

**BUREAU
VERITAS**

Structural Rules for Container Ships

July 2019

**Rule Note
NR625 DT R02 E**

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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

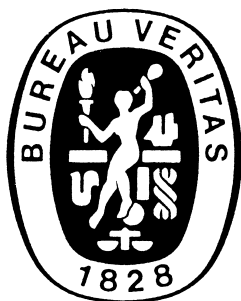
- 14.1 Invalidity of one or more provisions does not affect the remaining provisions.
- 14.2 Definitions herein take precedence over other definitions which may appear in other documents issued by the Society.
- 14.3 In case of doubt as to the interpretation of the Conditions, the English text shall 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 625

NR 625 Structural Rules for Container Ships

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SECTION 1

APPLICATION

1 Scope of application

1.1 General

1.1.1 These Rules apply to ships with a length greater than 65m and assigned with the service notation **container ship**.

1.1.2 The requirements for the container lashing equipment, according to Chapter 14, may be applied for ships with the additional service feature **equipped for the carriage of containers** and granted with the additional class notation **LASHING**, **LASHING-WW** or **LASHING (specific area)**.

2 Rule application

2.1 Structural requirements

2.1.1 These Rules apply to double bottom ships of double or single side skin construction, intended to carry containers in holds or on decks.

The ship structure is to be longitudinally or transversely framed with full transverse bulkheads and intermediate web frames.

When single side skin construction is adopted, a torsion box girder at the topsides or an equivalent structure is to be fitted. Typical midship sections are shown in Fig 1 and Fig 2.

Figure 1 : Container ship of double side skin construction

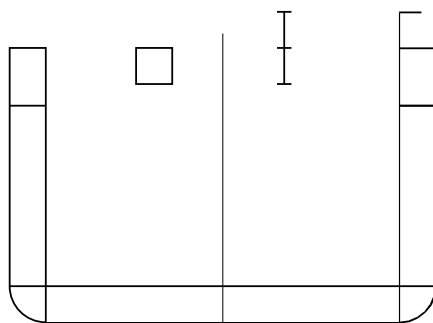
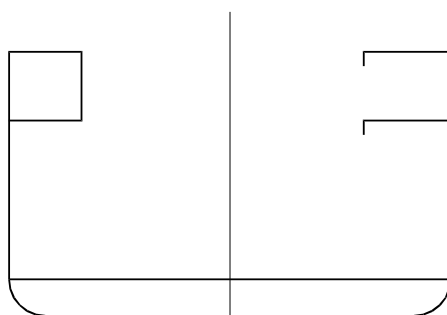


Figure 2 : Container ship of single side skin construction



2.1.2 Materials and welding

These Rules apply to welded hull structures made of steel having characteristics complying with requirements in Ch 3, Sec 1. These Rules applies also to welded steel ships in which parts of the hull, such as superstructures or small hatch covers, are built in material other than steel, complying with requirements in Ch 3, Sec 1.

Ships whose hull materials are different than those given in the first paragraph are to be individually considered by the Society, on the basis of the principles and criteria adopted in these Rules.

2.2 Ship parts

2.2.1 General

For the purpose of application of these Rules, the ship is considered as divided into the following five parts:

- fore part
- cargo hold region
- machinery space
- aft part
- superstructures and deckhouses.

2.2.2 Fore part

The fore part is the part of the ship located forward of the collision bulkhead, i.e.:

- the fore peak structures
- the stem.

2.2.3 Cargo hold region

The cargo hold region is the part of the ship that contains cargo holds. It includes the full breadth and depth of the ship, the collision bulkhead and the transverse bulkhead at its aft end. The cargo hold region does not include the pump room, if any.

2.2.4 Machinery space

The machinery space is the part of the ship between the aft peak bulkhead and the transverse bulkhead at the aft end of the cargo hold region and includes the pump room, if any.

2.2.5 Aft part

The aft part includes the structures located aft of the aft peak bulkhead.

2.2.6 Superstructures and deckhouses

A superstructure is a decked structure on the freeboard deck extending from side to side of the ship or with the side plating not being inboard of the shell plating more than 0,04 B.

A deckhouse is a decked structure on the freeboard or superstructure deck which does not comply with the definition of a superstructure.

2.3 Other structural parts

2.3.1 Other structural parts not covered by these Rules, e.g. rudder scantlings, are to comply with the applicable requirements of NR467, Rules for Steel Ships.

SECTION 2

RULE PRINCIPLES

1 Design basis

1.1 General

1.1.1 Ships are to be designed to withstand, in intact condition, the environmental conditions as defined in [1.4] anticipated during the design life, for the appropriate loading conditions. Structural strength is to be determined against buckling and yielding. Ultimate strength calculations must include ultimate hull girder capacity and ultimate strength of plates and stiffeners.

1.1.2 Ships are to be designed to have sufficient reserve strength to withstand loads in damaged conditions, e.g. flooded scenarios.

1.1.3 Finite element analysis

Scantlings of structural members within the cargo hold region of ships having a length L of 150 m or above are to be assessed according to the requirements specified in Chapter 7.

1.1.4 Fatigue life

Ships having a length L of 150 m or above are to be assessed according to the design fatigue life for structural details specified in Chapter 9.

1.2 Hull form limit

1.2.1 Loads applying to the ship hull, as described in these Rules, are based on hull forms within the following limits:

- $L < 500$ m
- $C_B > 0,6$
- $L/B > 5$
- $B/D < 2,5$

Specific consideration will be given by the Society to ships with different hull forms.

1.3 Design life

1.3.1 Rule loads and scantling criteria are based on a target design life of 25 years. The design life is the period during which the ship is assumed to be exposed to operating conditions.

1.4 Environmental conditions

1.4.1 Wave environment

The rule requirements are based on North Atlantic wave environment for the strength assessment of ships having the navigation notation **Unrestricted navigation**, and a reduced wave environment for ships having the navigation notation **Coastal area** or **Sheltered area**.

The rule requirements are based on Worldwide wave environment for the fatigue assessment.

1.4.2 Wind and current

The effects of wind and current with regard to the strength of the structure are not considered.

1.4.3 Ice

The effects of ice and ice accretion are not taken into account by the Rules.

1.4.4 Design temperatures

The structural assessment of hull strength members is assumed to be valid for the following design temperatures:

- lowest mean daily average temperature in air: -10°C
- lowest mean daily average temperature in seawater: 0°C .

Ships intended to operate in areas with lower mean daily average temperature, e.g. regular service during winter seasons to Arctic or Antarctic waters, are subject to specific requirements.

In the above, the following definitions apply:

daily average : Average during one day and one night

mean : Statistical mean over an observation period (at least 20 years)

lowest : The lowest value during one year.

For seasonally restricted service, the lowest value within the period of operation applies.

1.5 Operating conditions

1.5.1 The Rules specify the minimum loading conditions that are to be assessed for compliance.

Specification of loading conditions other than those required by the Rules is the responsibility of the Owner. These other loading conditions are to be documented and assessed for compliance.

1.6 Operating draughts

1.6.1 The design operating draughts are to be specified by the builder/designer, subject to acceptance by the Owner, and are to be used to derive the appropriate structural scantlings.

All operational loading conditions in the loading manual are to comply with the specified design operating draughts.

The following design operating draughts are, as a minimum, to be considered:

- scantling draught for the assessment of structure
- minimum ballast draught at midship for assessment of structure
- minimum forward draught, T_F , for the assessment of bottom structure forward subjected to slamming loads, as defined in Ch 4, Sec 5, [3.2.1]

1.7 Maximum service speed

1.7.1 The maximum service speed is to be specified. Although the hull structure assessment accounts for the service speed, this does not relieve the responsibilities of the Owner and personnel to properly handle the ship.

1.8 Owner's extras

1.8.1 The Owner's specification above the general classification or statutory requirements may affect the structural design. Owner's extras may include requirements for:

- vibration analysis
- maximum percentage of high strength steel
- additional scantlings above those required by the Rules
- additional design margin on the loads specified by the Rules, etc.
- improved fatigue resistance, in the form of a specified increase in design fatigue life or equivalent.

Owner's extras are not specified in these Rules. Owner's extras, if any, that may affect the structural design are to be clearly specified in the design documentation.

2 Design principles

2.1 Overall principles

2.1.1 General

These Rules are based on the following overall principles:

- the safety of the structure can be assessed by addressing the potential structural failure mode(s) when the ship is subject to operational loads and environmental loads/conditions
- the design complies with the design basis, see Sec 3
- the structural requirements are based on consistent design load sets which cover the appropriate operating modes of a container ship.

2.1.2 The ship structure is so designed that:

- It has a degree of redundancy. The ship structure should work in a hierarchical manner and, in principle, failure of structural elements lower down in the hierarchy does not result in immediate consequential failure of elements higher up in the hierarchy
- It has sufficient reserve strength to withstand the wave and internal loads in damaged conditions that are reasonably foreseeable, e.g. flooding scenarios
- The incidence of in-service cracking is minimised, particularly in locations which affect the structural integrity or containment integrity, affect the performance of structural or other systems, or are difficult to inspect and repair
- it has adequate structural redundancy to survive in the event that the structure is accidentally damaged by a minor impact leading to flooding of any compartment.

2.2 Loads

2.2.1 Design load scenarios

The structural assessment is based on the design load scenarios encountered by the ship, as defined in Ch 4, Sec 7.

The following design load scenarios are based on the static and dynamic loads given below:

- Static design load scenario (S):
Application of relevant static loads, typically: load scenarios in harbour, sheltered water, or tank testing
- Static plus Dynamic design load scenario (S+D):
Application of relevant static loads and simultaneously occurring dynamic load components, typically: load scenarios for seagoing operations
- Impact design load scenario (I):
Application of impact loads such as bottom slamming and bow impact encountered during seagoing operations
- Sloshing design load scenario (SL):
Application of sloshing loads encountered during seagoing operations
- Fatigue design load scenario (F):
Application of relevant dynamic loads
- Accidental design load scenario (A):
Application of specific loads not occurring during normal operations.

2.3 Structural capacity assessment

2.3.1 General

The basic principle in structural design is to apply the defined design loads, identify plausible failure modes and use appropriate capacity models to verify the required structural scantlings.

2.3.2 Capacity models for strength assessment

The capacity models for strength assessment are able to analyse the failure mode with regard to the required degree of accuracy.

The capacity models either are in a prescriptive format or require the use of more advanced calculations such as finite element analysis methods.

2.3.3 Capacity models for fatigue assessment

The capacity models for fatigue assessment:

- provide rule requirements to assess structural details against fatigue failure
- are based on a linear cumulative damage summation (Palmgren-Miner rule) in combination with a design S-N curve, a reference stress range and an assumed long-term stress distribution curve, and
- either are in a prescriptive format or require the use of more advanced calculations, such as finite element analysis methods. These methods account for the combined effects of global and local dynamic loads.

2.3.4 Net scantling approach

The objective of the net scantling approach is to:

- provide a relationship between the thickness used for strength calculations during the newbuilding stage and the minimum thickness accepted during the operational phase
- enable the status of the structure with respect to corrosion to be clearly ascertained throughout the life of the ship.

The net scantling approach distinguishes between local corrosion and global corrosion:

- local corrosion is defined as uniform corrosion of local structural elements, such as a single plate or stiffener
- global corrosion is defined as the overall average corrosion of larger areas, such as primary supporting members and the hull girder.

Both the local corrosion and the global corrosion are used as a basis for the newbuilding review and are to be assessed during operation of the ship.

No credit is given in the assessment of structural capability for the presence of coatings or similar corrosion protection systems.

The application of the net thickness approach to assess the structural capacity is specified in Ch 3, Sec 2.

3 Rule design methods

3.1 General

3.1.1 Design methods

Scantling requirements are specified to cover the relevant failure modes, as necessary, for various structural parts.

The criteria for the assessment of scantlings are based on one of the following design methods:

- Working Stress Design (WSD) method, also known as the permissible or allowable stress method
- Partial Safety Factor (PSF) method, also known as Load and Resistance Factor Design (LRFD).

For both WSD and PSF, two design assessment conditions are given, as well as the corresponding acceptance criteria. These conditions are associated with the probability level of the combined loads, A and B.

a) Composition of the WSD method

- for condition A:

$$W_{\text{stat}} \leq \eta_1 R$$

- for condition B:

$$W_{\text{stat}} + W_{\text{dyn}} \leq \eta_2 R$$

where:

W_{stat} : Simultaneously occurring static loads (or load effects in terms of stresses)

W_{dyn} : Simultaneously occurring dynamic loads. The dynamic loads are typically a combination of local and global load components

R : Characteristic structural capacity (e.g. specified minimum yield stress or buckling capacity)

η_i : Permissible utilisation factor (resistance factor). The utilisation factor includes consideration of uncertainties in loads, structural capacity and the consequence of failure.

b) Composition of the PSF method

- for condition A:

$$\gamma_{\text{stat-1}} W_{\text{stat}} + \gamma_{\text{dyn-1}} W_{\text{dyn}} \leq \frac{R}{\gamma_R}$$

- for condition B:

$$\gamma_{\text{stat-2}} W_{\text{stat}} + \gamma_{\text{dyn-2}} W_{\text{dyn}} \leq \frac{R}{\gamma_R}$$

where:

$\gamma_{\text{stat-i}}$: Partial safety factor that accounts for the uncertainties related to static loads in condition A or B

$\gamma_{\text{dyn-i}}$: Partial safety factor that accounts for the uncertainties related to dynamic loads in condition A or B

γ_R : Partial safety factor that accounts for the uncertainties related to structural capacity.

The acceptance criteria for both the WSD method and the PSF method are calibrated for the various requirements such that consistent and acceptable safety levels for all combinations of static and dynamic load effects are derived.

3.2 Minimum requirements

3.2.1 The minimum requirements specify the minimum scantling requirements which are to be applied irrespective of all other requirements, hence thickness below the minimum is not allowed.

The minimum requirements are usually in one of the following forms:

- minimum thickness, which is independent of the specified minimum yield stress
- minimum stiffness and proportion, which are based on buckling failure modes.

3.3 Load-capacity based requirements

3.3.1 General

In general, the working stress design (WSD) method is applied in the requirements, except for the hull girder ultimate strength criteria, where the partial safety factor (PSF) method is applied for its highly critical failure mode, in order to better account for uncertainties related to static loads, dynamic loads and capacity formulations.

The identified load scenarios are addressed by the Rules in terms of design loads, design format and acceptance criteria set.

Load-based prescriptive requirements provide scantling requirements for all plating, local support members, most primary supporting members and the hull girder and cover all structural elements including deckhouses and foundations for deck equipment.

In general, these requirements explicitly control one particular failure mode and hence several requirements may be applied to assess one particular structural member.

3.3.2 Design loads for strength assessment

The structural assessment of the compartment boundaries, e.g. the bulkheads, is based on the loading condition deemed relevant for the type of ship and the operation the ship is intended for.

To provide consistency of approach, standardised rule values for parameters, such as GM and C_B , are applied to calculate the rule load values.

The design load scenarios for structural verification apply the applicable simultaneously acting local and global load components. The relevant design load scenarios are given in Ch 4, Sec 7.

The simultaneously occurring dynamic loads are specified, applying a dynamic load combination factor to the dynamic load values given in Chapter 4. The dynamic load combination factors that define the dynamic load cases are given in Ch 4, Sec 2.

Design load conditions for the hull girder ultimate strength are given in Ch 5, Sec 2.

3.3.3 Design loads for fatigue assessment

For the fatigue requirements given in Chapter 9, the load assessment is based on the expected load history and an average approach is applied. The expected load history for the design life is characterised by the 10^{-2} probability level of the dynamic load value, the load history for each structural member is represented by Weibull probability distributions of the corresponding stresses.

The considered wave induced loads include:

- hull girder loads (i.e. vertical and horizontal bending moments)
- dynamic wave pressures
- dynamic pressure from cargo.

The load values are based on rule parameters corresponding to the loading conditions, e.g. GM, C_B and the applicable draughts amidships.

The simultaneously occurring dynamic loads are accounted for, combining the stresses due to the various dynamic load components. The stress combination procedure is given in Chapter 9.

3.3.4 Structural response analysis

The following approaches are used for the determination of the structural response to the applied design load combinations:

- a) Beam theory is used for prescriptive requirements
- b) Finite element analysis is used for:
 - standard mesh for cargo hold model
 - fine mesh for local models
 - very fine mesh for fatigue assessment.

3.4 Acceptance criteria

3.4.1 General

The acceptance criteria are categorised into four sets. The specific acceptance criteria sets applied in the rule requirements depend on the probability level of the characteristic combined load.

- a) The acceptance criteria set AC-1 is typically applied for the static design load combinations and for the sloshing design loads. The allowable stress for such loads is lower than for an extreme load to take into account effects of:
 - repeated yield
 - allowance for some dynamics
 - margins for some selected limited operational mistakes.
- b) The acceptance criteria set AC-2 is typically applied for the static + dynamic design load combinations, where the considered loads are extreme loads with a low probability of occurrence.
- c) The acceptance criteria set AC-3 is typically applied for accidental loads, such as flooding loads.
- d) The acceptance criteria set AC-4 is typically applied for impact loads, such as bottom slamming and bow impact loads.

3.4.2 Criteria

A general overview of the acceptance criteria is provided in Tab 1 and Tab 2 for the different design load scenarios covered by these Rules for the yield and buckling failure modes:

- for the yield criteria, the permissible stress is proportional to the specified minimum yield stress of the material
- for the buckling failure mode, the acceptance criteria are based on the control of stiffness and proportions as well as on the buckling utilisation factor.

3.5 Design verification

3.5.1 Design verification - Hull girder ultimate strength

The requirements for the ultimate strength of the hull girder are based on a partial safety factor (PSF) method. A safety factor is assigned to each of the basic variables, the still water bending moment, the wave bending moment and the ultimate capacity. The safety factors are determined using a structural reliability assessment approach, the long-term load history distribution of the wave bending moment is derived using ship motion analysis techniques suitable for determining extreme wave bending moments.

The purpose of the hull girder ultimate strength verification is to demonstrate that one of the most critical failure modes of the ship is controlled.

3.5.2 Design verification - Finite element analysis

The finite element analysis is used to verify the scantlings given by the load-capacity based prescriptive requirements to better consider the complex interactions between the ship's structural components, complex local structural geometry, change in thicknesses and member section properties as well as the complex load regime with sufficient accuracy.

A linear elastic three dimensional finite element analysis of the cargo region or of the full length model is carried out to assess and verify the structural response of the actual hull girder and primary supporting members and to provide the scantling requirements for the primary supporting members. The purpose of the finite element analysis is to verify that the stresses and buckling capability of the primary supporting members are within acceptable limits for the applied design loads.

3.5.3 Design verification - Fatigue assessment

The fatigue assessment is required to verify that the fatigue life of critical structural details is adequate. A simplified fatigue requirement is applied to details such as end connections of longitudinal stiffeners using stress concentration factors (SCF) to account the actual detail geometry. A fatigue assessment procedure using finite element analysis for determining the actual hot spot stress of the geometric detail is applied to selected details. In both cases, the fatigue assessment method is based on the Palmgren-Miner linear damage model.

3.5.4 Relationship between prescriptive scantling requirements and finite element analysis

The scantlings defined by the prescriptive requirements are not to be reduced by any form of alternative calculations such as finite element analysis, unless explicitly stated.

Table 1 : Acceptance criteria - prescriptive requirements

Acceptance criteria	Plate panels and local supporting members (1)		Primary supporting members (1)		Hull girder members	
	Yield	Buckling	Yield	Buckling	Yield	Buckling
AC-1 AC-2 AC-3	Permissible stress: Ch 6, Sec 4 Ch 6, Sec 5	Control of stiffness and proportions: Ch 8, Sec 1	Permissible stress: Ch 6, Sec 6	Control of stiffness and proportions: Ch 8, Sec 1	Permissible stress: Ch 5, Sec 1	Allowable buckling utilisation factor: Ch 8, Sec 1
AC-4	Plastic criteria: Ch 10, Sec 1, [3] Ch 10, Sec 3, [6]	Control of stiffness and proportions: Ch 8, Sec 1	Plastic criteria: Ch 10, Sec 1, [3]	Control of stiffness and proportions: Ch 8, Sec 1	N/A	N/A
(1) Refer to Chapter 10 for other structures and to Chapter 11 for superstructures, deckhouses and hull outfitting.						

Table 2 : Acceptance criteria - Finite Element Analysis

Acceptance criteria	Cargo hold analysis		Fine mesh analysis
	Yield	Buckling	Yield
AC-1 AC-2 AC-3	Permissible stress: refer to Ch 7, Sec 2, [5]	Allowable buckling utilisation factor: refer to Ch 8, Sec 1	Permissible Von Mises stress: refer to Ch 7, Sec 3, [6] Screening criteria: refer to Ch 7, Sec 3, [3]

SECTION 3 VERIFICATION OF COMPLIANCE

1 General

1.1 Newbuilding

1.1.1 For newbuildings, the plans and documents submitted for approval, as indicated in [2.1], are to comply with the applicable requirements in these Rules, taking into account of the relevant criteria, such as the additional service features and classification notations assigned to the ship or the ship length.

1.2 Ships in service

1.2.1 For ships in service, the requirements in Chapter 13 are to be complied with.

2 Documents and information

2.1 Documents to be submitted

2.1.1 Documents are to be submitted as required in NR467, Rules for Steel Ships, Pt B, Ch 1, Sec 3. In addition, the following documents are to be submitted to the Society for review:

- container stowage plan, describing the arrangement of containers in hold, on deck and on hatch covers; the plan shall also include the gross weight of containers and the maximum design weight of container stacks
- list and/or plan of all fixed securing devices as requested in Ch 11, Sec 4, [9]
- fixed cell guides arrangement and scantlings.

2.2 Information to be submitted

2.2.1 The following additional information is to be included in the relevant documents:

- the distributions of still water permissible vertical bending moments, vertical shear forces, and the maximum torsional moment in seagoing and harbour conditions, as defined in Ch 4, Sec 4, are to be included in the loading manual
- the permissible stack weights for 20' and 40' containers stacks in hold and on deck, as defined in Ch 4, Sec 8, [3.2.2], are to be included on the midship section drawing and in the loading manual

SECTION 4

SYMBOLS AND DEFINITIONS

1 Main symbols and units

1.1 General

1.1.1 Unless otherwise specified, the main symbols and their units used in these Rules are those defined in Tab 1.

2 Symbols

2.1 Ship's main data

2.1.1 Unless otherwise specified, symbols regarding ship's main data and their units used in these Rules are those defined in Tab 2.

Table 1 : Main symbols

Symbol	Meaning	Unit
A	Area	m ²
	Sectional area of stiffeners and primary members	cm ²
C	Coefficient	–
F	Force and concentrated loads	kN
I	Hull girder inertia	m ⁴
	Inertia of stiffeners and primary members	cm ⁴
M	Bending moment	kN·m
M	Mass	t
P	Pressure	kN/m ²
Q	Shear force	kN
T	Draught of the ship, see [3.1.5]	m
Z	Hull girder section modulus	m ³
	Section modulus of stiffeners and primary supporting members	cm ³
a _i	Acceleration for the effect 'i'	m/s ²
b	Width of attached plating	mm
	Width of face plate of stiffeners and primary supporting members	mm
g	Gravity acceleration, taken equal to 9,81 m/s ²	m/s ²
h	Height	m
	Web height of stiffeners and primary supporting members	mm
ℓ	Length/span of stiffeners and primary supporting members	m
n	Number of items	–
r	Radius	mm
	Radius of curvature of plating or bilge radius	mm
t	Thickness	mm
η	Permissible utilisation factor (usage factor)	–
γ	Safety factor	–
θ	Angle	deg
ρ	Density of seawater, taken equal to 1,025 t/m ³	t/m ³
σ	Normal stress	N/mm ²
τ	Shear stress	N/mm ²

2.2 Materials

2.2.1 Unless otherwise specified, symbols regarding materials and their units used in these Rules are those defined in Tab 3.

2.3 Loads

2.3.1 Unless otherwise specified, symbols regarding loads and their units used in these Rules are those defined in Tab 4.

2.4 Scantlings

2.4.1 Unless otherwise specified, symbols regarding scantlings and their units used in these Rules are those defined in Tab 5.

3 Definitions

3.1 Principal particulars

3.1.1 Rule length

The Rule length L is the distance, in m, measured on the waterline at the scantling draught T_{SC} from the forward side of the stem to the centre of the rudder stock. L is to be not less than 96% and need not exceed 97% of the extreme length on the waterline at the scantling draught T_{SC}.

In ships without rudder stock (e.g. ships fitted with azimuth thrusters), the rule length L is to be taken equal to 97% of the extreme length on the waterline at the scantling draught T_{SC}.

In ships with unusual stem or stern arrangements, the rule length is considered on a case-by-case basis.

Table 2 : Ship’s main data

Symbol	Meaning	Unit
L	Rule length	m
L _{PP}	Length between perpendiculars	m
L ₀	Rule length L, but not greater than 120 m	m
L ₁	Rule length L, but not greater than 200 m	m
L ₂	Rule length L, but not greater than 250 m	m
L ₃	Rule length L, but not greater than 300 m	m
B	Moulded breadth of the ship	m
D	Moulded depth of the ship	m
T	Moulded draught	m
T _{SC}	Scantling draught	m
T _{BAL}	Ballast draught (minimum midship)	m
T _{LC}	Midship draught at the considered loading condition	m
T _F	Minimum forward draught for bottom slamming	m
Δ	Moulded displacement at draught T _{SC}	t
C _B	Block coefficient at draught T _{SC}	–
C _{B-BAL}	Block coefficient at draught T _{BAL}	–
C _W	Waterplane coefficient at draught T _{SC}	–
C _{W-BAL}	Waterplane coefficient at draught T _{BAL}	–
V	Maximum service speed	knots
x, y, z	Coordinates of the calculation point with respect to the reference coordinate system, see [3.4]	m

Table 3 : Materials

Symbol	Meaning	Unit
E	Young’s modulus, see Ch 3, Sec 1, [2]	N/mm ²
G	Shear modulus: $G = \frac{E}{2(1 + \nu)}$	N/mm ²
R _{eH}	Specified minimum yield stress, see Ch 3, Sec 1, [2]	N/mm ²
τ _{eH}	Specified shear yield stress: $\tau_{eH} = \frac{R_{eH}}{\sqrt{3}}$	N/mm ²
ν	Poisson’s ratio, see Ch 3, Sec 1, [2]	–
k	Material factor, see Ch 3, Sec 1, [2]	–
R _m	Specified minimum tensile strength, see Ch 3, Sec 1, [2]	N/mm ²
R _Y	Nominal yield stress, taken equal to 235/k	N/mm ²

Table 4 : Loads

Symbol	Meaning	Unit
T_θ	Roll period	s
θ	Roll angle	deg
T_ϕ	Pitch period	s
ϕ	Pitch angle	deg
a_x	Longitudinal acceleration	m/s ²
a_y	Transverse acceleration	m/s ²
a_z	Vertical acceleration	m/s ²
k_r	Roll radius of gyration	m
GM	Metacentric height	m
S	Static load case	–
S+D	Dynamic load case	–
P_{ex}	Total sea pressure, see Ch 4, Sec 5, [1]	kN/m ²
P_{in}	Total internal pressure due to liquid	kN/m ²
P_s	Static sea pressure	kN/m ²
P_{ls}	Static tank pressure	kN/m ²
P_w	Dynamic wave pressure	kN/m ²
P_{ld}	Dynamic tank pressure	kN/m ²
P_d	Green sea deck pressure	kN/m ²
P_{sl}	Sloshing pressure	kN/m ²
P_{dl}	Total pressure due to uniform cargo	kN/m ²
P_{SLI}	Bottom and stern slamming pressure	kN/m ²
P_{FI}	Bow impact pressure	kN/m ²
P_{fs}	Static pressure in flooded conditions	kN/m ²
P_{ST}	Tank testing pressure (static)	kN/m ²
P_{SC}	Overpressure due to the inlet grating cleaning system	kN/m ²
F_{u-s}	Force due to unit cargo in static (S) design load scenario	kN
F_{u-d}	Force due to unit cargo in static plus dynamic (S+D) design load scenario	kN
M_{sw}	Vertical still water bending moment	kN·m
Q_{sw}	Vertical still water shear force	kN
M_{wv}	Vertical wave bending moment	kN·m
Q_{wv}	Vertical wave shear force	kN
M_{wt}	Torsional wave moment	kN·m
M_{wh}	Horizontal wave bending moment	kN·m

Table 5 : Scantlings

Symbol	Meaning	Unit
I_{y-n50}	Net vertical moment of inertia of hull girder	m ⁴
I_{z-n50}	Net horizontal moment of inertia of hull girder	m ⁴
Z_{D-n50} , Z_{B-n50}	Net vertical hull girder section moduli, at deck and bottom respectively	m ³
z_n	Vertical distance from BL to horizontal neutral axis	m
a	Length of an elementary plate panel (EPP), as defined in Ch 3, Sec 6, [2.1.1]	mm
b	Breadth of an elementary plate panel (EPP), as defined in Ch 3, Sec 6, [2.1.1]	mm
s	Stiffener spacing, as defined in Ch 3, Sec 6, [1.2.1]	mm
S	Primary supporting member spacing, as defined in Ch 3, Sec 6, [1.2.2]	m
ℓ	Span of stiffeners or primary supporting members, as defined in Ch 3, Sec 6, [1]	m
ℓ_b	Bracket arm length	m
t	Net thickness with full corrosion reduction	mm

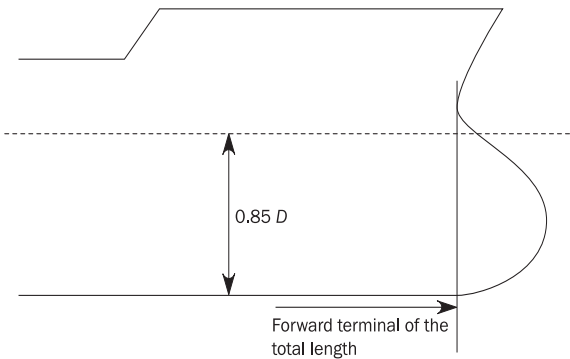
Symbol	Meaning	Unit
t_{n50}	Net thickness with half corrosion reduction	mm
t_c	Corrosion addition	mm
t_{gr}	Gross thickness	mm
t_{as_built}	As-built thickness taken as the actual thickness provided at the newbuilding stage	mm
t_{gr_off}	Gross thickness offered	mm
t_{gr_req}	Gross thickness required	mm
t_{off}	Net thickness offered	mm
t_{req}	Net thickness required	mm
t_{vol_add}	Thickness for voluntary addition	mm
t_{res}	Reserve thickness, taken equal to 0,5	mm
t_{c1}, t_{c2}	Corrosion addition on each side of structural member	mm
h_w	Web height of stiffener or primary supporting member	mm
t_w	Web thickness of stiffener or primary supporting member	mm
b_f	Face plate width of stiffener or primary supporting member	mm
h_{stf}	Height of stiffener or primary supporting member	mm
t_f	Face plate/flange thickness of stiffener or primary supporting member	mm
t_p	Thickness of the plating attached to a stiffener or a primary supporting member	mm
d_e	Distance from the upper edge of the web to the top of the flange for L3 profiles	mm
b_{eff}	Effective breadth of attached plating, in bending, for yield and fatigue	mm
A_{eff} or $A_{eff-n50}$	Net sectional area of stiffener or primary supporting member, with attached plating (of width s)	cm ²
A_{shr} or $A_{shr-n50}$	Net shear sectional area of stiffener or primary supporting member	cm ²
I_p	Net polar moment of inertia of a stiffener about its connection to plating	cm ⁴
I	Net moment of inertia of a stiffener, with attached plating, about its neutral axis parallel to the plating	cm ⁴
Z or Z_{n50}	Net section modulus of a stiffener or primary supporting member, with attached plating (of breadth b_{eff})	cm ³

3.1.2 Load line length

The load line length L_{LL} is the distance, in m, on the water-line 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.

Where the stem contour is concave above the waterline at 85% of the least moulded depth, both the forward terminal of the total length and the fore-side of the stem respectively is taken at the vertical projection to that waterline of the aftermost point of the stem contour (see Fig 1).

Figure 1 : Concave stem contour



3.1.3 Moulded breadth

The moulded breadth B is the greatest moulded breadth, in m, measured amidships at the scantling draught T_{SC} .

3.1.4 Moulded depth

The moulded depth D , in m, is the vertical distance, amidships, from the moulded baseline to the moulded deck line of the uppermost continuous deck measured at deck at side. On ships with a rounded gunwale, D is to be measured at the continuation of the moulded deck line.

3.1.5 Draughts

The draught T , in m, is the summer load line draught for the ship in operation, measured from the moulded baseline at midship.

Note 1: This may be less than the maximum permissible summer load waterline draught.

T_{SC} is the scantling draught, in m, at which the strength requirements for the scantlings of the ship are met and represents the full load condition. The scantling draught T_{SC} is to be not less than that corresponding to the assigned freeboard. The draught of ships to which timber freeboards are assigned corresponds to the loading condition of timber, and the requirements of the Society are to be applied to this draught.

T_{BAL} is the minimum design normal ballast draught amidships, in m, at which the strength requirements for the scantlings of the ship are met. This normal ballast draught is the minimum draught of ballast conditions including ballast water exchange operation, if any, for any ballast conditions in the loading manual including both departure and arrival conditions.

3.1.6 Moulded displacement

The moulded displacement, in t, corresponds to the underwater volume of the ship, at a draught, in seawater with a density of 1,025 t/m³.

3.1.7 Maximum service speed

The maximum ahead service speed V , in knots, means the greatest speed which the ship is designed to maintain in service at her deepest seagoing draught at the maximum propeller RPM and corresponding engine MCR (Maximum Continuous Rating).

3.1.8 Block coefficient at scantling draught

The block coefficient C_B , at draught T_{SC} , is defined by:

$$C_B = \frac{\Delta}{1,025 L B T_{SC}}$$

where:

Δ : Moulded displacement of the ship at draught T_{SC} .

3.1.9 Block coefficient at ballast draught

The block coefficient C_{B-BAL} , at draught T_{BAL} , is defined by:

$$C_{B-BAL} = \frac{\Delta_{BAL}}{1,025 L B T_{BAL}}$$

where:

Δ_{BAL} : Moulded displacement of the ship at draught T_{BAL} .

3.1.10 Waterplane coefficient at scantling draught

The waterplane coefficient C_W , at draught T_{SC} , is defined by:

$$C_W = \frac{A_{WP}}{L B}$$

where:

A_{WP} : Waterplane area at scantling draught T_{SC} , in m².

3.1.11 Waterplane coefficient at ballast draught

The waterplane coefficient C_{W-BAL} , at draught T_{BAL} , is defined by:

$$C_{W-BAL} = \frac{A_{WP-BAL}}{L B}$$

where:

A_{WP-BAL} : Waterplane area at ballast draught T_{BAL} , in m².

3.1.12 Lightweight

The lightweight is the ship displacement, in t, complete in all respects, but without cargo, consumable, stores, passengers and crew and their effects, and without any liquids on board except the machinery and piping fluids, such as lubricants and hydraulics, which are at operating levels.

3.1.13 Deadweight

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

3.1.14 Fore end

The fore end (FE) of the rule length L is the perpendicular to the scantling draught waterline at the forward side of the stem. See Fig 2.

3.1.15 Aft end

The aft end (AE) of the rule length L is the perpendicular to the scantling draught waterline at a distance L aft of the fore end. See Fig 2.

3.1.16 Midship

The midship is the perpendicular to the scantling draught waterline at a distance $0,5 L$ aft of the fore end.

3.1.17 Midship part

The midship part of a ship is the part extending $0,4 L$ amidships, unless otherwise specified.

3.2 Superstructure height and tiers

3.2.1 Standard height of superstructure

The standard height of superstructure is defined in Tab 6.

Figure 2 : Ends and midship

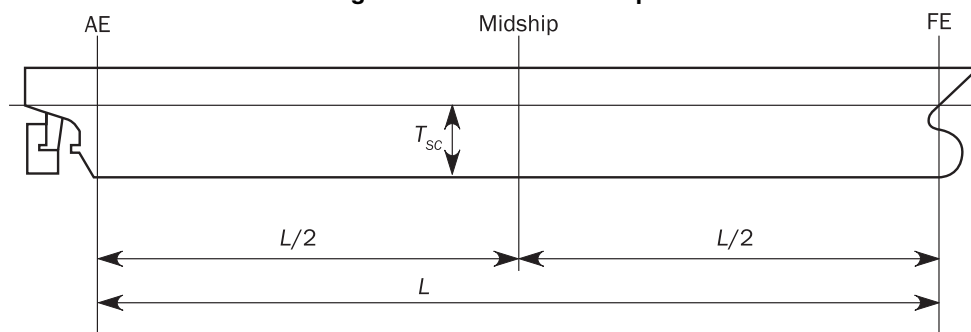


Table 6 : Standard height of superstructure

Load line length L_{LL} , in m	Standard height h_s , in m	
	Raised quarter deck	All other superstructures
$L_{LL} \leq 30$	0,90	1,80
$30 < L_{LL} < 75$	$0,9 + 0,00667 (L_{LL} - 30)$	1,80
$75 \leq L_{LL} < 125$	$1,2 + 0,012 (L_{LL} - 75)$	$1,8 + 0,01 (L_{LL} - 75)$
$L_{LL} \geq 125$	1,80	2,30

3.2.2 Tiers of superstructure

A tier is extending over one standard height of superstructure as defined in [3.2.1].

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

When the freeboard exceeds one standard superstructure height, as defined in [3.2.1] for “all other superstructures”, the lowest tier may be considered as an upper tier when calculating the scantlings of superstructures and deck-houses.

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

3.3 Operation definition

3.3.1 Sheltered water

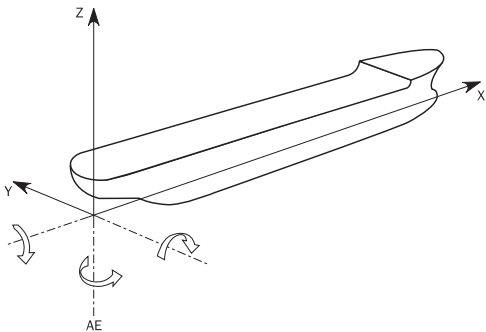
Sheltered waters are generally calm stretches of water when the wind force does not exceed 6 Beaufort scale, i.e. harbours, estuaries, roadsteads, bays, lagoons.

3.4 Reference coordinate system

3.4.1 The ship’s geometry, motions, accelerations and loads are defined with respect to the following right-hand coordinate system (see Fig 3):

- Origin : At the intersection of the longitudinal plane of symmetry of ship, the aft end of L, and the base-line
- X axis : Longitudinal axis, positive forwards
- Y axis : Transverse axis, positive towards portside
- Z axis : Vertical axis, positive upwards.

Figure 3 : Reference coordinate system



3.5 Naming convention

3.5.1 Structural nomenclature

The common structural nomenclature used within these Rules is shown in Fig 4 to Fig 6.

3.6 Glossary

3.6.1 Definitions of terms

The common terms used within this Rules are listed in Tab 7.

Figure 4 : Typical cargo hold configuration

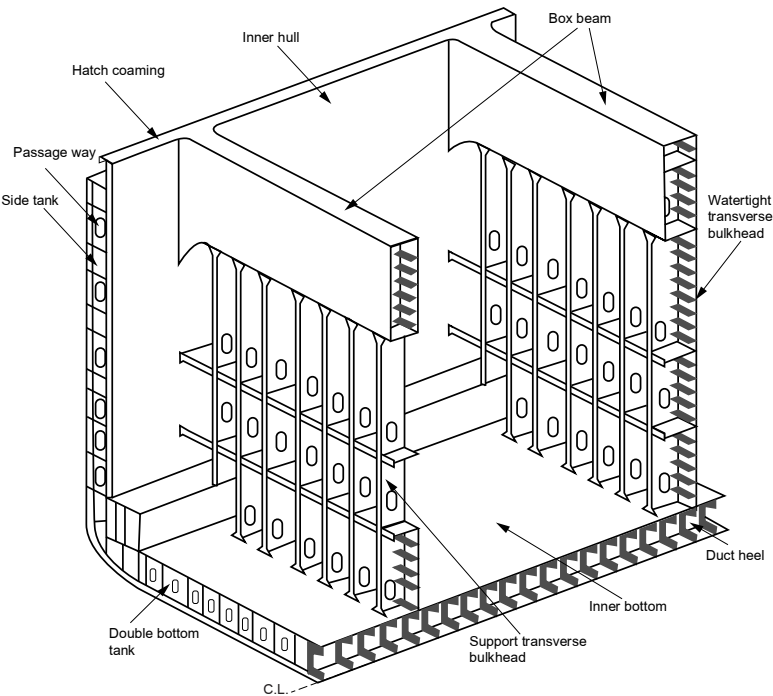


Figure 5 : Typical transverse section in way of cargo hold

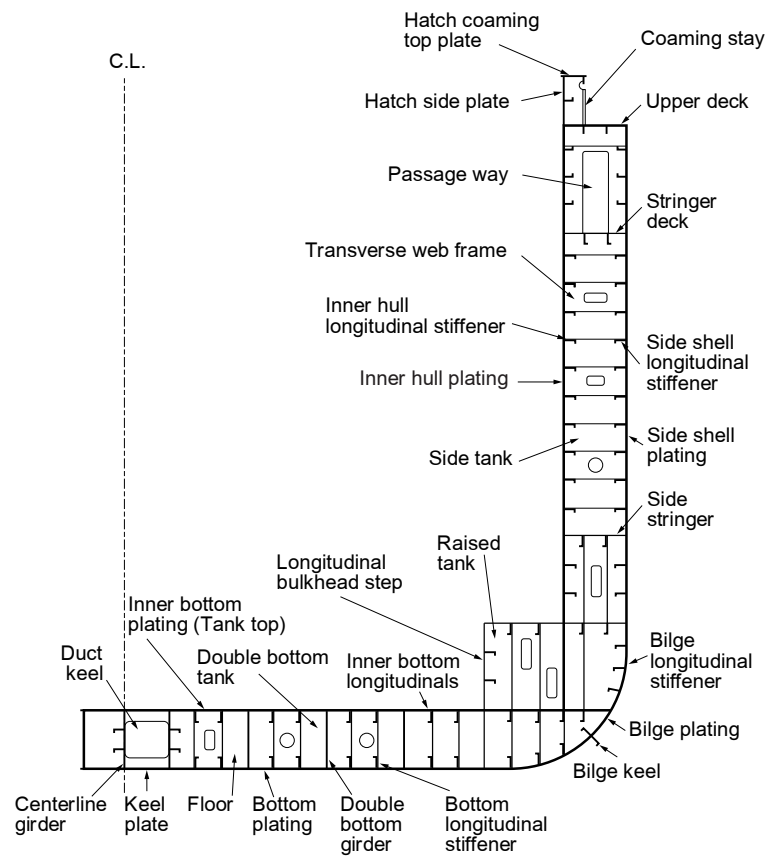


Figure 6 : Typical transverse bulkheads

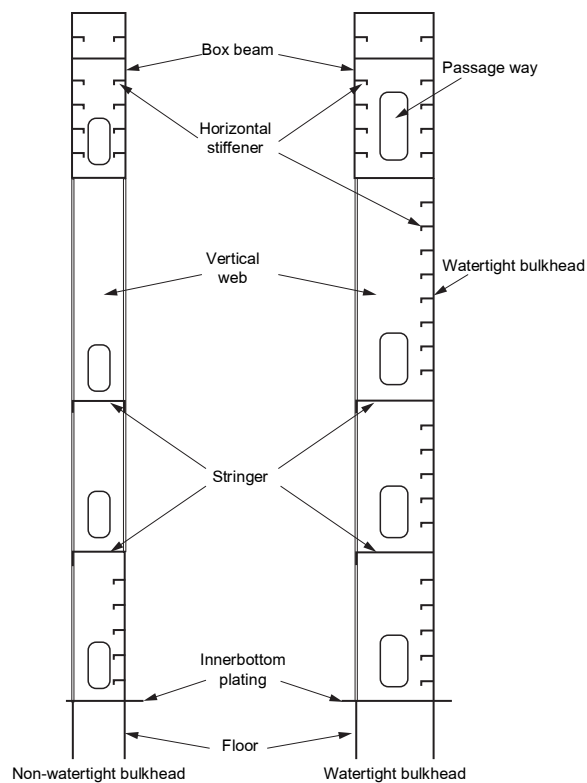


Table 7 : Definition of terms

Terms	Definition
Accommodation deck	Deck used primarily for the accommodation of the crew
Accommodation ladder	Portable set of steps on a ship's side for people boarding from small boats or from a pier
Aft peak	Area aft of the aft peak bulkhead
Aft peak bulkhead	First main transverse watertight bulkhead forward of the stern
Aft peak tank	Compartment in the narrow part of the stern, aft of the aft peak bulkhead
Anchor	Device attached to anchor chain at one end and lowered into the sea bed to hold a ship in position; it is designed to grip the bottom when it is dragged by the ship trying to float away under the influence of wind and current
Ballast tank	Compartment used for the storage of water ballast
Bay	Area between adjacent transverse frames or transverse bulkheads
Bilge keel	Piece of plate set perpendicular to a ship's shell along the bilges to reduce the rolling motion
Bilge plating	Curved plating between the bottom shell and the side shell, to be taken as follows: • Within the cylindrical part of the ship: from the start of the curvature at the lower turn of bilge on the bottom to the end of the curvature at the upper turn of the bilge • Outside the cylindrical part of the ship: from the start of the curvature at the lower turn of the bilge on the bottom to the lesser of: - a point on the side shell located 0,2D above the baseline/local centreline elevation - the end of the curvature at the upper turn of the bilge
Bilge strake	The lower strake of bilge plating
Boss	The boss of the propeller is the central part to which propeller blades are attached and through which the shaft end passes
Bottom shell	Shell envelope plating forming the predominantly flat bottom portion of the shell envelope, including the keel plate
Bow	Structural arrangement and form of the forward end of the ship
Bower anchor	Anchor carried at the bow of the ship
Bracket	Extra structural component used to increase the strength of a joint between two structural members
Bracket toe	Narrow end of a tapered bracket
Breakwater	Inclined and stiffened plate structure on a weather deck to break and deflect the flow of water coming over the bow
Breasthook	Triangular plate bracket joining port and starboard side structural members at the stem
Bridge	Elevated superstructure having a clear view forward and at each side, and from which a ship is steered
Buckling panel	Elementary plate panel considered for the buckling analysis
Builder	The party contracted by the Owner to build a ship in compliance with the Rules
Bulb profile	Stiffener having an increase in steel mass on the outer end of the web instead of a separate flange
Bulkhead	Structural partition wall subdividing the interior of the ship into compartments
Bulkhead deck	Uppermost continuous deck up to which transverse watertight bulkheads and shell are to extend
Bulkhead structure	Transverse or longitudinal bulkhead plating with stiffeners and girders
Bulwark	Vertical plating immediately above the upper edge of the ship's side surrounding the exposed deck(s)
Bunker	Compartment for the storage of fuel oil used by the ship's machinery
Cable	Rope or chain attached to the anchor
Camber	Upward rise of the weather deck from both sides towards the centreline of the ship
Cargo hold region	See Sec 1, [2.2.3]
Container hold	Generic term for spaces intended to carry container
Carling	Stiffening member used to supplement the regular stiffening arrangement
Casing	Covering or bulkheads around any space for protection
Centreline girder	Longitudinal member located on the centreline of the ship

Terms	Definition
Chain	Connected metal rings or links used for holding anchor, fastening timber cargoes, etc.
Chain locker	Compartment, usually at the forward end of the ship, used to store the anchor chain
Chain pipe	Section of pipe through which the anchor chain enters or leaves the chain locker
Chain stopper	Device for securing the chain cable when riding at anchor as well as securing the anchor in the housed position in the hawse pipe, thereby relieving the strain on the windlass
Coaming	Vertical boundary structure of a hatch or a skylight
Cofferdams	Spaces, between two bulkheads or decks, primarily designed as a safeguard against leakage from one compartment to another
Collar plate	Patch used to close, partly or completely, a hole cut for a stiffener passing through a web plate
Collision bulkhead	The foremost main transverse watertight bulkhead
Companionway	Weathertight entrance leading from a deck to spaces below
Compartment	Internal space bounded by bulkheads or plating
Confined space	Space identified by one of the following characteristics: limited openings for entry and exit, unfavourable natural ventilation or not designed for continuous worker occupancy
Cross deck	Area between cargo hatches
Deck	Horizontal structure element defining the upper or lower boundary of a compartment
Deckhouse	See Sec 1, [2.2.6]
Deck structure	Deck plating with stiffeners, girders and supporting pillars
Deck transverse	Transverse primary supporting member (PSM) of a deck
Deep tank	Any tank which extends between two decks or between the shell/inner bottom and the deck above or higher
Designer	The party who creates the documentation to be submitted to the Society for approval or for information. The designer can be the builder or a party contracted by the builder or the Owner to create this documentation
Discharges	Any piping leading through the ship's sides for conveying bilge water, circulating water, drains etc.
Docking bracket	Bracket located in the double bottom to locally strengthen the bottom structure for the purposes of docking
Double bottom structure	Inner bottom plating and all shell plating, stiffeners, primary supporting members and other elements located below
Doubler	Small piece of plate which is attached to a larger area of plate that requires strengthening in that location. Usually at the attachment point of a stiffener
Double skin member	Structural member where the idealised beam comprises the web with top and bottom flanges formed by the attached plating
Duct keel	A keel built of plates in box form. It is used to house ballast and other piping leading forward which otherwise would have to run through the cargo hold and/or ballast tanks.
Enclosed superstructure	Superstructure with bulkheads forward and/or aft fitted with weathertight doors and closing appliances
Engine room bulkhead	Transverse bulkhead located either directly forward or aft of the engine room
EPP	Elementary Plate Panel, the smallest plate element surrounded by structural members such as stiffeners, PSM, bulkheads, etc.
Face plate	Section of a stiffening member attached to the web and usually parallel to the plated surface
Flange	Section of a stiffening member attached to the web, or sometimes formed by bending the web over. It is usually parallel to the plated surface
Flat bar	Stiffener only made of a web
Floor	A bottom transverse member
Forecastle	Short superstructure situated at the bow
Fore peak	Area of the ship forward of the collision bulkhead
Fore peak deck	Short raised deck extending aft from the bow of the ship

Terms	Definition
Freeboard deck	Deck designated as such by the designer, in accordance with ICLL. Generally the uppermost complete deck exposed to weather and sea, with permanent means of closing for all the exposed openings
Freeing port	Opening in the bulwarks to allow water shipped on deck to run freely overboard
Girder	Collective term for primary supporting structural members
Gudgeon	Block with a hole in the centre to receive the pintle of a rudder; located on the stern post, it supports the rudder and allows it to swing
Gunwale	Upper edge of side shell
Gusset	Plate usually fitted to distribute forces at a strength connection between two structural members
Hatch cover	Cover fitted over a hatchway to prevent the ingress of water into the hold
Hatchway	Opening, generally rectangular, in a deck affording access to the compartment below
Hawse pipe	Steel pipe through which the hawser or cable of anchor passes, located in the ship's bow on either side of the stem, also known as spurling pipe
Hawser	Large steel wire or fibre rope used for towing or mooring
HP	Bulb profile in accordance with the Holland Profile standard
IACS	International Association of Classification Societies
ICLL	IMO International Convention on Load Lines, 1966, as amended
IMO	International Maritime Organisation
Inner hull	The innermost plating forming a second layer to the hull of the ship
Intercostal	Non-continuous member between stiffeners or PSM
JIS	Japanese Industrial Standard
Keel	Main structural member or backbone of a ship running longitudinally along the centreline of the bottom. Usually a flat plate stiffened by a vertical plate on its centreline inside the shell
Keel line	Line parallel to the slope of the keel intersecting the top of the keel at midship
Knuckle	Discontinuity in a structural member
Lightening hole	Hole cut in a structural member to reduce its weight
Limber hole	Small drain hole cut in a frame or a plate to prevent water or oil from collecting
Local support members	Local stiffening members influencing only the structural integrity of a single panel, e.g. deck beams
Longitudinal hull girder structural members	Structural members contributing to the longitudinal strength of the hull girder, including decks, side, bottom, inner bottom, bilge plate, longitudinal bulkheads, double hull stringers and double bottom girders
Longitudinal hull girder shear structural members	Structural members contributing to strength against hull girder vertical shear loads, including side, inner hull longitudinal bulkheads, hopper, longitudinal bulkheads and double bottom girders
Manhole	Round or oval hole cut in decks, tanks, etc, for the purpose of providing access
Margin plate	Outboard strake of the inner bottom and, when turned down at the bilge, the margin plate (or girder) forms the outer boundary of the double bottom
MARPOL	IMO International Convention for the Prevention of Pollution from Ships, 1973 and Protocol of 1978, as amended
Mid-hold	Middle hold(s) of the three cargo hold length FE model as defined in Ch 7, Sec 2, [1.2.2]
Notch	Discontinuity in a structural member caused by welding
Oil fuel tank	Tank used for the storage of fuel oil
Outer shell	Same as shell envelope
Owner	The party who has assumed all the duties and responsibilities for registration and operation of the ship and who, assuming such responsibilities, has agreed to take over all the duties and responsibilities on delivery of the ship from the builder with valid certificates prepared for the operator
Pillar	Vertical support placed between decks, where the deck is not supported by the shell or a bulkhead
Pipe tunnel	Void space running between the inner bottom and the shell plating, and forming a protective space for bilge, ballast and other lines linking the engine room to the tanks