

# Hull Structure and Arrangement for the Classification of Cargo Ships less than 65 m and Non Cargo Ships less than 90 m

**November 2018**  
NR 600 DT R03



Rule Note



**Documents**

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**RULES & GUIDANCE NOTES**

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## GENERAL CONDITIONS

## 1. INDEPENDENCE OF THE SOCIETY AND APPLICABLE TERMS

- 1.1 The Society shall remain at all times an independent contractor and neither the Society nor any of its officers, employees, servants, agents or subcontractors shall be or act as an employee, servant or agent of any other party hereto in the performance of the Services.
- 1.2 The operations of the Society in providing its Services are exclusively conducted by way of random inspections and do not, in any circumstances, involve monitoring or exhaustive verification.
- 1.3 The Society acts as a services provider. This cannot be construed as an obligation bearing on the Society to obtain a result or as a warranty. The Society is not and may not be considered as an underwriter, broker in Unit's sale or chartering, expert in Unit's valuation, consulting engineer, controller, naval architect, designer, manufacturer, shipbuilder, repair or conversion yard, charterer or shipowner; none of them above listed being relieved of any of their expressed or implied obligations as a result of the interventions of the Society.
- 1.4 The Society only is qualified to apply and interpret its Rules.
- 1.5 The Client acknowledges the latest versions of the Conditions and of the applicable Rules applying to the Services' performance.
- 1.6 Unless an express written agreement is made between the Parties on the applicable Rules, the applicable Rules shall be the Rules applicable at the time of entering into the relevant contract for the performance of the Services.
- 1.7 The Services' performance is solely based on the Conditions. No other terms shall apply whether express or implied.

## 2. DEFINITIONS

- 2.1 "Certificate(s)" means classification or statutory certificates, attestations and reports following the Society's intervention.
- 2.2 "Certification" means the activity of certification in application of national and international regulations or standards, in particular by delegation from different governments that can result in the issuance of a Certificate.
- 2.3 "Classification" means the classification of a Unit that can result or not in the issuance of a classification Certificate with reference to the Rules. Classification is an appraisalment given by the Society to the Client, at a certain date, following surveys by its surveyors on the level of compliance of the Unit to the Society's Rules or to the documents of reference for the Services provided. They cannot be construed as an implied or express warranty of safety, fitness for the purpose, seaworthiness of the Unit or of its value for sale, insurance or chartering.
- 2.4 "Client" means the Party and/or its representative requesting the Services.
- 2.5 "Conditions" means the terms and conditions set out in the present document.
- 2.6 "Industry Practice" means international maritime and/or offshore industry practices.
- 2.7 "Intellectual Property" means all patents, rights to inventions, utility models, copyright and related rights, trade marks, logos, service marks, trade dress, business and domain names, rights in trade dress or get-up, rights in goodwill or to sue for passing off, unfair competition rights, rights in designs, rights in computer software, database rights, topography rights, moral rights, rights in confidential information (including know-how and trade secrets), methods and protocols for Services, and any other intellectual property rights, in each case whether capable of registration, registered or unregistered and including all applications for and renewals, reversions or extensions of such rights, and all similar or equivalent rights or forms of protection in any part of the world.
- 2.8 "Parties" means the Society and Client together.
- 2.9 "Party" means the Society or the Client.
- 2.10 "Register" means the public electronic register of ships updated regularly by the Society.
- 2.11 "Rules" means the Society's classification rules and other documents. The Society's Rules take into account at the date of their preparation the state of currently available and proven technical minimum requirements but are not a standard or a code of construction neither a guide for maintenance, a safety handbook or a guide of professional practices, all of which are assumed to be known in detail and carefully followed at all times by the Client.
- 2.12 "Services" means the services set out in clauses 2.2 and 2.3 but also other services related to Classification and Certification such as, but not limited to: ship and company safety management certification, ship and port security certification, maritime labour certification, training activities, all activities and duties incidental thereto such as documentation on any supporting means, software, instrumentation, measurements, tests and trials on board. The Services are carried out by the Society according to the applicable referential and to the Bureau Veritas' Code of Ethics. The Society shall perform the Services according to the applicable national and international standards and Industry Practice and always on the assumption that the Client is aware of such standards and Industry Practice.
- 2.13 "Society" means the classification society 'Bureau Veritas Marine & Offshore SAS', a company organized and existing under the laws of France, registered in Nanterre under number 821 131 844, or any other legal entity of Bureau Veritas Group as may be specified in the relevant contract, and whose main activities are Classification and Certification of ships or offshore units.
- 2.14 "Unit" means any ship or vessel or offshore unit or structure of any type or part of it or system whether linked to shore, river bed or sea bed or not, whether operated or located at sea or in inland waters or partly on land, including submarines, hovercrafts, drilling rigs, offshore installations of any type and of any purpose, their related and ancillary equipment, subsea or not, such as well head and pipelines, mooring legs and mooring points or otherwise as decided by the Society.

## 3. SCOPE AND PERFORMANCE

- 3.1 Subject to the Services requested and always by reference to the Rules, the Society shall:
- review the construction arrangements of the Unit as shown on the documents provided by the Client;
  - conduct the Unit surveys at the place of the Unit construction;
  - class the Unit and enter the Unit's class in the Society's Register;
  - survey the Unit periodically in service to note whether the requirements for the maintenance of class are met.
- The Client shall inform the Society without delay of any circumstances which may cause any changes on the conducted surveys or Services.
- 3.2 The Society will not:
- declare the acceptance or commissioning of a Unit, nor its construction in conformity with its design, such activities remaining under the exclusive responsibility of the Unit's owner or builder;
  - engage in any work relating to the design, construction, production or repair checks, neither in the operation of the Unit or the Unit's trade, neither in any advisory services, and cannot be held liable on those accounts.

## 4. RESERVATION CLAUSE

- 4.1 The Client shall always: (i) maintain the Unit in good condition after surveys; (ii) present the Unit for surveys; and (iii) inform the Society in due time of any circumstances that may affect the given appraisalment of the Unit or cause to modify the scope of the Services.
- 4.2 Certificates are only valid if issued by the Society.
- 4.3 The Society has entire control over the Certificates issued and may at any time withdraw a Certificate at its entire discretion including, but not limited to, in the following situations: where the Client fails to comply in due time with instructions of the Society or where the Client fails to pay in accordance with clause 6.2 hereunder.
- 4.4 The Society may at times and at its sole discretion give an opinion on a design or any technical element that would 'in principle' be acceptable to the Society. This opinion shall not presume on the final issuance of any Certificate or on its content in the event of the actual issuance of a Certificate. This opinion shall only be an appraisal made by the Society which shall not be held liable for it.

## 5. ACCESS AND SAFETY

- 5.1 The Client shall give to the Society all access and information necessary for the efficient performance of the requested Services. The Client shall be the sole responsible for the conditions of presentation of the Unit for tests, trials and surveys and the conditions under which tests and trials are carried out. Any information, drawing, etc. required for the performance of the Services must be made available in due time.
- 5.2 The Client shall notify the Society of any relevant safety issue and shall take all necessary safety-related measures to ensure a safe work environment for the Society or any of its officers, employees, servants, agents or subcontractors and shall comply with all applicable safety regulations.

## 6. PAYMENT OF INVOICES

- 6.1 The provision of the Services by the Society, whether complete or not, involve, for the part carried out, the payment of fees thirty (30) days upon issuance of the invoice.

6.2 Without prejudice to any other rights hereunder, in case of Client's payment default, the Society shall be entitled to charge, in addition to the amount not properly paid, interests equal to twelve (12) months LIBOR plus two (2) per cent as of due date calculated on the number of days such payment is delinquent. The Society shall also have the right to withhold Certificates and other documents and/or to suspend or revoke the validity of Certificates.

- 6.3 In case of dispute on the invoice amount, the undisputed portion of the invoice shall be paid and an explanation on the dispute shall accompany payment so that action can be taken to solve the dispute.

## 7. LIABILITY

- 7.1 The Society bears no liability for consequential loss. For the purpose of this clause consequential loss shall include, without limitation:
- Indirect or consequential loss;
  - Any loss and/or deferral of production, loss of product, loss of use, loss of bargain, loss of revenue, loss of profit or anticipated profit, loss of business and business interruption, in each case whether direct or indirect.
- The Client shall defend, release, save, indemnify, defend and hold harmless the Society from the Client's own consequential loss regardless of cause.
- 7.2 Except in case of wilful misconduct of the Society, death or bodily injury caused by the Society's negligence and any other liability that could not be, by law, limited, the Society's maximum liability towards the Client is limited to one hundred and fifty per-cents (150%) of the price paid by the Client to the Society for the Services having caused the damage. This limit applies to any liability of whatsoever nature and howsoever arising, including fault by the Society, breach of contract, breach of warranty, tort, strict liability, breach of statute.
- 7.3 All claims shall be presented to the Society in writing within three (3) months of the completion of Services' performance or (if later) the date when the events which are relied on were first discovered by the Client. Any claim not so presented as defined above shall be deemed waived and absolutely time barred.

## 8. INDEMNITY CLAUSE

- 8.1 The Client shall defend, release, save, indemnify and hold harmless the Society from and against any and all claims, demands, lawsuits or actions for damages, including legal fees, for harm or loss to persons and/or property tangible, intangible or otherwise which may be brought against the Society, incidental to, arising out of or in connection with the performance of the Services (including for damages arising out of or in connection with opinions delivered according to clause 4.4 above) except for those claims caused solely and completely by the gross negligence of the Society, its officers, employees, servants, agents or subcontractors.

## 9. TERMINATION

- 9.1 The Parties shall have the right to terminate the Services (and the relevant contract) for convenience after giving the other Party thirty (30) days' written notice, and without prejudice to clause 6 above.
- 9.2 In such a case, the Classification granted to the concerned Unit and the previously issued Certificates shall remain valid until the date of effect of the termination notice issued, subject to compliance with clause 4.1 and 6 above.
- 9.3 In the event where, in the reasonable opinion of the Society, the Client is in breach, or is suspected to be in breach of clause 16 of the Conditions, the Society shall have the right to terminate the Services (and the relevant contracts associated) with immediate effect.

## 10. FORCE MAJEURE

- 10.1 Neither Party shall be responsible or liable for any failure to fulfil any term or provision of the Conditions if and to the extent that fulfilment has been delayed or temporarily prevented by a force majeure occurrence without the fault or negligence of the Party affected and which, by the exercise of reasonable diligence, the said Party is unable to provide against.
- 10.2 For the purpose of this clause, force majeure shall mean any circumstance not being within a Party's reasonable control including, but not limited to: acts of God, natural disasters, epidemics or pandemics, wars, terrorist attacks, riots, sabotages, impositions of sanctions, embargoes, nuclear, chemical or biological contaminations, laws or action taken by a government or public authority, quotas or prohibition, expropriations, destructions of the worksite, explosions, fires, accidents, any labour or trade disputes, strikes or lockouts.

## 11. CONFIDENTIALITY

- 11.1 The documents and data provided to or prepared by the Society in performing the Services, and the information made available to the Society, are treated as confidential except where the information:
- is properly and lawfully in the possession of the Society;
  - is already in possession of the public or has entered the public domain, otherwise than through a breach of this obligation;
  - is acquired or received independently from a third party that has the right to disseminate such information;
  - is required to be disclosed under applicable law or by a governmental order, decree, regulation or rule or by a stock exchange authority (provided that the receiving Party shall make all reasonable efforts to give prompt written notice to the disclosing Party prior to such disclosure).
- 11.2 The Parties shall use the confidential information exclusively within the framework of their activity underlying these Conditions.
- 11.3 Confidential information shall only be provided to third parties with the prior written consent of the other Party. However, such prior consent shall not be required when the Society provides the confidential information to a subsidiary.
- 11.4 Without prejudice to sub-clause 11.1, the Society shall have the right to disclose the confidential information if required to do so under regulations of the International Association of Classifications Societies (IACS) or any statutory obligations.

## 12. INTELLECTUAL PROPERTY

- 12.1 Each Party exclusively owns all rights to its Intellectual Property created before or after the commencement date of the Conditions and whether or not associated with any contract between the Parties.
- 12.2 The Intellectual Property developed by the Society for the performance of the Services including, but not limited to drawings, calculations, and reports shall remain the exclusive property of the Society.

## 13. ASSIGNMENT

- 13.1 The contract resulting from to these Conditions cannot be assigned or transferred by any means by a Party to any third party without the prior written consent of the other Party.
- 13.2 The Society shall however have the right to assign or transfer by any means the said contract to a subsidiary of the Bureau Veritas Group.

## 14. SEVERABILITY

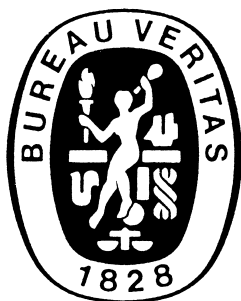
- 14.1 Invalidity of one or more provisions does not affect the remaining provisions.
- 14.2 Definitions herein take precedence over other definitions which may appear in other documents issued by the Society.
- 14.3 In case of doubt as to the interpretation of the Conditions, the English text shall prevail.

## 15. GOVERNING LAW AND DISPUTE RESOLUTION

- 15.1 These Conditions shall be construed and governed by the laws of England and Wales.
- 15.2 The Parties shall make every effort to settle any dispute amicably and in good faith by way of negotiation within thirty (30) days from the date of receipt by either one of the Parties of a written notice of such a dispute.
- 15.3 Failing that, the dispute shall finally be settled under the Rules of Arbitration of the Maritime Arbitration Chamber of Paris ("CAMP"), which rules are deemed to be incorporated by reference into this clause. The number of arbitrators shall be three (3). The place of arbitration shall be Paris (France). The Parties agree to keep the arbitration proceedings confidential.

## 16. PROFESSIONAL ETHICS

- 16.1 Each Party shall conduct all activities in compliance with all laws, statutes, rules, economic and trade sanctions (including but not limited to UN sanctions and EU sanctions) and regulations applicable to such Party including but not limited to: child labour, forced labour, collective bargaining, discrimination, abuse, working hours and minimum wages, anti-bribery, anti-corruption, copyright and trademark protection, personal data protection (<https://personal.dataprotection.bureauveritas.com/privacypolicy>).
- Each of the Parties warrants that neither it, nor its affiliates, has made or will make, with respect to the matters provided for hereunder, any offer, payment, gift or authorization of the payment of any money, directly or indirectly, to or for the use or benefit of any official or employee of the government, political party, official or candidate.
- 16.2 In addition, the Client shall act consistently with the Bureau Veritas' Code of Ethics. <https://group.bureauveritas.com/group/corporate-social-responsibility>



## RULE NOTE NR 600

# NR 600 Hull Structure and Arrangement for the Classification of Cargo Ships less than 65 m and Non Cargo Ships less than 90 m

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**Unless otherwise specified, these rules apply to ships for which contracts are signed after November 1<sup>st</sup>, 2018. The Society may refer to the contents hereof before November 1<sup>st</sup>, 2018, as and when deemed necessary or appropriate.**

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# CHAPTER 7

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| <b>SECTION 2</b> | <b>MATERIALS</b>           |
| <b>SECTION 3</b> | <b>SCANTLING PRINCIPLE</b> |



# SECTION 1 GENERAL

## 1 Application criteria

### 1.1 Types of ships covered by the present Rules

#### 1.1.1 General

The present Rules contain the requirements for the determination of the hull scantlings (fore, central and aft parts of the ship) and structure arrangement applicable to the following type of ships of normal form, speed and proportions and built in steel, aluminium, or composite materials:

- cargo ships with a length L less than 65 m
- non cargo ships with a length L less than 90 m.

Note 1: For definition of cargo ships and non cargo ships, refer to [2.1.2].

#### 1.1.2 Hull shape

In the present Rules, the hull loadings are estimated considering the hull shape of the two following types of hull:

- displacement hull: hull designed to be mainly supported by the pressure of water displaced by the hull
- planing hull: hull designed to use hydrodynamic lift to rise up and glide on the surface of the water when the hull speed exceeds a critical value. Under this critical speed value, the hull behaviour is to be considered as a displacement hull.

#### 1.1.3 Navigation notations

Any ships covered by the present Rules are to be assigned one of the following navigation notations:

- **unrestricted navigation**
- **summer zone**
- **tropical zone**
- **coastal area**
- **sheltered area,**

as defined in NR467 Steel Ships, Pt A, Ch 1, Sec 2, [5.2], except those having the service notation **launch** or **seagoing launch**.

Additional specific operating area notations may be granted as specified in NR467 Steel Ships, Pt A, Ch 1, Sec 2, [5.3].

#### 1.1.4 Additional requirements applicable to specific ships

- ships in aluminium  
Specific additional requirements applicable to ships built in aluminium materials are defined in NR561 Aluminium Ships.
- ships in composite materials  
Specific additional requirements applicable to ships built in composite and/or plywood materials are defined in NR546 Composite Ships.

### 1.2 Types of ships not covered by the present Rules

#### 1.2.1 Liquefied gas carrier

Ships having the service notation **liquefied gas carrier** are not covered by the present Rules and are to be in accordance with NR467 Steel Ships, Part B and Part D, Chapter 9.

#### 1.2.2 Cargo ships with alternate light and heavy cargo loading conditions

As a rule, for ships having alternate light and heavy cargo loading conditions, the scantlings may be determined from NR467 Steel Ships, Part B, Chapter 7 instead of the present Rules, when deemed necessary by the Society.

#### 1.2.3 High speed craft

Ships having:

- one of the service notations **HSC-CAT A**, **HSC-CAT B**, **HSC**, **light ship**, **crew boat**, and
- a navigation notation corresponding to sea areas defined on the basis of sea states characterised by a significant wave height,

are not covered by the present Rules.

## 1.3 Particular cases

#### 1.3.1 Hull scantling

The Society reserves its right, whenever deemed necessary, to apply the requirements defined in NR467 Steel Ships (Rules dedicated to ships greater than 65 m in length) in lieu of the present Rules (see Sec 3, [2]).

#### 1.3.2 Subdivision, compartment arrangement, arrangement of hull openings and freeing ports

The requirements to be applied for the subdivision of the hull, the compartment arrangement and the arrangement of hull openings are defined in Ch 2, Sec 2, Tab 1.

## 2 General

### 2.1 Wording

#### 2.1.1 Rules

In the present Rules, the references to other Rules of the Society are defined in Tab 1.

Table 1 : References to other Rules of the Society

| Reference                    | Rules                                                                                                  |
|------------------------------|--------------------------------------------------------------------------------------------------------|
| NR467<br>Steel Ships         | Rules for the Classification of Steel Ships                                                            |
| NR566                        | Hull Arrangement, Stability and Systems for Ships less than 500 GT                                     |
| NR546<br>Composite Ships     | Hull in Composite Materials and Plywood, Material Approval, Design Principles, Construction and Survey |
| NR561<br>Aluminium Ships     | Hull in Aluminium Alloys, Design Principles, Construction and Survey                                   |
| NR216<br>Materials & Welding | Rules on Materials and Welding for the Classification of Marine Units                                  |

2.1.2 Ship groups: Cargo ships and non cargo ships

In the present Rules, the wording “cargo ships” and “non cargo ships” means:

- cargo ships  
ships liable to carry cargoes and having a deadweight greater than 30% of the total displacement. These ships are fitted with cargo holds, tanks and lateral ballast tanks used in non loaded conditions (i.e. bulk or ore carriers, oil or chemical tankers, container ships, general cargo ships,...). As a rule, the value of the block coefficient is greater than 0,75
- non cargo ships
  - type of ships other than cargo ships defined here above, or
  - ships having a deadweight greater than 30% of the total displacement and not fitted with lateral ballast tanks used in non loaded navigation condition.

2.1.3 Multihull

In the present Rules, “multihull” means a ship with two hulls (floats) connected to a platform structure.

A multihull with more than two floats is to be considered on a case-by-case basis.

Two types of multihulls are considered in the present Rules:

- Catamaran: multihull which may be of displacement hull type or planing hull type, according to its design
- Swath (Small Waterplane Area Twin Hull ship): multihull with two submerged floats connected to the platform structure by narrow struts.

As a rule, a swath is not to be considered as ship having a planing hull and is not subjected to slamming impacts on bottom.

2.1.4 Planing hull

In the present Rules, “planing hull” defines a ship having a planing hull shape and able to sail:

- in planing mode, when the actual sea state is adapted to reach planing speeds without exceeding the expected design vertical acceleration resulting from hydrodynamic lift and slamming phenomenon on bottom, and

- in displacement mode, when the actual speed and sea state do not allow to sail in planing mode without exceeding the expected design vertical acceleration.

The Designer defines whether both the ship is designed to sail in planing mode and bottom slamming impacts are expected to occur.

In this case, the design vertical acceleration at  $L_{CG}$ , to be defined by the Designer, is to correspond to the highest accelerations obtained from a relationship between the actual ship speed and the sea state conditions expected by the Designer.

Planing hulls for which  $V \geq 10 L_{WL}^{0.5}$  are individually considered by the Society, where:

- $V$  : Speed of the ship, in knots  
 $L_{WL}$  : Waterline length, as defined in [4.2.5].

Note 1: As a guidance, a ship may be considered as able to sail in planing hull mode when:

$V \geq 7,16 \Delta^{1/6}$   
with:  
 $\Delta$  : Displacement of the ship, as defined in [4.6.1].

2.2 Classification

2.2.1 General

Ships complying with the requirements of the present Rules are to comply with the requirements of NR467 Steel Ships, Part A (Classification and Surveys).

2.2.2 Service notations and additional service features

The assignment of any service notation and any additional service feature, as defined in NR467 Steel Ships, Part A, is subject to compliance with the general requirements laid down in the present Rules and especially with the additional requirements laid down in Ch 6, Sec 1, as applicable.

2.2.3 Additional class notations

In addition to the present Rules, additional requirements of NR467 Steel Ships, Part F are to be considered, in relation to the additional class notations requested by the Interested Party.

3 Navigation coefficient

3.1 Ships with a navigation notation

3.1.1 The navigation coefficient  $n$ , depending on the assigned navigation notation as defined in NR467 Steel Ships, Part A, Chapter 1, Sec 2, [5.2], is given in Tab 2.

Table 2 : Navigation coefficient  $n$

| Navigation notation     | Navigation coefficient $n$ |
|-------------------------|----------------------------|
| unrestricted navigation | 1,00                       |
| summer zone             | 0,90                       |
| tropical zone           | 0,80                       |
| coastal area            | 0,80                       |
| sheltered area          | 0,65                       |

## 3.2 Sea going launch and launch

**3.2.1** For ships having the service notation **sea going launch** or **launch**, as defined in NR467 Steel Ships, Part A, Chapter 1, Sec 2, [4.15.2], the navigation coefficient  $n$  is as given in Tab 3.

**Table 3 : Navigation coefficient  $n$**

| Service notation                                        | Navigation coefficient $n$   |
|---------------------------------------------------------|------------------------------|
| <b>sea going launch</b>                                 | $0,65 + 0,008 L_w \leq 0,80$ |
| <b>launch</b>                                           | 0,65                         |
| <b>Note 1:</b><br>$L_w$ : Length as defined in [4.2.6]. |                              |

## 4 Definitions

### 4.1 Moulded base line

**4.1.1** The moulded base line is the horizontal line located at the upper face of the bottom plating or at the intersection between the upper face of the bottom plating and the solid bar keel.

For ships designed with a rake of keel, the base line is to be as defined above, at a point located at the midship section.

### 4.2 Lengths

#### 4.2.1 Rule length $L$

The rule length  $L$  is the distance, in m, measured on the summer load waterline, from the fore side of the stem to the after side of the rudder post, or to the centre of the rudder stock where there is no rudder post.

$L$  is to be taken not less than 96%, and need not exceed 97%, of the extreme length on the summer load waterline.

#### 4.2.2 Ends of the rule length

The fore end (FP) of the rule length  $L$  is the perpendicular to the summer load waterline at the fore side of the stem.

The aft end (AP) of the rule length  $L$  is the perpendicular to the summer load waterline at a distance  $L$  aft of FP.

#### 4.2.3 Midship $L_{CG}$

The midship  $L_{CG}$  is the perpendicular to the summer load waterline at a distance 0,5  $L$  aft of FP.

#### 4.2.4 Hull length $L_{HULL}$

The hull length  $L_{HULL}$  is equal to the distance, in m, measured from the fore end of the hull to the aft end of the hull.

#### 4.2.5 Waterline length $L_{WL}$

The waterline length  $L_{WL}$  is equal to the distance, in m, measured from the intersection between the waterline at full load displacement and the fore end of the hull to the aft end of the hull.

#### 4.2.6 Length $L_w$

The length  $L_w$  is to be taken equal to:

$$L_w = 0,5 (L_{WL} + L_{HULL})$$

## 4.3 Breadth

### 4.3.1 Moulded breadth $B$

The moulded breadth  $B$  is the greatest moulded breadth, in m, measured amidships below the weather deck.

### 4.3.2 Waterline breadths $B_{WL}$ and $B_{ST}$

The waterline breadth  $B_{WL}$  is the breadth of the hull, in m, measured amidships at the moulded draught.

For a catamaran, the waterline breadth  $B_{WL}$  is to be measured amidships at one float, at moulded draught.

For a swath, the waterline breadth  $B_{ST}$  is to be measured amidships at one strut, at moulded draught.

### 4.3.3 Breadth $B_E$ between multihull floats

The breadth  $B_E$  between the floats of a multihull is the distance, in m, measured between the longitudinal planes of symmetry of the floats. As a rule, the longitudinal plane of symmetry of a float is located at 0,5  $B_{WL}$  or 0,5  $B_{ST}$ .

### 4.3.4 Breadth $B_{SF}$ of swath submerged float

The moulded breadth  $B_{SF}$  of a swath submerged float is the greatest moulded breadth of the submerged float, in m, measured amidships.

## 4.4 Depth $D$

**4.4.1** The depth  $D$  is the distance, in m, measured vertically on the midship transverse section, from the moulded base line to the top of the deck beam at side on the uppermost continuous deck.

In the case of ships with a solid bar keel, the moulded base line is to be taken at the intersection between the upper face of the bottom plating and the solid bar keel at midship  $L_{CG}$ .

## 4.5 Moulded draught $T$

**4.5.1** The moulded draught  $T$  is the distance, in m, measured vertically on the midship transverse section, from the moulded base line to the summer load waterline.

In the case of ships with a solid bar keel, the moulded base line is to be taken as defined in [4.4.1].

## 4.6 Total block coefficient $C_B$

**4.6.1** The total block coefficient  $C_B$  is to be taken equal to:

- for monohull:

$$C_B = \frac{\Delta}{1,025 L_{WL} B_{WL} T}$$

- for catamaran:

$$C_B = \frac{\Delta}{1,025 L_{WL} 2 B_{WL} T}$$

- for swath:

$$C_B = \frac{\Delta}{1,025 L_{WL} 2 B_m T}$$

with:

$$B_m = \frac{B_{SF} D_{SF} + B_{ST} (T - D_{SF})}{T}$$

where:

- $\Delta$  : Moulded displacement, in tonnes, at draught  $T$ , in sea water (density  $\rho = 1,025 \text{ t/m}^3$ )
- $L_{WL}$  : Waterline length, in m, as defined in [4.2.5]
- $B_{WL}, B_{SF}, B_{ST}$ : Breadths, in m, measured amidships, as defined in [4.3.2] and [4.3.4]
- $D_{SF}$  : Depth, in m, of the submerged float amidships
- $T$  : Moulded draught, as defined in [4.5.1].

4.7 Chine and bottom

4.7.1 Chine

For hulls without a clearly identified chine, the chine is the hull point where the tangent to the hull is inclined by 50° compared to the horizontal.

4.7.2 Bottom

The bottom is the part of the hull between the centre line of the hull or the float and the chines.

4.8 Lightweight

4.8.1 The lightweight is the displacement, in t, without cargo, fuel, lubricating oil, ballast water, fresh water and feed water, consumable stores and passengers and crew and their effects, but including liquids in piping.

4.9 Deadweight

4.9.1 The deadweight is the difference, in t, between the displacement, at the summer draught in sea water of density  $\rho = 1,025 \text{ t/m}^3$ , and the lightweight.

4.10 Freeboard deck

4.10.1 The freeboard deck is defined in Regulation 3 of the 1966 International Convention on Load Lines, as amended.

4.11 Bulkhead deck

4.11.1 The bulkhead deck in a passenger ship means the uppermost deck at any point in the subdivision length  $L_s$  to which the main bulkheads and the ship shell are carried watertight. In a cargo ship, the freeboard deck may be taken as the bulkhead deck.

Note 1: The subdivision  $L_s$  of a ship is the greatest projected moulded length of that part of the ship at or below deck or decks limiting the vertical extent of flooding with the ship at the deepest subdivision draught.

4.12 Superstructure

4.12.1 General

A superstructure is a decked structure connected to 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 0,04 B.

4.12.2 Superstructure deck

A superstructure deck is a deck forming the upper boundary of a superstructure.

4.12.3 Deckhouse

A deckhouse is a decked structure other than a superstructure, located on the freeboard deck or above.

4.12.4 Standard height of superstructure  $h_s$

The standard height of superstructure  $h_s$  is defined in Tab 4.

Table 4 : Standard height of superstructure  $h_s$

| Load line length $L_{LL}$ , in m | Standard height $h_s$ , in m  |                            |
|----------------------------------|-------------------------------|----------------------------|
|                                  | Raised quarterdeck            | All other superstructures  |
| $L_{LL} \leq 30$                 | 0,90                          | 1,80                       |
| $30 < L_{LL} < 75$               | $0,9 + 0,00667 (L_{LL} - 30)$ | 1,80                       |
| $75 \leq L_{LL} < 90$            | $1,2 + 0,012 (L_{LL} - 75)$   | $1,8 + 0,01 (L_{LL} - 75)$ |

4.12.5 Tiers of superstructures and deckhouses

The lowest tier is the tier located immediately above the freeboard deck.

The second tier is the tier located immediately above the lowest tier, and so on.

4.13 Multihull platform

4.13.1 A multihull platform is a strength structure connecting the hulls by primary transverse cross structure elements. These transverse elements may be cross beams or cross bulkheads.

The part of the platform directly exposed to sea effect is designed as platform bottom.

The upper part of the platform together with the upper decks are defined as platform deck.

5 Reference co-ordinate system

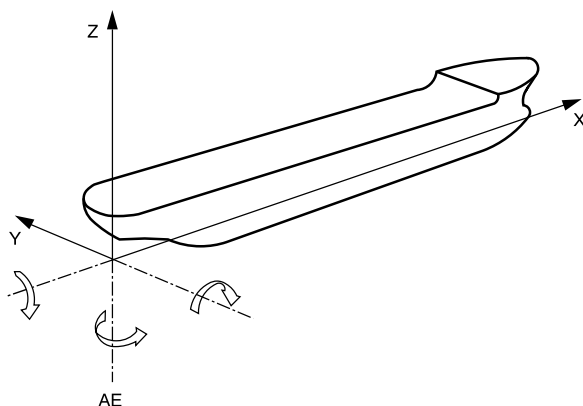
5.1 General

5.1.1 The ship's geometry, motions, accelerations and loads are defined with respect to the following right-hand co-ordinate system (see Fig 1):

- Origin: at the intersection between the longitudinal plane of symmetry of ship, the aft end of L and the baseline
- X axis: longitudinal axis, positive forwards
- Y axis: transverse axis, positive towards portside
- Z axis: vertical axis, positive upwards.

5.1.2 Positive rotations are oriented in anti-clockwise direction about the X, Y and Z axes.

Figure 1 : Reference co-ordinate system



## 6 Stability

### 6.1 General

**6.1.1** For information, intact stability and damage stability are to comply with the following Rules:

- For non-propelled ships and ships of less than 500 GT:
  - **passenger ship** with unrestricted navigation: NR467 Steel Ships
  - **ro-ro passenger ship** with unrestricted navigation: NR467 Steel Ships
  - **chemical tanker**: NR467 Steel Ships

- **fishing vessel**: NR467 Steel Ships
- ships with other service notations: NR566
- For ships of 500 GT and over: NR467 Steel Ships.

## 7 Documentation to be submitted

### 7.1 Documentation to be submitted

#### 7.1.1 Plans and documents to be submitted for approval

The plans and documents to be submitted to the Society for approval are listed in Tab 5.

Structural plans are to show details of connections of the various parts and to specify the materials used, including their manufacturing processes (see also Chapter 6).

#### 7.1.2 Plans and documents to be submitted for information

In addition to those in [7.1.1], the following plans and documents are to be submitted to the Society, for information:

- general arrangement
- capacity plan indicating, for all the compartments and tanks, their volume and the position of their centre of gravity
- lightweight distribution.

Moreover, when direct calculation analyses are carried out by the Designer according to the rule requirements, they are to be submitted to the Society.

Table 5 : Documentation to be submitted for approval for all ships

| Plan or document                                                                                                                                                                                            | Containing also information on                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Midship section<br>Transverse sections<br>Shell expansion<br>Decks and profiles<br>Double bottom<br>Pillar arrangements<br>Framing plan<br>Deep tank and ballast tank bulkheads, swash bulkheads            | Class characteristics<br>Main dimensions<br>Minimum ballast draught<br>Frame spacing<br>Contractual service speed<br>Density of cargoes<br>Design loads on decks and double bottom<br>Steel grades<br>Location and height of air vent outlets of various compartments<br>Corrosion protection<br>Openings in decks and shell and relevant compensations<br>Boundaries of flat areas in bottom and sides<br>Details of structural reinforcements and/or discontinuities<br>Bilge keel with details of connections to hull structures |
| Watertight subdivision bulkheads<br>Watertight tunnels                                                                                                                                                      | Openings and their closing appliances, if any                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Fore part structure                                                                                                                                                                                         | Location and height of air vent outlets of various compartments                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Transverse thruster, if any, general arrangement, tunnel structure, connections of thruster with tunnel and hull structures                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Aft part structure                                                                                                                                                                                          | Location and height of air vent outlets of various compartments                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| (1) Where other steering or propulsion systems are adopted (e.g. steering nozzles or azimuth propulsion systems), the plans showing the relevant arrangement and structural scantlings are to be submitted. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |

| Plan or document                                                                                                                                                                                            | Containing also information on                                                                                                                                                                            |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Machinery space structures<br>Foundations of propulsion machinery and boilers                                                                                                                               | Type, power and r.p.m. of propulsion machinery<br>Mass and centre of gravity of machinery and boilers                                                                                                     |
| Superstructures and deckhouses<br>Machinery space casing                                                                                                                                                    | Extension and mechanical properties of the aluminium alloy used<br>(where applicable)                                                                                                                     |
| Bow doors, stern doors and inner doors, if any,<br>side doors and other openings in the side shell                                                                                                          | Closing appliances<br>Electrical diagrams of power control and position indication circuits for bow doors, stern doors, side doors, inner doors, television system and alarm systems for ingress of water |
| Hatch covers, if any                                                                                                                                                                                        | Design loads on hatch covers<br>Sealing and securing arrangements, type and position of locking bolts<br>Distance of hatch covers from the summer load waterline and from the fore end                    |
| Movable decks and ramps, if any                                                                                                                                                                             |                                                                                                                                                                                                           |
| Windows and side scuttles, arrangements and details                                                                                                                                                         |                                                                                                                                                                                                           |
| Bulwarks and freeing ports                                                                                                                                                                                  | Arrangement and dimensions of bulwarks and freeing ports on the freeboard deck and superstructure deck                                                                                                    |
| Helicopter decks, if any                                                                                                                                                                                    | General arrangement<br>Main structure<br>Characteristics of helicopters: maximum mass, distance between landing gears or landing skids, print area of wheels or skids, distribution of landing gear loads |
| Rudder and rudder horn (1)                                                                                                                                                                                  | Maximum ahead service speed                                                                                                                                                                               |
| Stern frame or sternpost, stern tube (1)<br>Propeller shaft boss and brackets                                                                                                                               |                                                                                                                                                                                                           |
| Derricks and cargo gear<br>Cargo lift structures                                                                                                                                                            | Design loads (forces and moments)<br>Connections to the hull structures                                                                                                                                   |
| Sea chests, stabiliser recesses, etc.                                                                                                                                                                       |                                                                                                                                                                                                           |
| Hawse pipes                                                                                                                                                                                                 |                                                                                                                                                                                                           |
| Plan of outer doors and hatchways                                                                                                                                                                           |                                                                                                                                                                                                           |
| Plan of manholes                                                                                                                                                                                            |                                                                                                                                                                                                           |
| Plan of access to and escape from spaces                                                                                                                                                                    |                                                                                                                                                                                                           |
| Plan of tank testing                                                                                                                                                                                        | Testing procedures for the various compartments<br>Height of pipes for testing                                                                                                                            |
| Plan of watertight doors and scheme of relevant manoeuvring devices                                                                                                                                         | Manoeuvring devices<br>Electrical diagrams of power control and position indication circuits                                                                                                              |
| Equipment number calculation                                                                                                                                                                                | Geometrical elements for calculation<br>List of equipment<br>Construction and breaking load of steel wires<br>Material, construction, breaking load and relevant elongation of synthetic ropes            |
| (1) Where other steering or propulsion systems are adopted (e.g. steering nozzles or azimuth propulsion systems), the plans showing the relevant arrangement and structural scantlings are to be submitted. |                                                                                                                                                                                                           |

# SECTION 2 MATERIALS

## 1 General

### 1.1 Application

**1.1.1** This Section defines the main characteristics to take into account for steels, aluminium alloys or composite materials within the scope of the determination of the hull scantling as defined in the present Rules.

**1.1.2** Materials and products such as parts made of iron castings, where allowed, products made of copper and copper alloys, rivets, anchors, chain cables, cranes, masts, derrick posts, derricks, accessories and wire ropes are to comply with the applicable requirements of NR216 Materials and Welding.

**1.1.3** Materials with different characteristics may be considered, provided their specification (manufacture, chemical composition, mechanical properties, welding,...) is submitted to the Society for approval.

## 2 Steels for hull structure

### 2.1 General

#### 2.1.1 Characteristics of materials

The characteristics of steels to be used in the construction of ships are to comply with the applicable requirements of NR216 Materials and Welding.

#### 2.1.2 Testing and manufacturing process

Materials are to be tested in compliance with the applicable requirements of NR216 Materials and Welding.

The requirements of this Section presume that welding and other cold or hot manufacturing processes (parent material types and welding, preheating, heat treatment after welding,...) are carried out in compliance with current sound working practices and the applicable requirements of NR216 Materials and Welding.

#### 2.1.3 Mechanical characteristics of hull steels

The mechanical characteristics of steels are to comply with the requirements of NR467 Steel Ships, Pt B, Ch 4, Sec 1, in particular the mechanical characteristics of:

- the grade of steel used for the various strength members of the structure
- the steels for forging and casting.

Tab 1 gives, as a reminder, the mechanical properties of steels commonly used in the construction of ships.

Strength steels higher than those indicated in Tab 1 are considered by the Society, on a case-by-case basis.

**Table 1 : Mechanical properties of hull steels**

| Steel grades<br>$t \leq 100$ mm                                        | Minimum yield stress $R_{eH}$ ,<br>in N/mm <sup>2</sup> | Ultimate minimum tensile strength $R_m$ ,<br>in N/mm <sup>2</sup> |
|------------------------------------------------------------------------|---------------------------------------------------------|-------------------------------------------------------------------|
| A-B-D-E                                                                | 235                                                     | 400 - 520                                                         |
| AH32-DH32-EH32-FH32                                                    | 315                                                     | 440 - 590                                                         |
| AH36-DH36-EH36-FH36                                                    | 355                                                     | 490 - 620                                                         |
| AH40-DH40-EH40-FH40                                                    | 390                                                     | 510 - 650                                                         |
| <b>Note 1:</b> Refer to NR216 Materials and Welding, Ch 2, Sec 1, [2]. |                                                         |                                                                   |

When steels with a minimum specified yield stress  $R_{eH}$  other than 235 N/mm<sup>2</sup> are used for a ship, the hull scantlings are to be determined considering the material factor  $k$  defined in [2.1.4].

For ships intended to operate in areas with low temperatures ( $-20^{\circ}\text{C}$  or below), the material grades of the structures exposed to low air temperatures are to be selected as defined in NR467 Steel Ships, Pt B, Ch 4, Sec 1. For ships less than 40 m in length, the selection of these materials, over the full length of the ship, may be carried out considering the material selections defined in NR467 Steel Ships for the areas located outside 0,4 L amidships.

For structural members within or adjacent to refrigerated spaces, when the design temperatures are below  $0^{\circ}\text{C}$ , the material grades are to be selected as defined in NR467 Steel Ships, Pt B, Ch 4, Sec 1.

#### 2.1.4 Material factor $k$ for scantling

To take into account the steel materials, a material factor  $k$  is used in the scantling formulae, as a function of the minimum specified yield stress  $R_{eH}$ .

As a rule, the scantling of the structure elements is based on a steel material having a minimum yield stress  $R_{eH}$  equal to 235 N/mm<sup>2</sup>, corresponding to  $k = 1$ .

Unless otherwise specified, the values of material factor  $k$  are defined in Tab 2.

For intermediate values of  $R_{eH}$ ,  $k$  may be obtained by linear interpolation.

Steels having a yield stress higher than 390 N/mm<sup>2</sup> are considered by the Society on a case-by-case basis.

For steel having a yield stress lower than 235 N/mm<sup>2</sup>, the material factor may be taken equal to  $235/R_{eH}$ , where  $R_{eH}$  is the minimum yield stress, in N/mm<sup>2</sup>, of the considered material.

Table 2 : Material factor k

| $R_{eH}$ , in N/mm <sup>2</sup> | k    |
|---------------------------------|------|
| 235                             | 1,00 |
| 315                             | 0,78 |
| 355                             | 0,72 |
| 390                             | 0,68 |

2.1.5 Minimum yield stress for scantling criteria of hull structure

The minimum yield stress of steel  $R_y$  , in N/mm<sup>2</sup>, used for the scantling criteria of the hull structure is to be taken, unless otherwise specified, equal to:

$R_y = 235 / k$

where:

k : Material factor defined in [2.1.4].

3 Aluminium alloys for hull structure

3.1 Characteristics and testing

3.1.1 The characteristics of aluminium alloys to be used in the construction and their testing process are to comply with the applicable requirements of the following Rules:

- NR216 Materials and Welding
- NR561 Aluminium Ships.

Aluminium alloys with different characteristics may be accepted, provided their specification (manufacture, chemical composition, mechanical properties, welding,...) is submitted to the Society for approval.

3.1.2 Minimum yield stress for scantling criteria of hull structure

The minimum yield stress of aluminium  $R_y$  , in N/mm<sup>2</sup>, used for the scantling criteria of the hull structure is to be taken, unless otherwise specified, equal to:

$R_y = R'_{lim}$

where:

$R'_{lim}$  : Minimum yield stress of the aluminium alloys considered, to be taken equal to the minimum value, in welded condition, between  $R'_{p0,2}$  (proof stress) and  $0,7 R'_m$  (tensile strength), where  $R'_{p0,2}$  and  $R'_m$  are defined in NR561 Aluminium Ships.

3.1.3 Material factor k for scantling

To take into account the minimum yield stress of the aluminium alloy in welded condition, the material factor k used in the scantling formulae is to be taken equal to:

$k = 100 / R'_{lim}$

4 Composite materials and plywood for hull structure

4.1 Characteristics and testing

4.1.1 The characteristics of the composite materials and plywood and their testing and manufacturing process are to comply with the applicable requirements of NR546 Composite Ships, in particular for the:

- raw materials
- laminating process
- mechanical tests and raw material homologation.

4.2 Application

4.2.1 Attention is drawn to the use of composite and/or plywood materials from the point of view of structural fire protection.

The Flag Administration may request that international convention be applied instead of the present requirements, which may entail in some cases a limitation in the use of composite and/or plywood materials.

## SECTION 3

## SCANTLING PRINCIPLES

### Symbols

$L_{WL}$  : Waterline length, in m, as defined in Sec 1, [4.2.5].

### 1 Main scantling principles

#### 1.1 General

**1.1.1** The present Section defines the main scantling principles considered in the present Rules.

#### 1.2 Type of ships

##### 1.2.1 General

The motions and accelerations of a ship are calculated in relation to its group defined in Sec 1, [2.1.2] (cargo ship or non cargo ship).

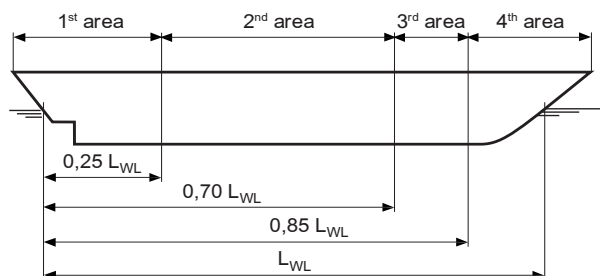
Their longitudinal distribution along the ship length is split into four different areas, as follows (see Fig 1):

- first area: from the aft part to  $0,25 L_{WL}$
- second area: from  $0,25 L_{WL}$  to  $0,70 L_{WL}$
- third area: from  $0,70 L_{WL}$  to  $0,85 L_{WL}$
- fourth area: from  $0,85 L_{WL}$  to the fore part.

The motions and accelerations of each area are calculated in the middle of the area and considered as a constant along the area.

As a rule, the ship motions and accelerations are calculated in head sea condition.

**Figure 1 : Definition of the longitudinal areas**



##### 1.2.2 Specific case of planing hull

The structure of a planing hull is to be examined, resulting from its two navigation modes, both:

- as cargo ship or non cargo ship, as applicable, when the ship sails in displacement mode (when the actual sea state does not allow to sail in planing mode with an actual vertical acceleration compatible with the vertical acceleration taken into account for the ship structure design), and
- as planing hull, when the ship sails in planing mode (when the actual vertical acceleration induced by the actual sea state and speed to reach planing mode is compatible with the vertical acceleration taken into account for the ship structure design).

The global and local loads, and the permissible stresses considered to check the structure are specific to each case of navigation modes.

#### 1.3 Corrosion addition

##### 1.3.1 Ships in steel or aluminium alloys

As a rule, the scantlings obtained by applying the criteria specified in the present Rules for steel and aluminium structures are gross scantling, i.e. they include additions for corrosion.

##### 1.3.2 Ships in composite materials

The scantlings obtained by applying the criteria specified in the present Rules for composite structures include a rule partial safety factor  $C_v$  which takes into account the ageing effect on the laminate mechanical characteristics.

#### 1.4 Rounding off

**1.4.1** The rounding off of plate thicknesses on metallic hulls is to be obtained from the following procedure:

- the thickness is calculated in accordance with the rule requirements
- the rounded thickness is taken equal to the value rounded off to the nearest half-millimetre.

Stiffener section moduli as calculated in accordance with the rule requirements are to be rounded off to the nearest standard value. However, no reduction may exceed 3%.

## 2 Hull analysis approach

### 2.1 Global hull girder strength and local strength

#### 2.1.1 General

As a rule, the global hull girder strength and the local strength are examined independently in the present Rules, as follows:

- the longitudinal scantling of the hull girder and the transverse scantling of the platform of catamaran are examined on the basis of a maximum permissible stress and a buckling check of the elements contributing to the global strength in the cases listed in Ch 4, Sec 2, [1.1.3]
- the local scantling is examined on the basis of the local permissible stresses defined in relation to the type of local loads applied and the type of structure elements.

#### 2.1.2 Particular case

- a) Ship in steel and aluminium alloys:

When the global stress, in  $\text{N/mm}^2$ , calculated according to Ch 4, Sec 2 (excluding the cases of additional specific

wave hull girder loads defined in Ch 3, Sec 2, [6]) is greater than  $0,35 R_y$ , the global and local stresses are to be combined to check the scantlings of the structure elements contributing to the hull girder strength.

Where:

$R_y$  : As defined in Sec 2, [2.1.5] for steel structure and in Sec 2, [3.1.2] for aluminium structure.

As a rule, the following requirements are to be fully applied:

- NR467 Steel Ships, Part B, Chapter 7, or
- Ch 4, App 2 of the present Rules.

Note 1: For catamaran and swath, Ch 4, App 2 is to be applied.

- b) Ship in composite materials:

When deemed necessary by the Society, the analysis of the composite structure, taking into account the global hull girder loads and the local loads, is to be carried out as defined in NR546 Composite Ships according to the safety factors defined in Ch 2, Sec 3, [3.2].

**STRUCTURE DESIGN PRINCIPLES,  
GENERAL ARRANGEMENT AND  
SCANTLING CRITERIA**

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|                  |                                                                                  |
|------------------|----------------------------------------------------------------------------------|
| <b>SECTION 1</b> | <b>STRUCTURE DESIGN PRINCIPLES</b>                                               |
| <b>SECTION 2</b> | <b>SUBDIVISION, COMPARTMENT ARRANGEMENT AND<br/>ARRANGEMENT OF HULL OPENINGS</b> |
| <b>SECTION 3</b> | <b>SCANTLING CRITERIA</b>                                                        |



# SECTION 1

# STRUCTURE DESIGN PRINCIPLES

## 1 General

### 1.1 Application

#### 1.1.1 Steel structure

The requirements of the present Section apply to longitudinally or transversely framed structure arrangement of hulls built in steel materials for:

- structural continuity of hull
- single and double bottoms
- sides and decks
- transverse and longitudinal structures
- superstructures and deckhouses
- special features.

Any other arrangement may be considered, on a case-by-case basis.

Additional specific structure design principles in relation to the service notation of the ship are defined in Ch 6, Sec 1.

#### 1.1.2 Aluminium structure

Equivalent arrangement for hulls built in aluminium alloys is defined in NR561 Aluminium Ships.

#### 1.1.3 Composite and plywood structure

Equivalent arrangement for hulls built in composite materials and/or plywood is defined in NR546 Composite Ships.

## 2 Structural continuity of hull girder

### 2.1 General principles for longitudinal hull girder

**2.1.1** Attention is to be paid to the structural continuity:

- in way of changes in the framing system
- at the connections of primary supporting members and secondary stiffeners.

**2.1.2** The longitudinal members contributing to the hull girder longitudinal strength are to extend continuously over a sufficient distance towards the ends of the ship.

The secondary stiffeners contributing to the hull girder longitudinal strength are generally to be continuous when crossing primary supporting members. Otherwise, the detail of connections is considered by the Society on a case-by-case basis.

**2.1.3** Where stress concentrations may occur in way of structural discontinuity, adequate compensation and reinforcements are to be provided.

**2.1.4** Openings are to be avoided, as far as practicable, in way of highly stressed areas.

Where necessary, the shape of openings is to be specially designed to reduce the stress concentration factors.

Openings are to be generally well rounded with smooth edges.

**2.1.5** Primary supporting members are to be arranged in such a way that they ensure adequate continuity of strength. Abrupt changes in height or in cross-section are to be avoided.

### 2.2 General principles for multihull platform

**2.2.1** Attention is to be paid to the structural continuity of the primary transverse cross structure of the platform ensuring the global transverse resistance of the multihull.

The primary transverse cross structure of catamaran is generally to be continuous when crossing float structures.

The connection between the transverse cross structures of swath and struts is to be examined by direct calculation.

The general continuity principles defined in [2.1] apply also to the primary transverse cross structure of the platform.

### 2.3 Insert plates and doublers

**2.3.1** A local increase in plating thickness is generally to be achieved through insert plates. Local doublers, normally allowed only for temporary repair, may however be accepted by the Society on a case-by-case basis.

In any case, doublers and insert plates are to be made of materials of a quality at least equal to the quality of the plates on which they are welded.

**2.3.2** Doublers having a width, in mm, greater than:

- 20 times their thickness, for thicknesses equal to or less than 15 mm
- 25 times their thickness, for thicknesses greater than 15 mm

are to be fitted with slot welds, to be effected according to Chapter 6.

**2.3.3** When doublers fitted on the outer shell and strength deck within 0,6 L amidships are accepted by the Society, their width and thickness are to be such that slot welds are not necessary according to the requirements in [2.3.2]. Outside this area, the possibility of fitting doublers requiring slot welds will be considered by the Society on a case-by-case basis.

## 2.4 Connection between steel and aluminium

**2.4.1** Any direct contact between steel and aluminium alloy is to be avoided.

Any heterogeneous jointing system is considered by the Society on a case-by-case basis.

The use of transition joints made of aluminium/steel-clad plates or profiles is to be in accordance with NR216 Materials and Welding.

## 3 Bottom structure arrangement

### 3.1 General arrangement

**3.1.1** The bottom structure is to be checked by the Designer to make sure that it withstands the loads resulting from the dry-docking of the ship or the lifting by crane, when applicable. This check under such loading cases is not within the scope of classification.

**3.1.2** Provision is to be made for the free passage of water from all the areas of the bottom to the suction, by means of scallops in floors and bottom girders.

**3.1.3** Additional girders and floors may be fitted in the engine room to ensure adequate rigidity of the structure, according to the recommendations of the engine supplier.

**3.1.4** If fitted, solid ballast is to be securely positioned. If necessary, intermediate girders and floors may be required. The builder is to check that the solid ballast material is compatible with the hull material.

**3.1.5** Where face plates of floors and girders are at the same level, the face plate of the stiffer member is generally to be continuous. Butt welds of the face plates are to provide strength continuity.

**3.1.6** As a rule, bottom girders are to be fitted in way of each line of pillars. If it is not the case, local longitudinal members are to be provided.

### 3.2 Longitudinal framing arrangement of single bottom

**3.2.1** As a general rule, hull with a longitudinally framed single bottom is to be fitted with a continuous or an inter-coastal centre girder welded to the floors.

**3.2.2** Where side girders are fitted locally in lieu of the centre girder, they are to be extended over a sufficient distance beyond the ends of the centre girder and an additional stiffening of the bottom in the centreline area may be required.

**3.2.3** Centre and side bottom girders are to be extended as far as possible towards the ends of the hull.

**3.2.4** Cut-outs fitted in the web of floors for the crossing of bottom longitudinals are to be taken into account for shear analysis of the floors.

### 3.3 Transverse framing arrangement of single bottom

**3.3.1** Requirements of [3.1] apply also to transversally framed single bottom.

**3.3.2** In general, the height, in m, of the floors at the centreline should not be less than  $B/16$ . In the case of ships with considerable rise of floors, this height may be required to be increased so as to ensure a satisfactory connection to the frames.

**3.3.3** The ends of the floors at side are to be aligned with the side transverse members.

It may be accepted, on a case-by-case basis, that the floor ends at side be welded on a primary longitudinal member of the side shell or of the bottom.

**3.3.4** Openings and cut-outs in the web of bottom girders for the crossing of floors are to be taken into account for shear analysis of the floors.

### 3.4 Double bottom arrangement

#### 3.4.1 Double bottom height

As a general rule, the double bottom height is to be:

- sufficient to ensure access to any part of the bottom, and
- not less than 0,76 m in way of the centre girder.

**3.4.2** Where the height of the double bottom varies, the variation is generally to be made gradually and over an adequate length.

The knuckles of inner bottom plating are to be located in way of floors.

Where this arrangement is not possible, suitable longitudinal structures such as partial girders, longitudinal brackets etc., fitted across the knuckle, are to be fitted.

**3.4.3** Adequate continuity is to be provided between double bottom area and single bottom area.

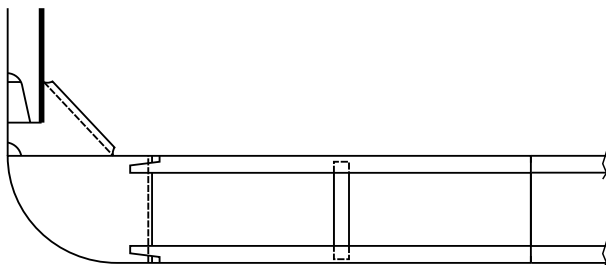
**3.4.4** Floors are to be fitted:

- watertight in way of the transverse watertight bulkheads
- reinforced in way of the double bottom steps.

**3.4.5** Watertight floors are to be fitted with stiffeners having a section modulus not less than that required for tank bulkhead vertical stiffeners.

**3.4.6** In case of open floors consisting of a frame connected to the bottom plating and a reverse frame connected to the inner bottom plating, the construction principle is to be as shown in Fig 1.

Figure 1 : Open floor



### 3.4.7 Double bottom compartment

Arrangement of the double bottom compartments is to be in accordance with Sec 2, [4].

### 3.4.8 Duct keel

Where a duct keel is arranged, the strength continuity of the structure of the floors is to be ensured.

## 3.5 Arrangement, scantlings and connections of bilge keels

### 3.5.1 Arrangement

Bilge keels may not be welded directly on the shell plating. An intermediate flat, or a doubler, is required on the shell plating.

The thickness of the intermediate flat is to be equal to the thickness of the bilge strake.

The ends of the bilge keels are to be sniped at an angle of  $15^\circ$  or rounded with a large radius. They are to be located in way of a bilge transverse stiffener. The ends of the intermediate flat are to be sniped at an angle of  $15^\circ$ .

The arrangement shown in Fig 2 is recommended.

The arrangement shown in Fig 3 may also be accepted.

Figure 2 : Bilge keel arrangement

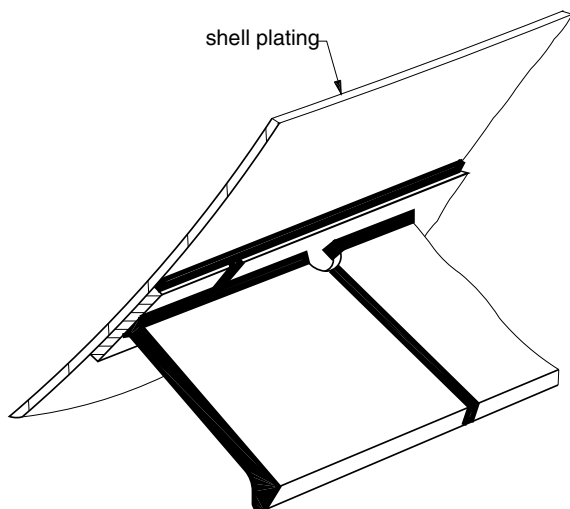
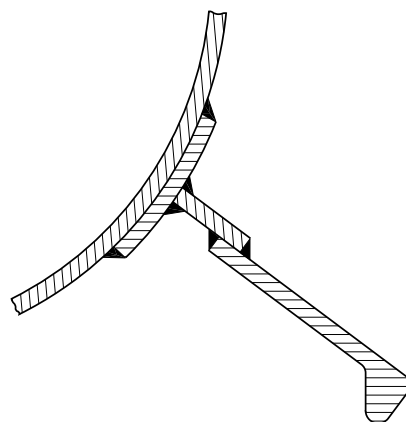


Figure 3 : Bilge keel arrangement



### 3.5.2 Materials

The bilge keel and the intermediate flat are to be made of steel having the same yield stress and grade as the steel of the bilge strake.

### 3.5.3 Welding

Welding of the bilge keel with the intermediate flat is to be in accordance with Ch 7, Sec 2.

## 4 Side structure arrangement

### 4.1 General

**4.1.1** In a transverse framing system, the side structure is made of secondary transverse frames, possibly supported by horizontal stringers.

**4.1.2** In a longitudinal framing system, the side structure is made of secondary longitudinal stiffeners supported by vertical primary supporting members.

**4.1.3** Where the connection between side shell and deck plate is rounded, the radius, in mm, is to be not less than  $15 t_s$ , where  $t_s$  is the thickness, in mm, of the sheerstrake.

### 4.2 Stiffener arrangement

**4.2.1** In general, the section modulus of 'tweendeck frames is to be not less than that required for the frames located immediately above.

**4.2.2** Transverse web frames and secondary side frames are to be attached to floors and deck beams by brackets or any other equivalent structure (see Ch 4, Sec 6).

**4.2.3** For transverse framing system, the attention of the Designer is drawn on the risk of buckling of the side shell plate panels in way of the frame ends. Extra-thickness or additional intercostal stiffeners may be requested in these areas on the side shell.

### 4.3 Openings in the side shell plating

**4.3.1** Openings in the side shell are to be well rounded at the corners and located, as far as practicable, well clear of the superstructure ends.

**4.3.2** Large size openings are to be adequately compensated by means of insert plates of increased thickness. Such compensation is to be partial or total, depending on the stresses occurring in the area of the openings.

**4.3.3** Secondary stiffeners cut in way of openings are to be attached to local structural members supported by the continuous adjacent secondary stiffeners, or any other equivalent arrangement.

**4.3.4** The sea chest thickness is generally to be equal to the thickness of the local shell plating.

**4.3.5** Openings for stabilizer fins are considered by the Society on a case-by-case basis.

## 5 Deck structure arrangement

### 5.1 General

**5.1.1** Adequate continuity of decks (plates and stiffeners) is to be ensured in way of:

- stepped strength decks
- changes in the framing system
- large openings.

**5.1.2** Deck supporting structures under cranes and windlass are to be adequately stiffened.

**5.1.3** Pillars or other supporting structures are generally to be fitted under heavy concentrated loads on decks.

**5.1.4** Stiffeners are also to be fitted in way of the ends and corners of deckhouses and partial superstructures.

**5.1.5** Beams fitted at sides of a deck hatch are to be effectively supported by at least two deck girders located at each side of the deck opening.

### 5.2 Opening arrangement

**5.2.1** The deck openings are to be as much spaced apart as possible.

As practicable, they are to be located as far as possible from the highly stressed deck areas or from the stepped deck areas.

**5.2.2** Extra thickness or additional reinforcements may be requested where deck openings are located:

- close to the primary transverse cross structure of the multihull platform
- in areas of deck structural singularity (cockpit, stepped deck,...)
- in way of the fixing of out-fittings.

**5.2.3** As a rule, all the deck openings are to be fitted with radiused corners. Generally, the corner radius is not to be less than 5% of the transverse width of the openings.

**5.2.4** Corner radiusing, in the case of two or more openings athwart ship in one single transverse section, is considered by the Society on a case-by-case basis.

### 5.3 Hatch supporting structures

**5.3.1** Hatch side girders and hatch end beams of reinforced scantling are to be fitted in way of cargo hold openings.

In general, hatch end beams and deck transverses are to be in line with bottom and side transverse structures, so as to form a reinforced ring.

Adequate continuity of strength of longitudinal hatch coamings is to be ensured.

The details of connection of deck transverses with longitudinal girders and web frames are to be submitted to the Society for approval.

### 5.4 Pillar arrangement under deck

**5.4.1** Pillars are to be connected to the inner bottom at the intersection of girders and floors and to any deck at the intersection of deck beams and deck girders.

Where it is not the case, an appropriate local structure is to be fitted to support the pillars.

**5.4.2** Pillars are to be attached at their heads and heels by continuous welding.

Heads and heels of pillars are to be attached to the surrounding structure by means of brackets, insert plates or doubling plates so that the loads are well distributed.

In general, the thickness of the insert plates or doubling plates is to be not less than 1,5 times the thickness of the pillar.

**5.4.3** If tensile stress is expected in the pillar, an insert plate is to be fitted in place of a doubling plate and head and heel brackets or equivalent arrangement are to be provided.

**5.4.4** In tanks and in spaces intended for products able to procure explosive gases, solid or open section pillars are to be fitted.

**5.4.5** Manholes may not be cut in the web of primary supporting structures in way of the heads and heels of pillars.

**5.4.6** Tight or non-tight bulkheads may be considered as pillars, provided their scantlings comply with Ch 4, Sec 7.

**5.4.7** The pillar scantlings are to comply with the requirements of Ch 4, Sec 7.

### 5.5 Deck structure in way of launching appliances used for survival craft or rescue boats

**5.5.1** Attention is drawn on any possible specific requirements that could be issued by a Flag Administration with respect to local structure reinforcements in way of launching appliances used for survival craft or rescue boats.

## 6 Bulkhead structure arrangement

### 6.1 General

**6.1.1** Plane bulkheads may be horizontally or vertically stiffened.

Stiffening of horizontally framed bulkheads consists of horizontal secondary stiffeners supported by vertical primary supporting members.

Stiffening of vertically framed bulkheads consists of vertical secondary stiffeners which may be supported by horizontal stringers.

The structural continuity of the vertical and horizontal primary supporting members with the surrounding supporting hull structures is to be carefully ensured.

**6.1.2** As a general rule, the transverse bulkheads are to be stiffened, in way of bottom and deck girders, by vertical stiffeners in line with these girders or by any equivalent system.

Where a deck girder is not continuous, the bulkhead vertical stiffener supporting the end of the deck girder is to be strong enough to sustain the bending moment transmitted by the deck girder.

### 6.2 Watertight bulkheads

**6.2.1** Crossing, through watertight transverse bulkheads, of bottom, side shell or deck longitudinal stiffeners is to be closed by watertight collar plates.

**6.2.2** The stiffener ends of watertight bulkheads are to be aligned with the hull structure members and are to be fitted with end brackets.

Where this arrangement is made impossible due to hull lines, any other solution may be accepted, provided embedding of the bulkhead secondary stiffeners is satisfactorily achieved.

**6.2.3** The secondary stiffeners of watertight bulkheads in 'tweendecks may be snipped at ends, provided their scantling is increased accordingly.

#### 6.2.4 Watertight doors

The thickness of watertight doors is to be not less than the thickness of the adjacent bulkhead plating, taking into account the actual spacing of the stiffeners.

Where bulkhead stiffeners are cut in way of a watertight door, reinforced stiffeners are to be fitted and suitably overlapped; cross-bars are to be provided to support the interrupted stiffeners.

### 6.3 Non-tight bulkheads

**6.3.1** As a rule, non-tight bulkheads not acting as pillars are to be provided with vertical stiffeners having a maximum spacing equal to:

- 0,9 m, for transverse bulkheads
- two frame spacings, without exceeding 1,5 m, for longitudinal bulkheads.

### 6.3.2 Swash bulkheads

As a rule, the total area of the openings in swash bulkheads fitted in tanks is to be between 10% and 30% of the total area of the swash bulkhead.

### 6.4 Corrugated bulkheads

#### 6.4.1 General

The main dimensions  $a$ ,  $b$ ,  $c$ ,  $d$  and  $t$  of the corrugated bulkheads are defined in Fig 4.

Unless otherwise specified, the following requirement is to be complied with:

$$a \leq 1,2 d$$

Moreover, in some cases, the Society may prescribe an upper limit for the ratio  $b / t$ .

In general, the bending internal radius  $R_i$ , in mm, is to be not less than:

- for normal strength steel:

$$R_i = 2,5 t$$

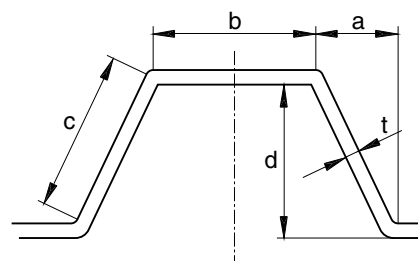
- for high tensile steel:

$$R_i = 3,0 t$$

When welds, in a direction parallel to the bend axis, are provided in the zone of the bend, the welding procedures are to be submitted to the Society for approval, as a function of the importance of the structural element.

In general, where girders or vertical primary supporting members are fitted on corrugated bulkheads, they are to be arranged symmetrically.

**Figure 4 : Corrugated bulkhead**



#### 6.4.2 Structural arrangement

Strength continuity of the corrugated bulkheads is to be ensured at the ends of the corrugations.

Where corrugated bulkheads are cut in way of primary supporting members, attention is to be paid to ensure correct alignment of the corrugations on each side of the primary supporting members.

The connection of the corrugated bulkheads with the deck and the bottom is to be carefully designed and specially considered by the Society.

In general, where vertically corrugated bulkheads are welded on the inner bottom:

- plate floors are to be fitted in way of the flanges of corrugations in the case of transverse bulkheads, and
- girders are to be fitted in way of the flanges of corrugations in the case of longitudinal bulkheads.

However, other arrangements ensuring adequate structural continuity may be accepted by the Society.

In general, the upper and lower parts of horizontally corrugated bulkheads are to be flat over a depth equal to 0,1 D.

Where stools are fitted at the lower part of transverse bulkheads, the thickness of the adjacent plate floors is to be not less than that of the stool plating.

#### 6.4.3 Bulkhead stool

In general, plate diaphragms or web frames are to be fitted in bottom stools in way of the double bottom longitudinal girders or plate floors, as the case may be.

Brackets or deep webs are to be fitted to connect the upper stool to the deck transverses or hatch end beams, as the case may be.

The continuity of the corrugated bulkhead with the stool plating is to be adequately ensured. In particular, the upper strake of the lower stool is to be of the same thickness and yield stress as those of the lower strake of the bulkhead.

### 6.5 Bulkheads acting as pillars

**6.5.1** As a rule, bulkheads acting as pillars (i.e. those designed to sustain the loads transmitted by a deck structure) are to be provided with vertical stiffeners spaced, at a maximum, two frames apart.

**6.5.2** A vertical stiffening member is to be fitted on the bulkhead in line with the deck supporting member transferring the loads from the deck and is to be checked as defined in Ch 4, Sec 7.

### 6.6 Bracketed stiffeners

**6.6.1** The bracket scantlings at ends of bulkhead stiffeners are to be defined by direct calculation, taking into account the bending moment and shear forces acting on the stiffener in way of the bracket as defined in Ch 4, Sec 6.

## 7 Superstructures and deckhouses

### 7.1 Connection of superstructures and deckhouses with the hull structure

**7.1.1** Superstructure and deckhouse frames are to be fitted, as far as practicable, in way of deck frame structure and are to be efficiently connected.

Ends of superstructures and deckhouses are to be efficiently supported by bulkheads, diaphragms, webs or pillars.

Where hatchways are fitted close to the superstructure ends, additional strengthening may be required.

### 7.1.2 Construction details

The vertical stiffeners of the superstructure and deckhouse walls of the first tier (directly located above the freeboard deck) are to be attached to the decks at their ends.

Brackets are to be fitted at the lower end, and preferably also the upper end, of the vertical stiffeners of the exposed front bulkheads of engine casings and superstructures.

**7.1.3** Connection to the hull deck of the corners of superstructures and deckhouses is considered by the Society on a case-by-case basis. Where necessary, local reinforcements may be required.

**7.1.4** As a general rules, the side plating at ends of superstructures is to be tapered into the side shell bulwark or the sheerstrake of the strength deck.

Where a raised deck is fitted, the local reinforcement in way of the step is to extend, as a general rule, over at least three-frame spacings.

### 7.2 Structural arrangement of superstructures and deckhouses

**7.2.1** Web frames, transverse partial bulkheads or other equivalent strengthening of each tier (superstructure and deckhouses) are to be arranged, where practicable, in line with the transverse reinforced structure below.

Web frames are also to be arranged in way of the large openings, tender davits, winches, provision cranes and other areas subjected to local loads.

Web frames, pillars, partial bulkheads and similar strengthening are to be arranged, in conjunction with the deck transverses, at ends of superstructures and deckhouses.

#### 7.2.2 Openings

The arrangement of superstructure and deckhouse openings is to be as defined in Ch 5, Sec 1.

The attention of the Shipowners, Shipyards and Designer is drawn on the fact that the Flag Administration may request the application of National Rules.

#### 7.2.3 Access openings and doors

Access openings cut in side bulkheads of enclosed superstructures are to be fitted with doors having a strength equivalent to the strength of the surrounding structure.

Special consideration is to be given to the connection of the doors to the surrounding structure.

Securing devices which ensure watertightness are to include tight gaskets, clamping dogs or other similar appliances, and are to be permanently attached to the bulkheads and doors. These doors are to be operable from both sides.

## SECTION 2

## SUBDIVISION, COMPARTMENT ARRANGEMENT AND ARRANGEMENT OF HULL OPENINGS

### Symbols

$L_{LL}$  : Load line length, in m, as defined in [2.1]  
 $FP_{LL}$  : Forward freeboard perpendicular.  $FP_{LL}$  is to be taken at the forward end of  $L_{LL}$  and is to coincide with the forward side of the stem on the waterline on which the length  $L_{LL}$  is measured.

### 1 General

#### 1.1 Application

**1.1.1** The present Section is applicable to cargo ships and to non cargo ships as defined in Ch 1, Sec 1, [2.1.2], in accordance with the scope of application defined in Tab 1.

**Table 1 : Scope of application**

| Gross tonnage                                                                                                                                                                                                                                                                                                                                                                                                      | < 500 GT (1) | ≥ 500 GT (2) |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|--------------|
| Subdivision arrangement                                                                                                                                                                                                                                                                                                                                                                                            | NR566        | [3]          |
| Compartment arrangement                                                                                                                                                                                                                                                                                                                                                                                            | NR566        | [4]          |
| Access arrangement                                                                                                                                                                                                                                                                                                                                                                                                 | [5]          | [5]          |
| Hull opening arrangement                                                                                                                                                                                                                                                                                                                                                                                           | NR566        | NR467        |
| <p>(1) Except ships with one of the following service notations:</p> <ul style="list-style-type: none"> <li>• <b>passenger ship</b> with unrestricted navigation</li> <li>• <b>ro-ro passenger ship</b> with unrestricted navigation</li> <li>• <b>fishing vessel</b></li> <li>• <b>chemical tanker</b>.</li> </ul> <p>(2) And ships with one of the service notations defined in (1), whatever their tonnage.</p> |              |              |

#### 1.1.2 Additional specific arrangement

Additional specific arrangement in relation to the service notation of the ship are defined in Ch 6, Sec 1.

#### 1.1.3 Openings in superstructures and deckhouses

Arrangement of openings in superstructures and deckhouses are defined in Ch 5, Sec 1.

### 2 Definition

#### 2.1 Load line length $L_{LL}$

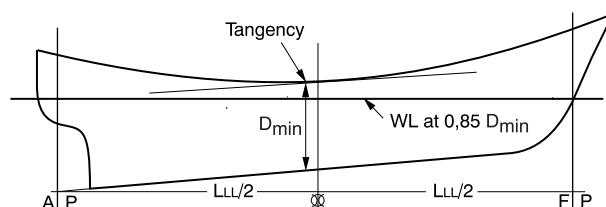
**2.1.1** The load line length  $L_{LL}$  is the distance, in m, on the waterline at 85% of the least moulded depth from the top of the keel, measured from the forward side of the stem to the centre of the rudder stock.  $L_{LL}$  is to be not less than 96% of the total length on the same waterline.

In ship design with a rake of keel, the waterline on which this length is measured is 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 ship (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 Fig 1).

For ships without a rudder stock, the length  $L_{LL}$  is to be taken as 96% of the waterline at 85% of the least moulded depth.

**Figure 1 :  $L_{LL}$  of ships with a rake of keel**



### 2.2 Machinery spaces of category A

**2.2.1** Machinery spaces of category A are those spaces or trunks to such spaces which contain:

- internal combustion machinery used for main propulsion, or
- internal combustion machinery used for purposes other than propulsion where such machinery has in the aggregate a total power output of not less than 375 kW, or
- any oil fired boiler or fuel oil unit.

### 3 Subdivision arrangement

#### 3.1 Number of transverse watertight bulkheads

##### 3.1.1 General

All ships, in addition to complying with the requirements of [3.1.2], are to have at least the following transverse watertight bulkheads:

- one collision bulkhead
- one after peak bulkhead for ships having the service notation **passenger ship** or **ro-ro passenger ship**
- two bulkheads forming the boundaries of the machinery space for ships with machinery amidships, or one bulkhead forward of the machinery space for ships with machinery aft. In the case of ships with an electrical propulsion plant, both the generator room and the engine room are to be enclosed by watertight bulkheads.

3.1.2 Additional bulkheads

As a rule, for ships not required to comply with subdivision regulations, the number of transverse bulkheads adequately spaced are to be at least as indicated in Tab 2.

Additional bulkheads may be required for ships having to comply with subdivision or damage stability criteria.

Table 2 : Number of transverse bulkheads

| Ship length, in m | For ships with aft machinery | For the other ships |
|-------------------|------------------------------|---------------------|
| L < 65            | 3                            | 4                   |
| L ≥ 65            | 4                            | 5                   |

3.2 Water ingress detection

3.2.1 General

When a ship is fitted, below the freeboard deck, with a single cargo hold or with cargo holds not separated by at least one bulkhead made watertight up to the freeboard deck, a water ingress detection system is to be fitted according to NR467 Steel Ships, Pt C, Ch 1, Sec 10, [6.12.2].

3.2.2 Bulk carriers

For ships granted with the service notation **bulk carrier, bulk carrier ESP, ore carrier ESP, combination carrier/OBO ESP or combination carrier/OOC ESP**, the water ingress detection system is to be fitted according to NR467 Steel Ships, Pt C, Ch 1, Sec 10, [6.12.1].

3.3 Collision bulkhead

3.3.1 A collision bulkhead, made watertight up to the bulkhead deck, is to be fitted. This bulkhead is to be located at a distance from  $FP_{LL}$  not less than 5 per cent of the length  $L_{LL}$  and, except as may be permitted by the Society, not more than 8 per cent of  $L_{LL}$  or 5 per cent of  $L_{LL} + 3\text{ m}$ , whichever is the greater.

Note 1: For ships not covered by the SOLAS Convention,  $L_{LL}$  need not be taken less than 50 m, unless otherwise required by the National Authorities.

3.3.2 Where any part of the ship below the waterline extends forward of the forward perpendicular, e.g. a bulbous bow, the distances, in metres, stipulated in [3.3.1] are to be measured from a point located either:

- at mid-length of such an extension, or
- at a distance equal to 1,5 per cent of the length  $L_{LL}$  forward of the forward perpendicular

whichever gives the smallest measurement.

3.3.3 The bulkhead may have steps or recesses, provided they are within the limits specified in [3.3.1] or [3.3.2].  
No door, manhole, ventilation duct or any other opening is to be fitted in the collision bulkhead below the bulkhead deck.

3.3.4 At the Owner’s request and subject to the agreement of the flag Administration, the Society may accept, on a case-by-case basis, a distance from the collision bulkhead

to the forward perpendicular  $FP_{LL}$  greater than the maximum limit specified in [3.3.1] and [3.3.2], provided that subdivision and stability calculations show that, when the ship is in upright condition on full load summer waterline, flooding of the space forward of the collision bulkhead will not result in any part of the freeboard deck becoming immersed, or in any unacceptable loss of stability.

In such a case, the attention of the Owner and the Shipyard is drawn to the fact that the flag Administration may impose additional requirements and that such an arrangement is, in principle, formalised by the issuance of a certificate of exemption under the SOLAS Convention provisions. Moreover, in case of change of flag, the taking Administration may not accept the exemption.

3.3.5 Where a long forward superstructure is fitted, the collision bulkhead is to be extended weathertight up to the next deck above the bulkhead deck. This extension need not be fitted directly above the bulkhead below, provided that:

- it is located within the limits specified in [3.3.1] or [3.3.2], considering the exemption given in [3.3.6], and
- the part of the deck which forms the step is made effectively weathertight.

3.3.6 Where bow doors are fitted and a sloping loading ramp forms part of the extension of the collision bulkhead above the freeboard deck, the part of the ramp beyond 2,3 m above the freeboard deck may extend forward of the limit specified in [3.3.1] or [3.3.2]. The ramp is to be weathertight over its full length.

3.3.7 The number of openings in the extension of the collision bulkhead above the freeboard deck is to be restricted to the minimum compatible with the design and normal operation of the ship. All such openings are to be capable of being closed weathertight.

3.4 After peak bulkheads, machinery space bulkheads and sterntubes

3.4.1 General

Bulkheads are to be fitted to separate the machinery space from the cargo and accommodation spaces forward and aft, and made watertight up to the bulkhead deck. In passenger ships, an after peak bulkhead is also to be fitted and made watertight up to the bulkhead deck. The after peak bulkhead may, however, be stepped below the bulkhead deck, provided the degree of safety of the ship as regards subdivision is not thereby impaired.

3.4.2 Sterntubes

In all the cases, sterntubes are to be enclosed in watertight spaces of moderate volume. In passenger ships, the stern gland is to be located in a watertight shaft tunnel or other watertight space separate from the sterntube compartment and of such a volume that, if flooded by leakage through the stern gland, the bulkhead deck will not be immersed. In cargo ships, other measures to minimise the danger of seawater ingress in case of damage to the sterntube arrangement may be taken at the discretion of the Society.

3.5 Height of transverse watertight bulkheads other than collision bulkhead and after peak bulkheads

3.5.1 Transverse watertight bulkheads are to extend watertight up to the bulkhead deck. In exceptional cases and at the Owner’s request, the Society may allow transverse watertight bulkheads to terminate at a deck below the freeboard deck, provided that deck is at an adequate distance above the full load summer waterline.

3.5.2 Where it is not practicable to arrange a watertight bulkhead in one plane, a stepped bulkhead may be fitted. In this case, the part of the deck which forms the step is to be watertight and equivalent in strength to the bulkhead.

3.6 Openings in watertight bulkheads and decks - Ships with service notation other than passenger ship or ro-ro passenger ship

3.6.1 The requirements from [3.6.2] to [3.6.10] apply to ships having a service notation other than **passenger ship** or **ro-ro passenger ship**.

The openings in watertight bulkheads below the bulkhead deck of ships having the service notation **passenger ship** or **ro-ro passenger ship** are to comply with NR467 Steel Ships, respectively Part D, Chapter 11 and Part D, Chapter 12.

3.6.2 The number of openings in watertight subdivisions is to be kept to a minimum compatible with the design and proper working of the ship. Where penetrations of watertight bulkheads and internal decks are necessary for access, piping, ventilation, electrical cables, etc., arrangement is to be made to maintain the watertight integrity. The Society may permit relaxation in the watertightness of openings

above the freeboard deck, provided it is demonstrated that any progressive flooding can be easily controlled and that the safety of the ship is not impaired.

3.6.3 No door, manhole ventilation duct or any other opening is permitted in the collision bulkhead below the subdivision deck.

3.6.4 Lead or other heat sensitive materials may not be used in systems which penetrate watertight subdivision bulkheads, where deterioration of such systems in the event of fire would impair the watertight integrity of the bulkheads.

3.6.5 Valves not forming part of a piping system are not permitted in watertight subdivision bulkheads.

3.6.6 The requirements relevant to the degree of tightness, as well as the operating systems, for doors or other closing appliances complying with the provisions from [3.6.7] to [3.6.10], are specified in Tab 3.

3.6.7 Openings used while at sea

Doors provided to ensure the watertight integrity of internal openings which are used while at sea are to be sliding watertight doors capable of being remotely closed from the bridge and are also to be operable locally from each side of the bulkhead. Indicators are to be provided at the control position showing whether the doors are open or closed, and an audible alarm is to be provided at the door closure. The power, control and indicators are to be operable in the event of main power failure. Particular attention is to be paid to minimise the effect of control system failure. Each power-operated sliding watertight door is to be provided with an individual hand-operated mechanism. The possibility of opening and closing the door by hand at the door itself from both sides is to be assured.

Table 3 : Doors in watertight subdivision bulkheads

| Doors                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                          |                     | Sliding type                              |                         |                      | Hinged type                               |                         |                      | Rolling type<br>(cargo between deck spaces) |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|---------------------|-------------------------------------------|-------------------------|----------------------|-------------------------------------------|-------------------------|----------------------|---------------------------------------------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                          |                     | Remote operation indication on the bridge | Indicator on the bridge | Local operation only | Remote operation indication on the bridge | Indicator on the bridge | Local operation only |                                             |
| Watertight                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Below the freeboard deck | Open at sea         | X                                         |                         |                      |                                           |                         |                      |                                             |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                          | Normally closed (2) |                                           | X                       |                      |                                           | X                       |                      |                                             |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                          | Remained closed (2) |                                           |                         | X (3) (4)            |                                           |                         | X (3) (4)            | X (3) (4)                                   |
| Weathertight/<br>watertight (1)                                                                                                                                                                                                                                                                                                                                                                                                                                               | Above the freeboard deck | Open at sea         | X                                         |                         |                      |                                           |                         |                      |                                             |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                          | Normally closed (2) |                                           | X                       |                      |                                           | X                       |                      |                                             |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                          | Remained closed (2) |                                           |                         |                      |                                           |                         | X (3) (4)            |                                             |
| <p>(1) Watertight doors are required when they are located below the waterline at the equilibrium of the final stage of flooding; otherwise a weathertight door is accepted.</p> <p>(2) The following notice is to be affixed on both sides of the door: “To be kept closed at sea”.</p> <p>(3) The door is to be closed before the voyage commences.</p> <p>(4) If the door is accessible during the voyage, a device preventing non-authorised opening is to be fitted.</p> |                          |                     |                                           |                         |                      |                                           |                         |                      |                                             |

### 3.6.8 Openings normally closed at sea

Access doors and access hatch covers normally closed at sea and intended to ensure the watertight integrity of internal openings are to be provided with means of indication, locally and on the bridge, showing whether these doors or hatch covers are open or closed. A notice is to be affixed to each such door or hatch cover to the effect that it is not to be left open.

### 3.6.9 Doors or ramps in large cargo spaces

Watertight doors or ramps of satisfactory construction may be fitted to internally subdivide large cargo spaces, provided that the Society is satisfied that such doors or ramps are essential. These doors or ramps may be hinged, rolling or sliding doors or ramps, but are not to be remotely controlled. Such doors are to be closed before the voyage commences and are to be kept closed during navigation. Should any of the doors or ramps be accessible during the voyage, they are to be fitted with a device preventing non-authorised opening.

The word "satisfactory" means that the scantlings and sealing requirements for such doors or ramps are to be sufficient to withstand the maximum head of water at the flooded waterline.

### 3.6.10 Openings kept permanently closed at sea

Other closing appliances which are kept permanently closed at sea to ensure the watertight integrity of internal openings are to be provided with a notice affixed to each such closing appliance to the effect that it is to be kept closed at sea. Manholes fitted with closely bolted covers need not be so marked.

## 4 Compartment arrangement

### 4.1 Definitions

#### 4.1.1 Cofferdam

A cofferdam means an empty space arranged so that compartments on each side have no common boundary. A cofferdam may be located vertically or horizontally. As a rule, a cofferdam is to be properly ventilated and of sufficient size to allow for inspection.

### 4.2 Cofferdam arrangement

#### 4.2.1 Cofferdams are to be provided between:

- fuel oil tanks and lubricating oil tanks
- compartments intended for liquid hydrocarbons (fuel oil, lubricating oil) and compartments intended for fresh water (drinking water, water for propelling machinery and boilers)
- compartments intended for liquid hydrocarbons (fuel oil, lubricating oil) and tanks intended for the carriage of liquid foam for fire-extinguishing systems.

#### 4.2.2 Cofferdams separating:

- fuel oil tanks from lubricating oil tanks
- lubricating oil tanks from compartments intended for fresh water or boiler feed water

- lubricating oil tanks from those intended for the carriage of liquid foam for fire-extinguishing systems,

may not be required, when deemed impracticable or unreasonable by the Society in relation to the characteristics and dimensions of the spaces containing such tanks, provided that:

- the common boundary plate thickness of the adjacent tanks is increased, with respect to the thickness obtained according to Ch 4, Sec 3, by:
  - 2 mm in the case of tanks carrying fresh water or boiler feed water, and
  - 1 mm in all the other cases
- the sum of the throat thicknesses of the weld fillets at the edges of these plates is not less than the thickness of the plates themselves
- the structural test is carried out with a head increased by 1 m with respect to Ch 7, Sec 3.

**4.2.3** Spaces intended for the carriage of flammable liquids are to be separated from accommodation and service spaces by means of a cofferdam. Where accommodation and service spaces are arranged immediately above such spaces, the cofferdam may be omitted only where the deck is not provided with access openings and is coated with a layer of material recognized as suitable by the Society.

The cofferdam may also be omitted where such spaces are adjacent to a passageway, subject to the conditions stated in [4.2.2] for fuel oil or lubricating oil tanks.

### 4.3 Double bottom

**4.3.1** Except for ships with service notation **fishing vessel**, a double bottom is to be fitted extending from the collision bulkhead to the after peak bulkhead, as far as this is practicable and compatible with the design and proper working of the ship.

**4.3.2** Any part of a ship which is not fitted with a double bottom is to be capable of withstanding bottom damages as specified in NR467 Steel Ships, Pt B, Ch 3, Sec 3, [3.4].

**4.3.3** Where a double bottom is required to be fitted, the inner bottom is to be continued out to the ship sides in such a manner as to protect the bottom to the turn of the bilge. Such protection is to be deemed satisfactory if the inner bottom, at any part, is not lower than a plane parallel to the keel line and located at a vertical distance  $h$ , measured from the keel line, not less than, in m:

$$h = B / 20 \text{ without being less than } 0,760 \text{ m.}$$

However,  $h$  need not be taken greater than 2 m.

**4.3.4** Small wells constructed in the double bottom in connection with the drainage arrangement of holds are not to extend downward more than necessary. A well extending to the outer bottom is, however, permitted at the after end of the shaft tunnel of the ship. Other wells may be permitted by the Society if it is satisfied that the arrangements give protection equivalent to that afforded by a double bottom complying with [4.3]. In no case the vertical distance from the bottom of such a well to a plane coinciding with the keel line is to be less than 500 mm.

#### 4.4 Compartments forward of the collision bulkhead

**4.4.1** The fore peak and other compartments located forward of the collision bulkhead are not to be used for the carriage of fuel oil or other flammable products.

#### 4.5 Minimum bow height

**4.5.1** The minimum bow height  $F_b$  is to be as defined in NR566, Ch 1, Sec 4 or NR467 Steel Ships, Part B, Ch 2, Sec 2 for ships greater than 500 GT.

#### 4.6 Shaft tunnels

**4.6.1** Shaft tunnels are to be watertight.

#### 4.7 Watertight ventilators and trunks

**4.7.1** Watertight ventilators and trunks are to be carried at least up to:

- the freeboard deck for ships other than passenger ships
- the bulkhead deck for passenger ships.

#### 4.8 Fuel oil tanks

**4.8.1** The arrangements for the storage, distribution and utilisation of the fuel oil are to be such as to ensure the safety of the ship and persons on board.

**4.8.2** As far as practicable, fuel oil tanks are to be part of the ship structure and are to be located outside the machinery spaces of category A.

Where fuel oil tanks, other than double bottom tanks, are necessarily located adjacent to or within machinery spaces of category A:

- at least one of their vertical sides is to be contiguous to the machinery space boundaries
- they are preferably to have a common boundary with the double bottom tanks, and
- the area of the tank boundary common with the machinery spaces is to be kept to a minimum.

Where such tanks are located within the boundaries of machinery spaces of category A, they may not contain fuel oil having a flashpoint less than 60°C.

**4.8.3** Fuel oil tanks may not be located where spillage or leakage thereof can constitute a hazard by falling on heated surfaces.

Precautions are to be taken to prevent any oil that may escape under pressure from any pump, filter or heater from coming into contact with heated surfaces.

Fuel oil tanks in boiler spaces may not be located immediately above the boilers or in areas subjected to high temperatures, unless special arrangements are provided in agreement with the Society.

**4.8.4** Where a compartment intended for goods or coal is located close to a heated liquid container, a suitable thermal insulation is to be provided.

#### 4.8.5 Fuel oil tank protection

All ships with an aggregate oil fuel capacity of 600 m<sup>3</sup> are to comply with the requirements of Regulation 12 A of Annex I to Marpol Convention, as amended.

### 5 Access arrangement

#### 5.1 General

**5.1.1** The number and size of small hatchways for trimming and of access openings to tanks or other enclosed spaces are to be kept to the minimum consistent with the access and maintenance of the space.

#### 5.2 Double bottom

**5.2.1** Manholes are to be provided in floors and girders so as to provide convenient access to any part of the double bottom.

**5.2.2** Manholes may not be cut in the continuous centre-line girder or in the floors and girders below pillars, except where allowed by the Society, on a case-by-case basis.

**5.2.3** Inner bottom manholes are to be not smaller than 400 mm x 400 mm. Their number and location are to be so arranged as to provide convenient access to any part of the double bottom.

**5.2.4** However, the size of manholes and lightening holes in floors and girders is, in general, to be less than 50 per cent of the local height of the double bottom.

Where manholes of greater size are needed, edge reinforcement by means of flat bar rings or other suitable stiffeners may be required.

**5.2.5** Inner bottom manholes are to be closed by watertight plate covers.

Doubling plates are to be fitted on the covers, where secured by bolts.

Where no ceiling is fitted, covers are to be adequately protected from damage caused by the cargo.

### 5.3 Access arrangement to, and within, spaces in, and forward of, the cargo area

#### 5.3.1 General

The requirements defined in [5.3.2] for access to tanks, in [5.3.3] for access within tanks and in [5.3.4] for construction of ladders are not applicable to:

- ships with service notation **oil tanker ESP** (see NR467 Steel Ships, Part D, Chapter 7)
- spaces in double bottom and double side tanks.

Additional specific requirements, defined in NR467 Steel Ships, Part D, are applicable to the following service notations:

- livestock carrier:** see NR467, Part D, Chapter 3
- bulk carrier:** see NR467, Part D, Chapter 4
- ore carrier:** see NR467, Part D, Chapter 5
- combination carrier:** see NR467, Part D, Chapter 6
- oil tanker:** see NR467, Part D, Chapter 7
- chemical tanker:** see NR467, Part D, Chapter 8
- passenger ships:** see NR467, Part D, Chapter 11
- ro-ro passenger ship:** see NR467, Part D, Chapter 12.
- tugs:** see NR467, Part E, Chapter 1
- supply vessels:** see NR467, Part E, Chapter 3
- oil recovery ships:** see NR467, Part E, Chapter 5
- diving support vessels:** see NR467, Part E, Chapter 7
- standby rescue vessels:** see NR467, Part E, Chapter 10

#### 5.3.2 Access to tanks

Tanks and subdivisions of tanks having lengths of 35 m and above are to be fitted with at least two access hatchways and ladders, as far apart as practicable longitudinally.

Tanks less than 35 m in length are to be served by at least one access hatchway and ladder.

The dimensions of any access hatchway are to be sufficient to allow a person wearing a self-contained breathing apparatus to ascend or descend the ladder without obstruction and also to provide a clear opening to facilitate the hoisting of an injured person from the bottom of the tank. In no case is the clear opening to be less than 600 mm x 600 mm.

When a tank is subdivided by one or more swash bulkheads, at least two hatchways are to be fitted, and these hatchways are to be so located that the associated ladders effectively serve all subdivisions of the tank.

#### 5.3.3 Access within tanks

Where one or more swash bulkheads are fitted in a tank, they are to be provided with openings not less than 600 mm x 800 mm and so arranged as to facilitate the access of persons wearing a breathing apparatus or carrying a stretcher with a patient.

To provide ease of movement on the tank bottom throughout the length and breadth of the tank, a passageway is to be fitted on the upper part of the bottom structure of each tank or, alternatively, manholes having at least the dimensions of 600 mm x 800 mm are to be arranged in the floors at a height of not more than 600 mm from the bottom shell plating.

The passageways located in the tanks are to be as follows:

- They are to have a minimum width of 600 mm, considering the requirement for the possibility of carrying an unconscious person. Elevated passageways are to be provided with guard rails over their entire length. Where guard rails are provided on one side only, foot rails are to be fitted on the opposite side. Shelves and platforms forming a part of the access to the tanks are to be of non-skid construction, where practicable, and be fitted with guard rails. Guard rails are to be fitted to bulkhead and side stringers when such structures are being used for recognised access.
- Access to elevated passageways from the ship bottom is to be provided by means of easily accessible passageways, ladders or treads. Treads are to provide lateral support for the foot. Where rungs of ladders are fitted against a vertical surface, the distance from the centre of the rungs to that surface is to be at least 150 mm.
- When the height of the bottom structure does not exceed 1,50 m, the passageways required in a) may be replaced by alternative arrangements having regard to the bottom structure and requirement for ease of access of a person wearing a self-contained breathing apparatus or carrying a stretcher with a patient.

Where manholes are fitted, as indicated in [5.2.4], access is to be facilitated by means of steps and hand grips with platform landings on each side.

Guard rails are to be 900 mm in height and consist of a rail and intermediate bar. These guard rails are to be of substantial construction.

#### 5.3.4 Construction of ladders

In general, the ladders are not to be inclined at an angle exceeding 70°. The flights of ladders are not to be more than 9 m in actual length. Resting platforms of adequate dimensions are to be provided.

Ladders and handrails are to be constructed of steel of adequate strength and stiffness and securely attached to the tank structure by stays. The method of support and length of stay are to be such that vibration is reduced to a practical minimum.

Provision is to be made for maintaining the structural strength of the ladders and railings taking into account the corrosive effect of the cargo.

As a rule, the width of ladders between stringers should not be less than 400 mm.

The treads are to be equally spaced at a distance apart measured vertically not exceeding 300 mm. They are to be formed of two square steel bars of not less than 22 mm by 22 mm in section fitted to form a horizontal step with the edges pointing upward, or of equivalent construction. The treads are to be carried through the side stringers and attached thereto by double continuous welding.

All sloping ladders are to be provided with handrails of substantial construction on both sides, fitted at a convenient distance above the treads.