — the effective length of the forecastle, in m.

2.3 Freeboard correction for non-standard sheer

2.3.1 Determination method of sheer

(1) The sheer is to be measured from the deck at side to a line of reference drawn parallel to the keel through the sheer line amidships.

(2) In ships designed with a rake of keel, the sheer is to be measured in relation to a reference line drawn parallel to the design load waterline.

(3) In flush deck ships and in ships with detached superstructures the sheer is to be measured at the freeboard deck.

(4) In ships with topsides of unusual form in which there is a step or break in the topsides, the sheer is to be considered in relation to the equivalent depth amidships.

(5) In ships with a superstructure of standard height which extends over the whole length of the freeboard deck, the sheer is to be measured at the superstructure deck.

2.3.2 Shear area

(1)The area bounded by forward and after perpendiculars and sheer line and a line parallel to the design waterline through the sheer line amidships on the profile is to be taken as the sheer area.

(2) Where a superstructure extends over the whole length of the freeboard deck and the height of which exceeds the standard height, the forward and after sheer area are to be increased by $\frac{LZ}{6}$ (m^2) respectively, where: L is the length of ship, in m; Z is difference between actual and standard height of superstructure, in m.

(3)Where an enclosed poop or forecastle is of more than standard height, or with greater sheer than that of the freeboard deck, the forward or after sheer area are to be increased by $\frac{YL_1}{3}$ (m^2),

respectively, where: Y is the difference between actual and standard height of superstructure at the after or forward perpendicular, in m; L_1 is the mean enclosed length of poop or forecastle up to a maximum length of 0.5 L, in m.

(4) Standard sheer area A is to be taken from Table 2.3.2(4).

Standard Sheer Area *A* **Table 2.3.2(4)**

L (m)	20	30	40	50	60	70	80	90	100	110
A (m^2)	4.2	7.5	11.7	16.7	22.5	29.2	36.7	45.0	54.2	64.2
L (m)	120	130	140	150	160	170	180	190	≥200	
A (m^2)	75.0	86.7	99.2	112.6	126.7	141.7	157.6	174.2	191.8	

Notes: (1) The forward sheer area is $\frac{2}{3}A$, and the after sheer area is $\frac{1}{3}A$.

(2) For ships at intermediate length, the sheer area is to be obtained by linear interpolation.

2.3.3 Freeboard correction for non-standard sheer area

(1) The freeboard correction f_3 for non-standard sheer area is to be calculated as follows:

$$f_3 = 500(\frac{A-a}{L})(1.5-\frac{l}{L}) \qquad \text{mm}$$

where:

L — length of ship, in m;

l — total length of enclosed superstructure, in m;

A— standard sheer area, in m^2;

a— sum of the actual forward and after sheer area, in m^2;

(2) Where the actual after sheer area is greater than $\frac{1}{3}A$ and the actual forward sheer area is less than $\frac{2}{3}A$, only the difference between $\frac{2}{3}A$ and the actual forward sheer area is to be measured.

(3) Where the actual forward sheer area is greater than $\frac{2}{3}A$ and the actual after sheer area is not less than $\frac{1}{4}A$, the difference between $\frac{2}{3}A$ and the actual forward sheer area is to be measured. Where the actual after sheer area is less than $\frac{1}{6}A$, the actual forward sheer area is to be measured as $\frac{2}{3}A$. Where the actual after sheer area is between $\frac{1}{4}A$ and $\frac{1}{6}A$, the difference between $\frac{2}{3}A$ and the actual forward sheer area is to be obtained by linear interpolation; at the same time, the difference between $\frac{1}{3}A$ and the actual after sheer area is to be measured.

(4) Addition for deficiency in sheer: where the actual sheer area is less than standard sheer area, the correction for deficiency in sheer in accordance with the above calculation is to be added to the freeboard.

(5) Deduction for excess sheer: where the actual sheer area is greater than standard sheer area and an enclosed superstructure covers 0.1L forward and 0.1 L abaft amidships, the correction for excess of sheer in accordance with the above calculation may be deducted from the freeboard. In ships where no enclosed superstructure covers amidships, no deduction is to be made from the freeboard; where an enclosed superstructure covers less than 0.1L forward and 0.1L abaft amidships, the deduction is to be obtained by linear interpolation. The maximum deduction for excess sheer is to be at the rate of 125 mm per 100 m of length.

2.4 Freeboard correction for position of deck line

2.4.1 Where the actual depth measured to the upper edge of deck line is greater or less than the depth for freeboard D_1, the difference between the depths is to be added to or deducted from the freeboard.

2.5 Minimum bow height

2.5.1 The bow height defined as the vertical distance at the forward perpendicular between the waterline corresponding the assigned summer freeboard and the designed trim and the top of the

exposed deck at side is not to be less than:

$$54L(1-\frac{L}{500})\frac{1.36}{C_b+0.68} \qquad \text{mm}$$

where: L—length of ship, in m;

C_b—block coefficient, which is to be taken as not less than 0.68.

2.5.2 For ships in service categories 1, 2 and 3, their minimum bow height may be reduced by 10%, 20% and 35% respectively, based on 2.5.1 of this Chapter.

2.5.3 Where the bow height required in 2.5.1 and 2.5.2 of this Chapter is obtained by sheer, the sheer is to extend for at least 15 percent of the length of the ship measured from the forward perpendicular. Where it is obtained by fitting a superstructure, such superstructure is to extend from the stem to a point at least 0.07 L abaft the forward perpendicular, and it is to be an enclosed superstructure as provided in 2.1(10) of Chapter 1.

2.5.4 For Class III ro-ro passenger ships and ro-ro cargo ships in service category 3 provided with only one vehicle deck with bow ramp door and mean breadth of bow deck house at each side is not less than 0.15 B and the length measured abaft from the forward perpendicular is not less than 0.07 L and the height is not less than the standard height of the superstructure, if the deck house complies with the requirements of 2.1 (10)②(a), (b) and (c) of Chapter 1 of PART THREE and the height including the deck house height being taken into account meets the requirements of 2.5.1 and 2.5.2 of this Chapter, the requirements for bow height of the Guidelines are to be deemed as being complied with.

2.5.5 For Class III ro-ro passenger ships and ro-ro cargo ships in service category 2 provided with only one vehicle deck with bow ramp door and mean breadth of bow deck house at each side is not less than 0.2 B and the length measured abaft from the forward perpendicular is not less than 0.07 L and the height is not less than the standard height of the superstructure, if the deck house complies with the requirements of 2.1 (10)②(a), (b) and (c) of Chapter 1 of PART THREE and the height including the deck house height being taken into account meets the requirements of 2.5.1 and 2.5.2 of this Chapter, the requirements for bow height of the Guidelines are to be deemed as being complied with.

2.5.6 Ships which, to suit exceptional structural and operational requirements, cannot meet the requirements of 2.5.1, 2.5.2 and 2.5.3 of this Chapter may be given special consideration of minimum bow height subject to the approval.

3 Minimum seasonal freeboard

3.1 Summer freeboard

3.1.1 Summer freeboard F is to be calculated as follows:

$$F = F_o + f_1 + f_2 + f_3 + f_4$$

where: F_o — basic freeboard, in mm; calculated in accordance with 1.1 of this Chapter;

f_1 — freeboard correction for block coefficient, in mm; calculated in accordance with 2.1 of this Chapter;

f_2 — freeboard correction for recess in freeboard deck, in mm; calculated in accordance with 2.1-1 of this Chapter;

f_3— freeboard correction for efficient superstructures and trunks, in mm; calculated in accordance with 2.2 of this Chapter;

f_4— freeboard correction for non-standard sheer, in mm; calculated in accordance with 2.3 of this Chapter.

3.1.2 For type B ships with $L \leq 50$ m, summer freeboard F as defined by 3.1.1 of this Chapter is not to be less than:

$$F = 190 + 3.5L + 0.035L^2 \quad \text{mm}$$

where: L — length of ship, in m.

3.1.3 Summer freeboard as defined in accordance with 3.1.1 to 3.1.2 of this Chapter is to be corrected by 2.4 and 2.5 of this Chapter, if applicable.

3.1.4 The summer freeboard, as calculated in accordance with 3.1.1 to 3.1.2 of this Chapter, but without the correction by 2.4 of this Chapter, is not to be less than 50 mm. For ships having in position 1 hatchways with covers which do not comply with the requirements of 2.4.4 and 2.5 of Chapter 2, the freeboard is not to be less than 150 mm.

3.2 Tropical freeboard

3.2.1 Tropical freeboard is the freeboard by a deduction from the summer freeboard of $\frac{1}{48}$ of the summer draught.

3.2.2 The freeboard in salt water, as calculated in accordance with 3.2.1 of this Chapter, but without the correction by 2.4 of this Chapter, is not to be less than 50 mm. For ships having in position 1 hatchways with covers which do not comply with the requirements of 2.4.4 and 2.5 of Chapter 2, the freeboard is not to be less than 150 mm.

3.3 Fresh water freeboard

3.3.1 The minimum freeboard in fresh water of unit density is to be obtained by deducting from the minimum freeboard in salt water: $\frac{\Delta}{40T}$(cm), where Δ is displacement in salt water in tons at the summer load waterline, in t; T is tons per cm immersion in salt water at the summer load waterline, in t/cm.

3.3.2 Where the displacement at the summer load waterline cannot be certified, the deduction is to be $\frac{1}{48}$ of summer draught measured from the top of the keel to the centre of the ring of the load line mark.

3.4 Winter freeboard

3.4.1 The minimum freeboard in winter is to be the freeboard obtained by an addition to the summer freeboard of $\frac{1}{48}$ of summer draught, measured from the top of the keel to the centre of the ring of the load line mark.

3.5 Winter North Atlantic freeboard

3.5.1 The minimum freeboard for ships of not more than 100 m in length which enter any part of the North Atlantic defined in 3.1 of Chapter 1 of this PART during the winter seasonal period is to be the winter freeboard plus 50 mm. For other ships, the winter North Atlantic freeboard is to be the winter freeboard.

Chapter 4 SPECIAL REQUIREMENTS FOR SHIPS ASSIGNED TIMBER LOAD LINES

1 General provisions

1.1 The provisions of this Chapter apply only to ships to which timber load lines are assigned.

1.2 Ships carrying a timber deck cargo on an uncovered part of a freeboard or superstructure deck (excluding wood pulp or similar cargo) may be granted a less freeboard, in accordance with this Chapter, than that required in the provisions of Chapter 3 of this PART and the corresponding timber load line marked on the ship's side.

1.3 For the purpose of assignment of timber load line, the shape and scale are illustrated in Figure 1.3.
The Summer Timber Load Line is to be indicated by a horizontal line marked "LS".
The Winter Timber Load Line is to be indicated by a horizontal line marked "LW".
The Winter North Atlantic Timber Load Line is to be indicated by a horizontal line marked "LWNA".
The Tropical Timber Load Line is to be indicated by a horizontal line marked "LT".
The Fresh Water Timber Load Line in summer is to be indicated by a horizontal line marked "LF".
The Tropical Fresh Water Timber Load Line is to be indicated by a horizontal line marked "LTF".
All above-mentioned load lines are to be coincided with the upper edge of the corresponding line respectively.

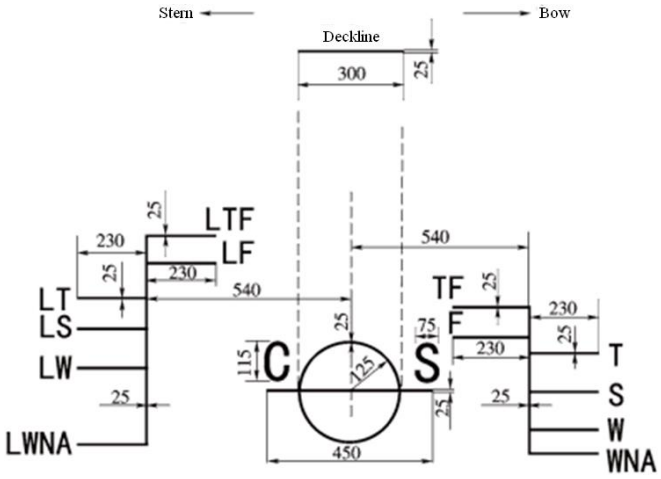


Figure 1.3 Timber load line mark (starboard)

2 Conditions of assignment of timber load line

2.1 Construction of ship

2.1.1 Superstructure

Ships are to have a forecastle of at least standard height and a length of at least 0.07 *L*. In addition, if the ship is less than 100 m in length, a poop of at least standard height, or a raised quarter deck with either a deckhouse or a strong steel hood of at least the same total height is to be fitted aft.

2.1.2 Double bottom tanks

Double bottom tanks where fitted within the midship half length of the ship are to have adequate watertight longitudinal subdivision.

2.1.3 Bulwarks

The ships are to be fitted either with permanent bulwarks of at least 1 m in height, specially stiffened on the upper edge and supported by strong bulwark stays attached to the deck and provided with necessary freeing ports, or with efficient rails of the same height and of specially strong construction.

2.2 Loading

2.2.1 Stowage

(1) Openings in the weather deck over which cargo is stowed are to be securely closed and battened down. The ventilators and air pipes are to be efficiently protected.

(2) Timber deck cargoes are to extend over at least the entire available length which is the total length of the well or wells between superstructures. Where there is no limiting superstructure at the after end, the timber is to extend at least to the after end of the aftermost hatchway. The timber deck cargo is to extend athwartships as close as possible to the ship's side, due allowance being made for obstructions such as guard rails, bulwark stays, uprights, pilot access, etc., provided any gap thus created at the side of the ship is not to exceed a mean of 4% of the breadth. The timber is to be stowed as solidly as possible to at least the standard height of the superstructure other than any raised quarter deck.

(3) The height of the deck cargo above the weather deck is not to exceed one third of the extreme breadth of the ship.

(4) The timber deck cargo is to be compactly stowed, lashed and secured. It is not to interfere in any way with the navigation and necessary work of the ship.

2.2.2 Uprights

Uprights, when required by the nature of the timber, are to be of adequate strength considering the breadth of the ship; the strength of the uprights is not to exceed the strength of the bulwark and the spacing is to be suitable for the length and character of timber carried, but is not to exceed 3 m. Strong angles or metal sockets or equally efficient means are to be provided for securing the uprights.

2.2.3 Lashings

Timber deck cargo is to be effectively secured throughout its length by a lashing system subject to approval for the character of the timber carried.

2.2.4 Stability

Provision is to be made for a safe margin of stability at all stages of the voyage, regard being given to additions of weight, such as those arising from absorption of water or icing, and to losses of weight such as those arising from consumption of fuel and stores.

2.2.5 Protection of Crew, Access to Machinery Spaces, etc.

(1) In addition to the requirements of 3.2.5 of Chapter 2, guard-rails or lifelines not more than 350 mm apart vertically are to be provided on each side of the cargo deck to a height of at least 1 m above the cargo. In addition, a wire rope set up taut with a stretching screw, is to be provided as near as practicable to the centreline of the ship. The stanchion supports to all guard-rails and lifelines are to be so spaced as to prevent undue sagging. Where the cargo is uneven a safe walking surface of not less than 600 mm in width is to be fitted over the cargo and effectively secured beneath or adjacent to the lifeline.

(2) Where the requirements prescribed in 2.2.5(1) of this Chapter are impracticable, alternative arrangements subject to agreement may be used.

2.2.6 Steering arrangements

Steering arrangements are to be effectively protected from damage by cargo and, as far as practicable, are to be accessible. Where the steering arrangements might be damaged by deck cargo, efficient provision is to be made for steering in the event of a breakdown in the main steering arrangements.

3 Computation for freeboard

3.1 The minimum summer freeboard is to be computed in accordance with the relevant requirements of Chapter 3, except that the coefficient C in the formula for freeboard correction f_2 for efficient superstructures and trunks as indicated in 2.2.6 of that Chapter is to be replaced by:

$$C = (2.24 - 0.06\frac{E}{L})\frac{E}{L} + 0.42$$

where: L— length of ship, in m;

E— total effective length of superstructures and trunks, in m.

3.2 On assigning the timber load line for type B ships with reduced freeboard, each seasonal freeboard corresponding to timber load line is to be computed in accordance with those for type B ships.

3.3 The Winter Timber Freeboard is to be obtained by adding to the Summer Timber Freeboard 1/36 of the moulded summer timber draught.

3.4 The Winter North Atlantic Timber Freeboard is to be the same as the Winter North Atlantic Freeboard prescribed in 3.5 of Chapter 3 of this PART.

3.5 The Tropical Timber Freeboard is to be obtained by deducting from the Summer Timber Freeboard 1/48 of the moulded summer timber draught.

3.6 The Fresh Water Timber Freeboard is to be computed in accordance with 3.3.1 of Chapter 3 of this PART, based on the summer timber load waterline or with 3.3.2 of Chapter 3 of this PART, based on the summer timber draught measured from the top of the keel to the summer timber load line.

Chapter 5 SPECIAL REQUIREMENTS FOR SEMI-SUBMERSIBLE SHIPS

1 Definitions

1.1 Semi-submersible vessel means a ship designed to load and unload cargoes in a semi-submerged condition, with large open weather cargo deck and fitted with a forward or aft high superstructure or deckhouse or pontoon.

1.2 Semi-submerged condition means any condition in which the lifting cargo deck is submerged and reserve buoyancy is provided by the superstructure or deckhouse or pontoon only.

1.3 Lifting cargo deck means the open deck which is used for the carriage of goods and is submerged during loading and unloading cargoes.

1.4 Maximum submerged depth means the maximum draft to which the vessel is allowed to be submerged in semi-submerged operation conditions.

2 Reserve buoyance in semi-submerged operation conditions

2.1 At the maximum submerged depth, the ratio of reserve buoyancy (ratio of the reserve buoyancy to the displacement at this draught) is to comply with the following requirements:
(1) the ratio of reserve buoyance above the maximum submerged depth waterline and below the first tier deck is not to be less than 5%; or
(2) the ratio of reserve buoyance above the maximum submerged depth waterline and below the second tier deck is not to be less than 5%, but the ratio of reserve buoyance above the maximum submerged depth waterline and below the first tier deck is not to be less than 3.5%.

3 Tightness in semi-submerged operation conditions

3.1 Weather deck, shell plating, side and end bulkheads of superstructure or deckhouse or pontoon above the maximum submerged depth waterline and below the first tier deck and all the means of closing for openings in these locations are to be of sufficient strength to ensure the watertightness. Sidescuttles are to be located at least 1 m above the maximum submerged depth waterline. The watertight door below the maximum submerged depth waterline is to be of the power-operated sliding type, and a second power-operated watertight door in other form is to be fitted. Water leakage monitoring device and appropriate drainage facilities are to be provided between the two watertight doors.

3.2 Shell plating, side and end bulkheads of superstructure or deckhouse or pontoon between the first tier and second tier decks above the maximum submerged depth waterline and all the means of closing for openings in these locations are to be of sufficient strength to ensure the weathertightness. The height between the first and second tier decks above the maximum submerged depth waterline is not to be less than that of a standard height of superstructure as specified in Chapter 3 of this PART.

3.3 Where the first tier of deck above the maximum submerged depth waterline is weather deck, the openings in the deck are to comply with the provisions for openings in position 1, as specified in Chapter 2 of this PART. Where the second tier deck above the maximum submerged depth waterline is weather deck, suitable means of closing are to be provided for the openings in the deck, and the height is to comply with the provisions for the openings in location 2, as specified in Chapter 2 of this PARAT. For machinery space ventilators above the second tier weather deck, which is extended from the first tier weather deck above the maximum submerged depth waterline, the coamings of the ventilators may be of a height not less than 760 mm above the second weather deck, provided suitable means of closing are fitted for the openings.

3.4 In respect to the requirements for piping and valves used in discharging water overboard and the requirements for sealing of rudder and stern shaft and arrangement of accommodation, the

maximum submerged depth waterline is to be considered the uppermost load line.

4 Maximum submerged depth waterline mark

4.1 The permissible maximum operating submerged depth waterline is to be marked on the side bulkheads (port and starboard) of superstructure or deckhouse or pontoon fore and aft along the sides of the ship. The maximum submerged depth waterline mark is to be a line of 450 mm in length and 25 mm in width. The upper edge of the line is to be flush with the maximum submerged depth waterline. The operating draught is indicated by the letter "W" above the left end and the letter "D" above the right end of that line, each measuring 115 mm in height and 75 mm in width.

4.2 Prior to marking the maximum operating submerged depth waterline of a semi-submerged ship, compliance of the ship with the strength requirements and the requirements for stability, load lines or other requirements for operation of ships as specified in the Guidelines is to be confirmed and indicated in the instruction for operating load line.

4.3 Compliance of the ship with the strength and stability requirements for its operation is to be summarized in the instruction for operating load line, and a marking sketch showing the maximum submerged depth waterline mark is to be attached thereto.

Chapter 6 SPECIAL REQUIREMENTS FOR MARKING OF OPERATING DRAFT OF WORKING SHIPS

1 General provisions

1.1 This Chapter applies to floating cranes, and to open hopper dredgers and barges fitted with means of opening at their bottom (these three types of ships are hereinafter referred to as working ship).

1.2 For working ships, the maximum operating draught may be assigned and such draught appropriately marked in accordance with this Chapter.

1.3 In operational areas defined by the limited sea conditions in 3.17.2 of Chapter 7 of PART FOUR, the process of hoisting and handling operations of floating cranes, that of dredging operations of dredgers and that of loading, carrying and discharging operations of dredgers and barges are considered as their operating conditions.

1.4 The intact stability of working ships in operating conditions is to comply with the requirements of 3.17 of Chapter 7 of PART FOUR, or alternatively, their compliance with the requirements of the flag Administration for intact stability regarding assignment of operating draught is to be confirmed.

2 Assignment of operating draught

2.1 For working ships intended for assignment of operating draught, the maximum operating draught is to be assigned in accordance with this Chapter, based on the minimum summer freeboard corresponding to type B freeboard as specified in the amendments to the protocol of 1988 relating to the International Convention on Load Lines, 1966 (IMO resolution MSC.143(77)).

2.2 Where all requirements of this Chapter are complied with, the maximum draught of working ships in operation may correspond to a freeboard reduced by 2/3 of the minimum summer freeboard referred to in 2.1.

3 Special requirements for assigning operating draught of dredgers and barges

3.1 No bulwark is to be fitted on the freeboard deck abreast of any hopper which is an open hopper.

3.2 Means for overflow of process water is to be arranged for open hoppers as follows:
(1) through the overflow opening of the hopper coaming, the area of which at each side of the coaming is not to be less than 5% of that of that side of the coaming; or
(2) through overflow ducts in the hopper walls, the area of which at each side is not to be less than $0.35(L_h)^2/1000$ m^2, or $Q/6$ m^2, whichever is the greater, where L_h is the maximum length of the hopper in metres; Q is the total maximum water capacity of the suction dredge pumps, in m^3/sec; or
(3) through adjustable overflows, the area of which at each side is as given in (2) above; or
(4) using upper edge of hopper coaming as overflow opening.

3.3 In respect to the requirements for piping and valves used in discharging water overboard and the requirements for location of side scuttles or doors, the maximum operating draught is to be considered the uppermost load line or summer load waterline.

3.4 The spoil dumping system at bottom of the hopper is to be capable of discharging the spoil by gravity, such that the ship is to increase its draught from the maximum operating draught to the summer load waterline within 8 minutes using normal operation of the dumping system.

3.5 An accurate draught indicator, capable of showing fore, aft and midship draught, is to be fitted at the navigating bridge.

4 Operating draught mark

4.1 The permissible maximum operating draught line is to be permanently marked on both sides of the working ship, placed 540 mm aft of the centre of the load line mark. The maximum operating draught mark is to be a horizontal line of 25 mm in width and 450 mm in length. The upper edge of the line is to be flush with the maximum operating draught line. The operating draught is indicated by the letter W above the left end and the letter D above the right end of that line, each measuring 115 mm in height and 75 mm in width, as shown in Figure 4.1.

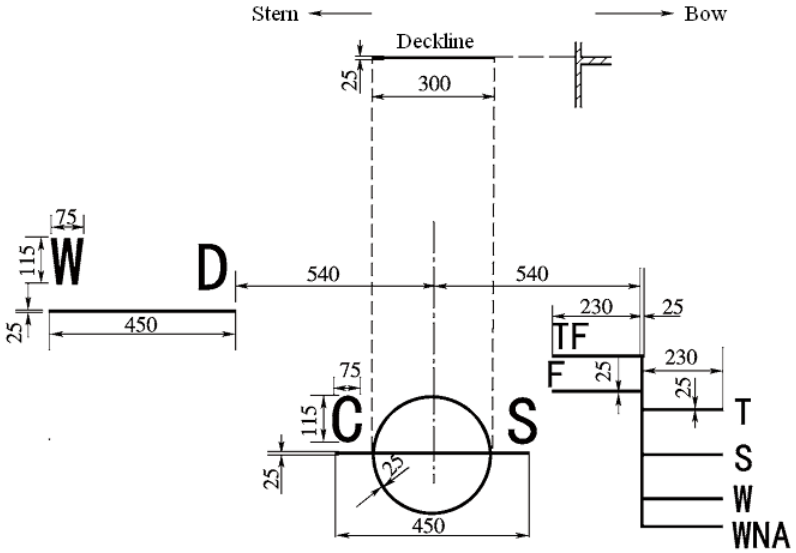


Figure 4.1 Operating Draught Mark (Starboard)

4.2 Prior to marking the maximum operating draught of a working ship, compliance of the ship with the stability requirements and other special requirements for operation of working ships is to be confirmed and indicated in the instruction for marking operating draught.

4.3 Limitations on sea conditions for operations of the working ship are to be clearly defined, compliance of the ship with the stability requirements and other special requirements for its operation summarized in the instruction for marking operating draught, and a marking sketch showing the maximum operating draught line is to be attached thereto.

Appendix 1 *K* Values for type A ships

L (m)	*K*	*L* (m)	*K*	*L* (m)	*K*	*L* (m)	*K*
20	100.2	73	132.6	126	177.6	179	195.7
21	100.5	74	133.5	127	178.4	180	195.6
22	100.8	75	134.3	128	179.3	181	195.6
23	101.1	76	135.1	129	180.1	182	195.5
24	101.5	77	135.9	130	180.9	183	195.5
25	101.9	78	136.7	131	181.8	184	195.4
26	102.3	79	137.5	132	182.6	185	195.4
27	102.7	80	138.4	133	183.3	186	195.3
28	103.2	81	139.2	134	184.0	187	195.2
29	103.7	82	140.0	135	184.7	188	195.1
30	104.2	83	140.9	136	185.4	189	195.0
31	104.7	84	141.7	137	186.1	190	194.9
32	105 2	85	142.5	138	186.7	191	194.8
33	105.7	86	143.4	139	187.3	192	194.7
34	106.3	87	144.2	140	187.9	193	194.6
35	106.8	88	145.0	141	188.5	194	194.4
36	107.4	89	145.9	142	189.0	195	194.3
37	108.0	90	146.8	143	189.5	196	194.2
38	108.5	91	147.7	144	190.0	197	194.0
39	109.0	92	148.5	145	190.4	198	193.8
40	109.7	93	149.4	146	190.8	199	193.6
41	110.3	94	150.3	147	191.2	200	193.5
42	110.9	95	151.1	148	191.6	20l	193.3
43	111.5	96	152.0	149	191.9	202	193.1
44	112.1	97	152.9	150	192.2	203	192.9
45	112.7	98	153.7	151	192.5	204	192.7
46	113.3	99	154.6	152	192.8	205	192.5
47	114.0	100	155.5	153	193.1	206	192.3
48	l14.6	101	156.4	154	193.3	207	192.1
49	115.3	102	157.3	155	193.6	208	191.9
50	116.0	103	158.2	156	193.9	209	191.6
5l	116.6	104	159.1	157	194.1	210	191.4
52	117.3	105	160.0	158	194.3	21l	191.2
53	118.0	106	160.9	159	194.5	212	191.0
54	118.7	107	161.7	160	194.6	213	190.7
55	119.4	108	162.6	161	194.8	214	190.5
56	120.0	109	163.5	162	195.0	215	190.3
57	120.7	110	164.4	163	195.1	216	190.0
58	121.4	111	165.3	164	195.2	217	189.7
59	122.1	112	166.1	165	195.3	218	189.5
60	122.8	113	166.9	166	195.4	219	189.2
6l	123.6	114	167.8	167	195.5	220	188.9
62	124.4	115	168.6	168	195.6	221	188.7
63	125.1	116	169.4	16q	195.6	222	188.4
64	125_8	117	170.3	170	195.6	223	188.1
65	126.6	118	171.1	171	195.6	224	187.8
66	127,3	119	171.9	172	195.6	225	187.5
67	128.0	120	172.7	173	195.7	226	187.2
68	128.8	121	173.5	174	195.7	227	186.9
69	129.5	122	174.3	175	195.7	228	186.6
70	130.2	123	175.1	176	195.7	229	186.3
71	131.0	124	175.9	177	195.7	230	186.0
72	131.9	125	176.8	178	195.7		

Appendix 2 *K* Values for type B ships

L (m)	*K*	*L* (m)	*K*	*L* (m)	*K*	*L* (m)	*K*
20	113.7	74	147.5	128	210.8	182	237.0
21	113.9	75	148.7	129	211_8	183	237.2
22	114.1	76	149.8	130	212.7	184	237.3
23	114.3	77	150.9	131	213.6	185	237.4
24	114.5	78	152.0	132	214.4	186	237.6
25	114.8	79	153.1	133	215.2	187	237.7
26	115.1	80	154.1	134	216.0	188	237.8
27	115.4	81	155.2	135	216.9	189	237.9
28	115.7	82	156.4	136	217.7	190	238.0
29	116.0	83	157.5	137	218.5	191	238.1
30	116.3	84	158.7	138	219.2	192	238.1
31	116.6	85	159.9	139	219.9	193	238.1
32	116.9	86	161.1	140	220.6	194	238.1
33	117.3	87	162.2	141	221.3	195	238.2
34	117.8	88	163.2	142	222.0	196	238.2
35	118.3	89	164.2	143	222.7	197	238.2
36	118.8	90	165.3	144	223.3	198	238.3
37	119.3	91	166.5	145	223.9	199	238.3
38	119.8	92	167.7	146	224.5	200	238.3
39	120.4	93	169.0	147	225.1	201	238.3
40	120.9	94	170.2	148	225.7	202	238.3
41	121.5	95	171.4	149	226.3	203	238.3
42	122.0	96	172.5	150	226.8	204	238.3
43	122.6	97	173.7	151	227.3	205	238.2
44	123.3	98	174.9	152	227.8	206	238.2
45	123.9	99	176.2	153	228.3	207	238.2
46	124.5	l00	177.5	154	228.7	208	238.1
47	125.1	101	178.8	155	229.2	209	238.1
48	125.7	102	180.0	156	229.6	210	238.0
49	126.3	103	181.3	157	230.0	211	237.9
50	126.9	104	182.6	158	230.4	212	237.7
51	127.5	105	183.9	159	230.8	213	237.6
52	128.2	106	185.2	160	231.2	214	237.5
53	128.9	107	186.5	161	231.3	215	237.4
54	129.6	108	187.8	162	231.9	216	237.4
55	130.4	109	189.1	163	232.3	217	237.3
56	131.2	110	190.4	164	232.7	218	237.2
57	132.0	111	191.7	165	233.0	219	237.1
58	132.8	112	193.0	166	233.3	220	237.0
59	133.6	113	194.3	167	233.6	221	236.9
60	134.3	114	195.6	168	233.9	222	236.8
6l	135.0	115	196.8	169	234.2	223	236.7
62	135.7	116	198.0	170	234.4	224	236.5
63	136.5	117	199.2	171	234.7	225	236.4
64	137.4	118	200.3	172	235.0	226	236.3
65	138.3	119	201.4	173	235.2	227	236.1
66	139.2	1 20	202.5	174	223.5	228	236.0
67	140.2	121	203.6	175	235.7	229	235.9
68	141.2	122	204.7	176	236.0		
69	142.2	123	205.8	177	236.2		
70	143.2	124	206.8	178	236.3		
71	144.2	125	207.8	179	236.5		
72	145.3	126	208.8	180	236.6		
73	146.4	127	209.8	181	236.8		