RULES FOR CLASSIFICATION

Ships

Edition July 2024

Part 3 Hull

Chapter 1 General principles

DNV AS

FOREWORD

DNV rules for classification contain procedural and technical requirements related to obtaining and retaining a class certificate. The rules represent all requirements adopted by the Society as basis for classification.

Any comments may be sent by e-mail to *rules@dnv.com*

CHANGES – CURRENT

This document supersedes the July 2023 edition of DNV-RU-SHIP Pt.3 Ch.1.
The numbering and/or title of items containing changes is highlighted in red.

Changes July 2024, entering into force 1 January 2025

Topic	*Reference*	*Description*
Documentation requirements	Sec.3 Table 1	Added documentation requirement 'Structural design brief' to collect relevant project data at the beginning of the project.
Compliance documents for anchor fibre ropes	Sec.3 Table 2	Removed required compliance documentation for anchor fibre ropes (MD).
Compliance document for aanchor steel wire ropes	Sec.3 Table 2	Added description that guidance for maintenance and inspection shall be provided.

Editorial corrections

In addition to the above stated changes, editorial corrections may have been made.

CONTENTS

SECTION 1 APPLICATION

1 Scope of application

1.1 General

1.1.1 These rules apply to monohull ships constructed of welded steel structures and composed of stiffened plate panels. Application of these rules will be specially considered for ships with different hull arrangement, stiffening arrangement or with hull constructed in other material than steel.

1.1.2 For ships with class notation **CSR**, separate requirements replace Ch.1 to Ch.13, except for certification requirements given in Sec.3 [4] and documentation requirements for items given in Sec.3 [2.2] not specified in CSR. Ch.14 and Ch.15 also apply to ships with class notation **CSR**.

1.1.3 Application of the rules to innovative designs shall be decided based on consideration of the technical background of the different requirements. Increased scope of analysis beyond what is defined in these rules may be required to ensure equivalent safety.

2 Rule application

2.1 Rule description

The rules in Pt.3 contain the main class hull structure requirements while ship type related requirements are given in Pt.5.

The parts are structured in chapters giving instructions for detail application and requirements which are applied to satisfy the rule objectives.

2.2 Rule requirements

2.2.1 Application of the rules

Rules for hull structure are provided in Pt.3, Pt.5 and Pt.6.

Pt.3 of the rules contains the main class hull requirements and includes application related to hull shape, arrangement and main dimensions, inclusive limitations of the scope for some vessels.

Pt.5 covers application and additional requirements related to mandatory and optional ship type notations in addition to novel designs, and is divided into ship type groups reflecting the intended use of the vessel, e.g. carriage of passengers or carriage of liquid cargo. Each chapter contains three main parts:

— general application
— application of hull requirements. The table of content is similar to Pt.3
— ship type specific requirements covering all necessary disciplines, i.e. hull, stability, safety.

Pt.6 contains all additional class notations, optional or mandatory.

2.2.2 Part 3

Pt.3 of the rules provides requirements as follows:

— Ch.1: *General principles*
— Ch.2: *General arrangement design*
— Ch.3: *Structural design principles*
— Ch.4: *Loads*
— Ch.5: *Hull girder strength*

- Ch.6: *Hull local scantling*
- Ch.7: *Finite element analysis*
- Ch.8: *Buckling*
- Ch.9: *Fatigue*
- Ch.10: *Special requirements*
- Ch.11: *Hull equipment, supporting structure and appendages*
- Ch.12: *Openings and closing appliances*
- Ch.13: *Welding*
- Ch.14: *Rudders and steering*
- Ch.15: *Stability*.

2.2.3 General criteria

The ship arrangement, the proposed details and the offered scantling in net or gross shall comply with the requirements and the minimum scantling given in the rules.

SECTION 2 RULE PRINCIPLES

Symbols

For symbols not defined in this section, see Sec.4.

1 General

1.1 Rule objectives

The objectives of Pt.3 are to establish requirements for mitigating the risks of major structural failure related to the safety of life, environment, property and to contribute to the durability of the hull structure for the ship's design life as well as establish requirements for stability.

2 General assumptions

2.1 Application and implementation of the rules

Pt.3 addresses hull structural aspects of classification. Requirements related to the verification of compliance with the structural requirements of the rules during construction and operation are given in Pt.2 Ch.4 and Pt.7 Ch.1, respectively. In order to achieve the safety level targeted by the rules, a number of aspects related to design, construction and operation of the ship are assumed. A summary of these assumptions is given in Pt.1 Ch.1.

3 Design basis

3.1 General

3.1.1 This subsection specifies the design parameters and assumptions concerning ship operations that are used as the basis for design principles in the rules.

3.1.2 The design basis used for the design of each ship shall be documented and submitted as part of the design review and approval. All changes of the design basis shall be formally advised.

Guidance note:

The design basis is normally specified in the main structural drawings, the preliminary loading manual and in plans for load and capacities. It may also be given in a separate document.

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3.1.3 Ships shall be designed to withstand, in the intact condition, the environmental conditions as defined in [3.5] anticipated during the design life, for the appropriate loading conditions. Structural strength shall be checked against buckling, yielding, fatigue and hull girder ultimate strength as specified in the rules.

3.1.4 Ships shall be designed to have sufficient strength to withstand the loads due to flooded conditions.

3.1.5 Adequate fatigue strength shall be documented for the specified fatigue life and design environments. Fatigue strength shall be assessed for ship types and details found prone to fatigue according to Ch.9.

3.1.6 Vibrations in the hull structural elements are not considered in relation to the requirements for scantlings given in the rules. It is, however, assumed that special considerations are made to avoid harmful vibrations, causing structural failures (especially in after body and machinery space tank structures), malfunction of machinery and instruments or annoyance to crew and passengers.

3.2 Hull form limit

The environmental loads in the rules are based on the following assumptions:

— L < 500 m
— C_B > 0.6
— L/B > 4.5
— B/D < 2.5.

The following may require special considerations for the wave loads:

— ships with unconventional hull forms
— ships with L > 90 m and any geometric parameter outside the limits specified above.

For ships with L > 350 m, special consideration shall be made for the wave loads.

3.3 Transverse strength

For vessels having a total number of effective transverse bulkheads less than given in Ch.2 Sec.2 [1.1], extended calculation scope may be required.

3.4 Design life

A design life of minimum 25 years shall be applied. The specified design life is the nominal period that the ship is assumed to be exposed to operating conditions.

3.5 Environmental conditions

3.5.1 North Atlantic wave environment

The ultimate limit state criteria is based on ships trading in the North Atlantic wave environment.

3.5.2 Wind and current

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

3.5.3 Ice

In case of additional notations, the effects of ice are covered by Pt.6 Ch.6.

3.5.4 Design temperatures

The rules assume that the structural assessment of hull strength members is valid for the following design temperatures:

— lowest mean daily average temperature in air is −10°C
— lowest mean daily average temperature in seawater is 0°C.

In the above, the following definitions apply:

mean	=	statistical mean over observation period (at least 20 years)
daily average	=	average during one day and night
lowest	=	lowest during year.

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

Ships intended to operate in areas with lower mean daily average temperature (below and including –10°C), e.g. regular service during winter seasons to Arctic or Antarctic waters are subject to the requirements for the additional class notation **DAT** given in Pt.6 Ch.6.

3.5.5 Thermal loads

The effects of thermal loads and residual stresses are covered by Pt.5 Ch.7 and Pt.6 Ch.1 Sec.7 when relevant.

3.6 Operating draughts

The design operating draughts shall be specified by the designer and shall be used to derive the appropriate structural scantlings. All operational loading conditions in the loading manual shall comply with the specified design operating draughts. The following design operating draughts shall as a minimum be considered:

— scantling draught for the assessment of structure
— normal and heavy ballast draught, if applicable, for assessment of structure.

Additional operating draughts may be specified in the ship type rules given in Pt.5.

3.7 Internal environment

3.7.1 Liquids in tanks

A density of 1.025 t/m^3, or a higher value if specified by the designer, shall be used as a minimum for tank design when filling of liquids for the strength assessment of all relevant tank structures. This minimum density does not apply for tanks for liquefied gas.

For the fatigue assessment, a representative mean density throughout the ship's life shall be used.

3.7.2 Cargo temperatures

The rules assume that the structural assessment of hull strength members is valid for the following design temperatures:

— maximum temperature of 100°C
— minimum temperature of -10°C.

Ships operating with cargo temperatures exceeding the limits given above are subject to the requirements given in Pt.6 Ch.1 Sec.12 and Pt.6 Ch.6 Sec.6.

3.8 Maximum service speed

The maximum service speed shall be specified in the design specification. Although the hull structure verification criteria take into account the service speed this does not relieve the responsibilities of the owner and personnel to properly handle the ship and reduce speed or change heading in severe weather.

Guidance note:

For maximum service speed $V \geq 1.6\sqrt{L}$, in knots, special consideration for the wave loads may be required.

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4 Design principles

4.1 Overall principles

4.1.1 Introduction

This subsection defines the underlying design principles of the rules in terms of loads, structural capacity models and assessment criteria and also construction and in-service aspects.

4.1.2 General

The 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 subjected to operational loads and environmental loads/conditions
- the design complies with the design basis, see Sec.3
- the structural requirements shall be based on consistent design load sets which cover the appropriate operating modes.

The ship's structure shall be designed such that:

- it has redundancy in general. The ship's structure shall work in a hierarchical manner and, in principle, failure of structural elements lower down in the hierarchy do not result in immediate consequential failure of elements higher up in the hierarchy
- the probability of in-service cracking is low
- it has adequate structural redundancy to survive in the event that the structure is accidentally damaged leading to flooding of any compartment
- it has good access conditions during construction to assure satisfactory quality of welding, coating and safe survey/inspection
- it has good access conditions during the operational phase to allow adequate maintenance and safe periodical survey/inspection by crew, Society and other relevant authorities.

4.1.3 Limit state design principles

The rules are based on the principles of limit state design.

Limit state design is a systematic approach where each structural element is evaluated with respect to possible failure modes related to the design scenarios identified. For each retained failure mode, one or more limit states may be relevant. By consideration of all relevant limit states, the limit load for the structural element is found as the minimum limit load resulting from all the relevant limit states.

The limit states are divided into four categories: serviceability limit state (SLS), ultimate limit state (ULS), fatigue limit state (FLS) and accidental limit state (ALS).

The rules include requirements for relevant limit states for the various parts of the structure.

4.2 Design load scenarios

The structural assessment of the structure is based on the design load scenarios encountered by the ship, see Ch.4 Sec.7 and Ch.10.

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

- static design load scenario (S):

  covers application of relevant static loads and typically covers load scenarios in harbour and sheltered water
- static plus dynamic design load scenario (S+D):

  covers application of relevant static loads and simultaneously occurring dynamic load components and typically cover load scenarios for seagoing operations
- impact design load scenario (I):

  covers application of impact loads such as bottom slamming, bow impact, stern slamming and liquid impact in tanks encountered during seagoing operations
- sloshing design load scenario (SL):

  covers application of sloshing loads encountered during seagoing operations
- fatigue design load scenario (F):

  covers application of wave induced loads

— accidental design load scenario (A):

covers application of some loads not occurring during normal operations, as accidental flooding of compartments

— testing design load scenario (T):

covers application of tank testing loads.

4.3 Structural capacity assessment

4.3.1 General

The basic principle in structural design shall apply the defined design loads, identify possible failure modes and employ appropriate capacity models to verify the required structural scantlings.

4.3.2 Capacity models for ULS, SLS and ALS

The strength assessment method shall be capable of analysing the failure mode in question to the required degree of accuracy.

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

4.3.3 Capacity models for FLS

The fatigue assessment method provides rule requirements for assessing structural details against fatigue failure.

The fatigue capacity model is based on a linear cumulative damage summation (Palmgren-Miner's rule) in combination with a design S-N curve, a reference stress range and an assumed long-term stress distribution curve.

The fatigue capacity assessment models are in either 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.

4.3.4 Net scantling approach

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

4.3.5 Intact structure

All strength calculations for ULS, SLS and FLS are based on the assumption that the structure is intact. The residual strength of the ship in a structurally damaged condition is assessed for ALS.

5 Rule design methods

5.1 General

Scantling requirements cover the relevant limit states (ULS, SLS, FLS and ALS) as necessary for various structural parts.

The criteria for the assessment of the scantlings are based on the WSD or PSF design method.

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

— 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).

— The WSD method has the following composition:

$$W_{stat} \leq \eta_1 R \text{ for condition A.}$$

$$W_{stat} + W_{dyn} \leq \eta_2 R \text{ for condition B.}$$

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 utilization factor (resistance factor). The utilization factor includes consideration of uncertainties in loads, structural capacity and the consequence of failure.

— The PSF method has the following composition:

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

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

where:

$\gamma_{stat\text{-}i}$ = partial safety factor that accounts for the uncertainties related to static loads

$\gamma_{dyn\text{-}i}$ = partial safety factor that accounts for the uncertainties related to dynamic loads

γ_R = partial safety factor that accounts for the uncertainties related to structural capacity.

The acceptance criteria for both the WSD method and 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.

5.2 Minimum requirements

5.2.1 Minimum requirements specify the minimum scantling requirements which apply irrespective of all other requirements.

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

— minimum thickness
— minimum stiffness and proportions.

5.2.2 Scantlings below minimum requirements may be accepted. The assessment of such proposals will be handled on a case-by-case basis maintaining the principles of the rules.

5.3 Load-capacity based requirements

5.3.1 General

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

The identified load scenarios are addressed in terms of design loads, design format and acceptance criteria set, as given in Table 2. The table is schematic and only intended to give an overview.

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

5.3.2 Design loads for SLS, ULS and ALS

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

To provide consistency of approach, standardized rule values for parameters, such as GM, k_r, T_{sc} and C_B are applied to calculate the rule load values.

The probability level of the dynamic global, local and impact loads, see Table 1, is 10^{-8} and is derived using the long-term statistical approach. The corresponding design life is 25 years.

The probability level of the sloshing loads, see Table 1, is 10^{-4}. These loads are considered to be frequent loads.

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 by applying a dynamic load combination factor to the dynamic load values given in Ch.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.4.

5.3.3 Design loads for FLS

The fatigue requirements are given in Ch.9.

The considered wave induced loads include:

— hull girder loads, i.e. vertical and horizontal bending moments and torsional moments
— dynamic wave pressures
— dynamic pressure and forces from cargo, ballast, etc.

The dynamic loads are taken at a probability level of 10^{-2}.

5.3.4 Structural response analysis

In general, the following approaches are applied for determination of the structural response to the applied design load combinations:

a) beam theory:

   — used for prescriptive requirements.

b) FE analysis:

   — coarse mesh for cargo hold model
   — fine mesh for local models
   — very fine mesh for fatigue assessment.

5.4 Acceptance criteria

5.4.1 General

The acceptance criteria are categorized into four acceptance criteria. These are explained below and shown in Table 1 to Table 3. The specific acceptance criteria set that is applied in the rule requirements is dependent on the probability level of the characteristic combined load.

The acceptance criteria set AC-I shall be applied for operational static and sloshing loads. The allowable stress for such loads is lower than that for an extreme load to take into account effects of:

- repeated yield
- allowance for some dynamics
- margins for some selected limited operational mistakes.

The acceptance criteria set AC-II shall be applied for the static + dynamic design load combinations where considered loads are extreme loads with a low probability of occurrence.

The acceptance criteria set AC-III shall be applied for tank testing, overfilling of ballast water tanks and accidental loads like flooding.

The acceptance criteria set AC-IV is typically applied for impact loads like bottom slamming, bow impact and liquid impact in tanks.

Table 1 Load scenarios and corresponding rule requirements

Operation	*Load type*	*Design load scenario*	*Acceptance criteria*
Load scenario 1: Normal operations at harbour and sheltered water			
Loading, unloading and ballasting	Typical maximum loads during loading, unloading and ballasting operations	S	AC-I
Special conditions in harbour	Typical maximum loads during special operations in harbour, e.g. propeller inspection afloat or dry-docking loading conditions	S	AC-I
Load scenario 2: Normal operations at sea			
Transit	Static and dynamic loads in heavy weather	S + D	AC-II
	Impact loads in heavy weather	Impact (I)	AC-IV
	Internal sloshing loads	Sloshing (SL)	AC-I
	Cyclic wave loads	Fatigue (F)	-
Load scenario 3: Flow through ballast water exchange			
Transit	Static and dynamic loads in heavy weather	S + D	AC-II
Load scenario 4: Overfilling of ballast water tanks and testing			
Overfilling of ballast water tanks	Overfilling of ballast water tanks with sustained liquid flow through air pipe	A	AC-III
Tank testing condition	Tank testing loads	T	AC-III
Load scenario 5: Flooding			
Flooded condition	Maximum loads on watertight bulkheads	A	AC-III (1)
Load scenario 6: Special operations stillwater			
Special operations (2)	Extreme permissible static loads	S	AC-I
Load scenario 7: Special operations at sea			
Special operations (2)	Static and dynamic loads for given sea states	S + D	AC-II
	(1) AC-I shall be applied for the collision bulkhead. (2) Special operations are operations other than normal loading/unloading in harbour and transit, e.g. pipe laying, crane operation or heavy lifting by semi-submerged operation.		

5.4.2 Acceptance criteria

Table 2 and Table 3 provide a general overview of the acceptance criteria 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.

Table 2 Acceptance criteria - prescriptive requirements

Acceptance criteria	*Plate panels and local supporting members*		*Primary supporting members*		*Hull girder members*	
	Yield	*Buckling*	*Yield*	*Buckling*	*Yield*	*Buckling*
AC-I AC-II AC-III	Permissible stress: Ch.6 Ch.10 Ch.11	Control of stiffness and proportions: Ch.8	Permissible stress: Ch.6 Ch.10 Ch.11	Control of stiffness and proportions: Ch.8	Permissible stress: Ch.5 Sec.2 Ch.5 Sec.3	Allowable buckling utilization factor: Ch.8
AC-IV	Plastic criteria: Ch.10	Control of stiffness and proportions: Ch.8	Plastic criteria: Ch.10	Control of stiffness and proportions: Ch.8 Ch.10	N/A	N/A

Table 3 Acceptance criteria - direct analysis

Acceptance criteria	*Direct/cargo hold analysis*		*Fine mesh analysis*
	Yield	*Buckling*	*Yield*
AC-I AC-II AC-III	Permissible stress: Ch.7	Allowable buckling utilization factor: Ch.8	Permissible von Mises stress: Ch.7

SECTION 3 VERIFICATION OF COMPLIANCE

1 General

1.1 Newbuilding

For newbuildings, the plans and documents submitted for approval, as given in [2], shall comply with applicable requirements in these rules, taking account of the relevant criteria, such as additional service features and class notations assigned to the ship or the ship length.

2 Documentation

2.1 Calculation data and results

The Society may require calculation data and results to be submitted for information.

The responsibility for error free specification and input of program data and the subsequent correct transposal of output resides with the designer.

2.2 Documentation requirement for design assessment of vessels

2.2.1 For the design of the vessel, documentation as specified in Table 1 shall be submitted. Table 1 is applicable for Ch.1 to Ch.13. Documentation requirement for Ch.14 and Ch.15 are specified in the beginning of these chapters.

2.2.2 Documentation shall submit as required by Table 1. The documentation will be reviewed by the Society as a part of the class contract.

Table 1 Plans and supporting calculation to be submitted for approval or information

Object	*Documentation type*	*Additional description*	*Info*
Vessel arrangement	Z010 – General arrangement plan		FI
Ship hull structure	H010 – Structural design brief	As applicable for rule calculation in Pt.3. It is recommended to provide a separate document (template is provided by DNV upon request) or alternatively the required information may be provided as part of other documents submitted.	FI
	H020 – Design load plan		FI
	H030 – Tank and capacity plan		FI
	H050 – Structural drawing	Decks and inner bottom.	AP
	H050 – Structural drawing	Transverse bulkheads.	AP
	H050 – Structural drawing	Longitudinal bulkheads.	AP
	H050 – Structural drawing	Fore ship.	AP
	H050 – Structural drawing	Engine room area.	AP
	H050 – Structural drawing	Aft ship.	AP

Object	Documentation type	Additional description	Info
	H050 – Structural drawing	Wave breaker.	AP
	H052 – Midship section drawing		AP
	H060 – Shell expansion drawing		AP
	H061 – Framing plan		AP
	H062 – Longitudinal section drawing		AP
	H070 – Standard details		FI
	H110 – Preliminary loading manual		AP
	H111 – Final loading manual		AP, VS
	H120 – Docking arrangement plan	Required for vessels with L > 90 m.	FI
Welding	H140 – Welding tables		AP
Structural fabrication	M150 – Non-destructive testing (NDT) plan		AP, L
Superstructure	H050 – Structural drawing		AP
Deck houses	H050 – Structural drawing		AP
Anchoring arrangement [1)]	Z030 – Arrangement plan	Including main dimensions and design loads (SWL, equipment weight, brake rendering load and chain breaking load) and footprint loads.	FI
	Z090 – Equipment list	Covering windlasses, anchors, grade of anchor chain, type and breaking load of chain, wire and fibre ropes.	AP
	H100 – Equipment number calculation		AP
Anchor [1)]	C010 – Design criteria	Applicable if different from standard or previously approved design.	FI, TA
	C030 – Detailed drawing		AP, TA
	C040 – Design analysis		FI, TA
Anchor chain stopper [1)]	C010 – Design criteria		FI, TA
	C020 – Assembly or arrangement drawing		FI, TA
	C030 – Detailed drawing		AP, TA
	C040 – Design analysis		FI, TA
Anchor windlass [1)]	C010 – Design criteria		FI, TA
	C020 – Assembly or arrangement drawing		FI, TA
	C040 – Design analysis		FI, TA
	C050 – Non-destructive testing (NDT) plan		AP, TA

Object	*Documentation type*	*Additional description*	*Info*
	C030 – Detailed drawing	Cable lifter, drum, shaft, gear, brake, clutch and frame.	AP, TA
Anchor windlass supporting structure [1)]	H053 – Foundation and supporting structure drawing	Including foundation above deck and fixation (bolts and shear stoppers) inclusive supporting structure below deck, and SWL, equipment weight, brake rendering load, chain/wire breaking load and foot print loads.	AP
Anchor chain stopper supporting structure [1)]	H053 – Foundation and supporting structure drawing	Including foundation above deck and fixation (bolts and shear stoppers) inclusive supporting structure below deck, and equipment weight, chain breaking load and foot print loads.	AP
Towing and mooring arrangements	Z030 – Arrangement plan [1)]	Plan providing information as detailed in Ch.11 Sec.2 [5.7.3].	AP
Emergency towing procedure	Z250 – Procedure	Covering SOLAS II-1/3-4.	FI
Supporting structure for shipboard fittings associated with mooring and towing operations, including emergency towing	H053 – Foundation and supporting structure drawing	Including foundation above deck and fixation to deck inclusive supporting structure below deck. Mooring fittings and towing devices (if provided) shall be included.	AP
Deck equipment/ machinery supporting structure	H053 – Foundation and supporting structure drawing	Applies to foundations and supporting structure considered critical for hull structural strength according to Ch.11 Sec.2 [3].	AP
Deck equipment / machinery / wind assisted propulsion systems, etc.	Z030 – Arrangement plan	Including main dimensions and design loads (SWL, equipment weight, brake rendering load and wire breaking load) and footprint loads.	FI
Supporting structures for heavy objects	H053 – Foundation and supporting structure drawing	Applies to foundations and supporting structure considered critical for hull structural strength according to Ch.11 Sec.2 [3].	AP
Lifting masts and rigging	Z030 – Arrangement plan		FI
	C010 – Design criteria	Safe working load.	FI
	Z250 – Procedure	Information about the operation of the derrick booms, if provided, i.e. how the derricks are intended to be worked, for instance, if more than one derrick is intended to simultaneously serve one hatch. Working position for each provided derrick to be included.	FI

Object	*Documentation type*	*Additional description*	*Info*
Lifting appliances	Z030 – Arrangement plan	Including: — main dimensions — limiting positions of movable parts — location on board during operation and in parked position.	FI
	C010 – Design criteria	Including: — load charts including safe working loads and corresponding arms — dynamic coefficients self-weights and positions of centre of gravity. For offshore cranes, also: — significant wave height (H_s) for operation — load charts showing crane capacity at each given H_s.	FI
Crane pedestals and lifting appliances supporting structures	H053 – Foundation and supporting structure drawing	Crane pedestals and supporting structures for: — launching and recovery of lifesaving appliances and work boats — lifting appliances when SWL is above 30 kN and/or overturning moment is greater than 100 kNm. Including design loads and reaction forces: — during operation — in stowed position.	AP
Propeller nozzles	H050 – Structural drawing		AP
Propeller shaft brackets	H050 – Structural drawing		AP
Stern frame	H050 – Structural drawing		AP
Bottom 1)	H050 – Structural drawing	Foundations of retractable bottom equipment, including supporting structure and watertight boundaries.	AP
	Z030 – Arrangement plan	Retractable bottom equipment, including resulting loads acting on the supporting structure, and details of sealings.	FI
Box coolers 1)	H050 – Structural drawing	Foundations, including supporting structures and watertight boundaries.	AP
	Z030 – Arrangement plan	Including details of sealings.	FI
External watertight integrity	B200 – Freeboard plan		AP
Weathertight doors	C030 – Detailed drawing	Doors, securing devices and locking devices, including specification of design pressure.	AP, TA
Cargo hatches	C030 – Detailed drawing	Including covers and opening, closing, sealing, securing and locking devices.	AP

Object	*Documentation type*	*Additional description*	*Info*
Shell doors (bow, side and stern as applicable) 1)	C030 – Detailed drawing	Doors and ramps, including securing and locking devices.	AP
	I200 – Control and monitoring system documentation	Shell doors control and monitoring system.	AP
	I200 – Control and monitoring system documentation	Water leakage monitoring system.	AP
	Z161 – Operation manual		AP
	Z163 – Maintenance manual		AP
Service hatches	C030 – Detailed drawing	Hatch covers, securing devices and locking devices. Including specification of design pressure.	AP
Manholes	Z030 – Arrangement plan		FI
Internal watertight doors/ ramps	Z030 – Arrangement plan	Including for each door: size, design principle (sliding, hinged), pressure rating and fire rating. Including remote control positions.	AP
	I200 – Control and monitoring system documentation	Internal watertight doors control and monitoring system.	AP
	C030 – Detailed drawing	Doors, securing devices and locking devices. Including specification of design pressure.	AP, TA
Engine rooms	Z265 – Calculation report	For vessels with periodically unmanned machinery space, filling time calculation.	FI
Windows and side scuttles 1)	C030 – Detailed drawing	Including main dimensions, deadlights, method of attachment and specification of glazing material and design pressure.	AP
	Z030 – Arrangement plan	Including type of glass, frames, references to standards and deadlights where applicable.	AP
Loading computer	I270 – Test conditions	Preliminary.	AP
	I270 – Test conditions	Final.	AP, VS
	I280 – Reference data		FI, VS
	Z060 – Functional description		FI, TA
	Z161 – Operational manual		FI, TA
1) Also applicable for ships with class notation **CSR**. AP = for approval, FI = for information, ACO = as carried out, L = local handling, R = on request, TA = covered by type approval, VS = vessel specific			

For general requirements for documentation, including definition of the info codes, see DNV-CG-0550 Sec.6.

For a full definition of the documentation types, see DNV-CG-0550 Sec.5.

3 Compliance documentation

3.1 Required compliance documentation

3.1.1 General

Table 2 and Table 3 are relevant for required compliance documentation for materials of hull structures and hull equipment, and related to Ch.11 and Ch.12 as described for these objects.

Required compliance documentation requirements for rudders are given in Ch.14 Sec.1 [1.4].

3.1.2 Required compliance documentation for anchors, anchor windlass, chain stoppers and anchor equipment

Compliance documentation shall be submitted as required by Table 2 to Table 4.

Table 2 Compliance documents

Object	*Compliance document type*	*Issued by*	*Compliance standard* [1)]	*Additional description*
Hull and hull appendages	MC	Society		Including: — rolled steel and wrought aluminium alloys for hull structures — forgings, castings and other materials for special parts and equipment and including sunken bits fitted in side shell. See also Ch.3 Sec.1 [1].
Mooring equipment	MD	Manufacturer		
Anchors	PC	Society		
	MC	Society		
Anchor chains	PC	Society		Including accessories, e.g. swivels. Content shall include the following: — grade of chain, method of manufacture, condition of supply and reference to material certificate — results of proof load test, breaking load test and, where applicable, mechanical tests — identification marking.
	MC	Society		
	MC	Society		Bars for K2 and K3 anchor chain cable.

Object	*Compliance document type*	*Issued by*	*Compliance standard* [1)]	*Additional description*
Anchor steel wire ropes	MD	Manufacturer		Guidance for maintenance and inspection shall be provided.
Anchor chain joining shackles	PC	Society		
	MC	Society		
Anchor windlasses	PC	Society		
	MC	Society		Cable lifter.
				Drum.
				Shaft.
				Clutch.
				Brake.
				Gear.
	MD	Manufacturer		Frame.
Anchor chain stoppers	MC	Society		
Associated electrical equipment (e.g. motors, power transformers, semi-conductor assemblies, electrical assemblies) serving the anchor windlasses shall be delivered with compliance documents in accordance with Pt.4 Ch.8 Sec.1 Table 8.				
1) Unless otherwise specified the compliance standard is the rules.				
PC = product certificate, MC = material certificate, MD = material declaration				

3.1.3 Required compliance documentation of internal watertight doors and shell doors

Compliance documentation shall be submitted as required by Table 3.

Table 3 Compliance documents

Object	*Compliance document type*	*Issued by*	*Compliance standard* [1)]	*Additional description*
Internal watertight doors	PC	Society		
Internal watertight doors control and monitoring system	PC	Society		
Shell doors control and monitoring system	PC	Society		
Light watertight doors (LWT)	TAC/PTR	Society		Internal watertight doors on or above the bulkhead deck, which may be partially or fully submerged in any damage state.
Semi-watertight doors (SWT)	TAC/PTR	Society		Internal watertight doors on or above the bulkhead deck, which are neither partially or fully submerged in any damage state.

Object	Compliance document type	Issued by	Compliance standard 1)	Additional description
1) Unless otherwise specified the compliance standard is the rules. PC = product certificate TAC = type approval certificate PTR = product test report				

3.1.4 Required compliance documentation of loading instrument system

Compliance documentation shall be submitted as required by Table 4

Table 4 Compliance documents

Object	Compliance document type	Issued by	Compliance standard 1)	Additional description
Loading computer	PC	Society		See Pt.6 Ch.4 Sec.6 for requirements about certification.
1) Unless otherwise specified the compliance standard is the rules. PC = product certificate				

3.1.5 For general compliance document requirements, see DNV-CG-0550 Sec.4.
For a definition of the compliance document types, see DNV-CG-0550 Sec.3.

4 Equivalence procedures

4.1 Rule applications

4.1.1 These rules apply to ships of normal form, proportions, speed and structural arrangements. Relevant design parameters defining the assumptions made are given in Sec.2 [3].

4.1.2 Special consideration shall be given to the application of the rules incorporating design parameters which are outside the design basis as specified in Sec.2 [3], for example, increased fatigue life.

4.2 Novel designs

4.2.1 Ships of novel design, i.e. those of unusual form, proportions, speed and structural arrangements outside those specified in Sec.2 [3.2], shall be specially considered according to the contents of [4.2.2] to [4.2.4]. Relevant requirements in Pt.5 are applicable based on given hull shape.

4.2.2 Information shall be submitted to the Society to demonstrate that the structural safety of the novel design is equivalent or better than that of the rules.

4.2.3 In such cases, the Society shall be contacted at an early stage in the design process to establish the applicability of the rules and additional information required for submission.

4.2.4 Dependent on the nature of the deviation, a systematic review may be required to document equivalence with the rules.

4.3 Alternative calculation methods

Where indicated in specific sections of the rules, alternative calculation methods to those shown in the rules may be accepted provided it is demonstrated that the scantling and arrangements are of equivalent or better strength to those derived using the rules.

SECTION 4 SYMBOLS AND DEFINITIONS

1 Primary symbols and units

1.1 General

1.1.1 Unless otherwise specified, the general symbols and their units used in these rules are those defined in Table 1.

Table 1 Primary symbols

Symbol	*Meaning*	*Units*
C	coefficient	-
F	force and concentrated loads	kN
M	bending moment	kNm
m	mass	t
P	pressure	kN/m^2
Q	shear force	kN
a	acceleration	m/s^2
g	gravity acceleration, taken equal to 9.81 m/s^2	m/s^2
n	number of items	-
r	radius	mm
	radius of curvature of plating or bilge radius	mm
x	x coordinate along longitudinal axis, see [3.6]	m
y	y coordinate along transverse axis, see [3.6]	m
z	z coordinate along vertical axis, see [3.6]	m
η	permissible utilisation factor (usage factor)	-
Υ	safety factor	-
δ	deflection/displacement	mm
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 Symbols

2.1 Ship's main data

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

Table 2 Ship's main data

Symbol	*Meaning*	*Units*
L	rule length	m
L_{LL}	freeboard length	m
L_{PP}	length between perpendiculars	m
L_0	rule length, L, but not to be taken less than 110 m	m
L_1	rule length, L, but need not be taken greater than 250 m	m
L_2	rule length, L, but need not be taken greater than 300 m	m
B	moulded breadth of ship	m
D	moulded depth of ship	m
D_{LL}	moulded freeboard depth of ship	m
FP_{LL}	perpendicular coinciding with the foreside of the stem on the waterline on which L_{LL} is measured. For ships with unconventional stem curvatures, e.g. a bulbous bow protruding the waterline, the position of FP_{LL} will be specially considered	
T	moulded draught	m
T_{LL}	moulded freeboard draught	m
T_{SC}	scantling draught	m
T_{full}	full load design draught	m
T_{BAL}	ballast draught (minimum midship)	m
$T_{BAL\text{-}H}$	heavy ballast draught	m
T_{Design}	design draught	m
T_{LC}	midship draught at considered loading condition	m
T_{DAM}	deepest equilibrium waterline in damage condition. For passenger vessels, deepest intermediate or final equilibrium damage waterline	m
$T_{F\text{-}f}$, $T_{F\text{-}e}$	minimum draught at forward perpendicular for bottom slamming, with respectively all ballast tanks full or with any tank empty in bottom slamming area	m
Δ	moulded displacement at draught T_{SC}	t

Symbol	Meaning	Units
C_B	block coefficient at draught T_{SC}	-
$C_{B\text{-}LL}$	block coefficient at draught T_{LL}, as defined in the *International Convention of Load Lines* (ICLL)	-
V	maximum service speed	knot
x, y, z	x, y, z coordinates of the calculation point with respect to the reference coordinate system	m

2.2 Materials

Unless otherwise specified, symbols regarding materials and their units used in these rules are those defined in Table 3.

Table 3 Materials

Symbol	Meaning	Units
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
τ_Y	nominal shear yield stress, taken equal to $\frac{R_Y}{\sqrt{3}}$	N/mm^2

2.3 Loads

Unless otherwise specified, symbols regarding loads and their units used in these rules are those defined in Table 4.

Table 4 Loads

Symbol	Meaning	Units
C_w	wave coefficient	-
T_θ	roll period	s

Symbol	*Meaning*	*Units*
θ	roll angle	deg
T_φ	pitch period	s
φ	pitch angle	deg
a_o	common acceleration parameter	-
a_z	vertical acceleration	m/s^2
a_y	transverse acceleration	m/s^2
a_x	longitudinal acceleration	m/s^2
f_p	probability factor	-
k_r	roll radius of gyration	m
GM	metacentric height	m
λ	wave length	m
P_{ex}	total sea pressure, see Ch.4 Sec.5 [1.1]	kN/m^2
P_{in}	total internal pressure due to liquid, see Ch.4 Sec.6 [1], or due to dry bulk cargo, see Pt.5 Ch.1 Sec.2	kN/m^2
P_s	static sea pressure	kN/m^2
$P_{\ell s}$	static tank pressure	kN/m^2
P_w	dynamic wave pressure	kN/m^2
$P_{\ell d}$	dynamic tank pressure	kN/m^2
P_D	green sea deck pressure	kN/m^2
$P_{slh\text{-}j}$	sloshing pressure, j = direction	kN/m^2
$P_{d\ell}$	total pressure due to distributed load on deck or platform, see Ch.4 Sec.5 [2.3] or Ch.4 Sec.6 [2.2]	kN/m^2
P_{SL}	bottom slamming pressure	kN/m^2
P_{FB}	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
F_U	total force due to concentrated load on deck or platform, see Ch.4 Sec.5 [2.3] or Ch.4 Sec.6 [2.3]	kN
$M_{sw\text{-}j}$	vertical still water bending moment, $j = h, s$ (hog, sag)	kNm
Q_{sw}	vertical still water shear force	kN
$M_{wv\text{-}j}$	vertical wave bending moment, $j = h, s$ (hog, sag)	kNm
Q_{wv}	vertical wave shear force	kN
M_{wt}	torsional wave moment	kNm

Symbol	*Meaning*	*Units*
M_{wh}	horizontal wave bending moment	kNm

2.4 Scantlings

Unless otherwise specified, symbols regarding scantlings and their units used in these rules are those defined in Table 5.

Table 5 Scantlings

Symbol	*Meaning*	*Units*
$I_{y\text{-}n50}$	net vertical moment of inertia of hull girder with half corrosion addition	m^4
$I_{z\text{-}n50}$	net horizontal moment of inertia of hull girder with half corrosion addition	m^4
$Z_{D\text{-}n50}$, $Z_{B\text{-}n50}$	net vertical hull girder section moduli with half corrosion addition, at deck and bottom respectively	m^3
$Z_{z\text{-}n50}$	horizontal hull girder section modulus with half corrosion addition	m^3
z_n	vertical distance from BL to horizontal neutral axis	m
a	length of elementary plate panel (EPP) as defined in Ch.3 Sec.7 [2.1.1]	mm
b	breadth of elementary plate panel (EPP) as defined in Ch.3 Sec.7 [2.1.1]	mm
	width of face plate of stiffeners and primary supporting members	mm
h	web height of stiffeners and primary supporting members	mm
s	stiffener spacing as defined in Ch.3 Sec.7 [1.2.1]	mm
S	primary supporting member spacing as defined in Ch.3 Sec.7 [1.2.2]	m
ℓ	span of stiffeners or primary supporting member as defined in Ch.3 Sec.7 [1]	m
ℓ_{bdg}	effective bending span, in m, as defined in Ch.3 Sec.7 [1.1.2]	m
ℓ_b	bracket arm length	m
t	net required thickness with full corrosion addition	mm
t_{n50}	net required thickness with half corrosion addition	mm
t_c	corrosion addition	mm
t_{gr}	gross thickness	mm
t_{as_built}	as built thickness	mm
t_{gr_off}	gross thickness offered	mm
t_{gr_req}	gross thickness required	mm
t_{off}	net thickness offered	mm
t_{vol_add}	thickness for voluntary addition	mm
t_{res}	reserve thickness	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, $t_{w\text{-}n50}$	web net thickness of stiffener or primary supporting member	mm
b_f	face plate width stiffener or primary supporting member	mm

Symbol	Meaning	Units
h_{stf}	height of stiffener	mm
t_f, $t_{f\text{-}n50}$	face plate/flange net thickness of stiffener or primary supporting member	mm
t_p, $t_{p\text{-}n50}$	net 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 L_3 profiles	mm
b_{eff}	effective breadth of attached plating, in bending, for yield and fatigue	mm
A_{eff} or $A_{eff\text{-}n50}$	net sectional area of stiffeners or primary supporting members, with attached plating (of width s)	cm^2
A_{shr} or $A_{shr\text{-}n50}$	net shear sectional area of stiffeners or primary supporting members	cm^2
I_p	net polar moment of inertia of stiffener about its connection to plating	cm^4
I_ω or $I_{\omega\text{-}n50}$	net sectorial moment of inertia of stiffener or primary supporting member about its connection to plating	cm^6
I	net moment of inertia of the stiffener, with attached shell 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 Definitions

3.1 Principal particulars

3.1.1 L, 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 shall not be 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 shall 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 shall be considered on a case-by-case basis and agreed with the Society.

3.1.2 L_{LL}, freeboard length

The freeboard length L_{LL}, in m, shall be taken as 96% of the total length on a waterline at 85% of the least moulded freeboard depth, D_{LL} in m, measured from the top of the keel, or as the length from the fore side of the stem to the axis of the rudder stock on that waterline, if that is greater. For ships without a rudder stock, the length L_{LL} shall be taken as 96% of the waterline at 85% of the least moulded depth.

In ships designed with a rake of keel the waterline on which this length is measured shall be parallel to the designed waterline.

Where the stem contour is concave above the waterline at 85% of the least moulded freeboard depth, both the forward end of the extreme length and the forward side of the stem shall be taken at the vertical projection to that waterline of the aftermost point of the stem contour (above that waterline), see Figure 1.

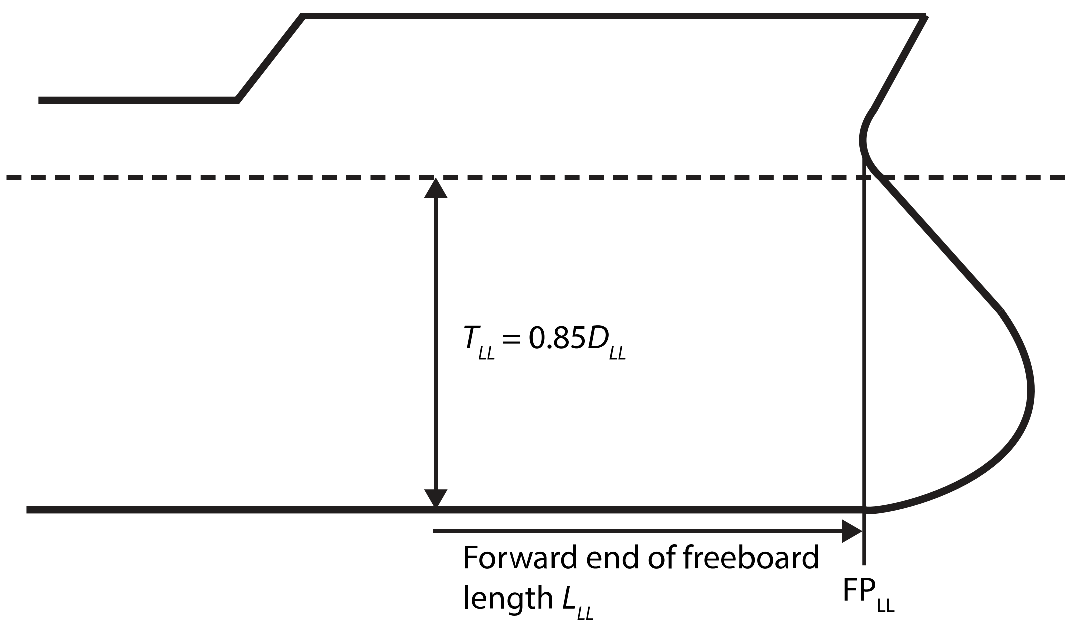

Figure 1 Concave stem contour

3.1.3 Moulded breadth

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

3.1.4 Moulded depth

D, the moulded depth, is the vertical distance, in m, 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 or sheer strake, *D* shall be measured to the continuation of the moulded deck line.

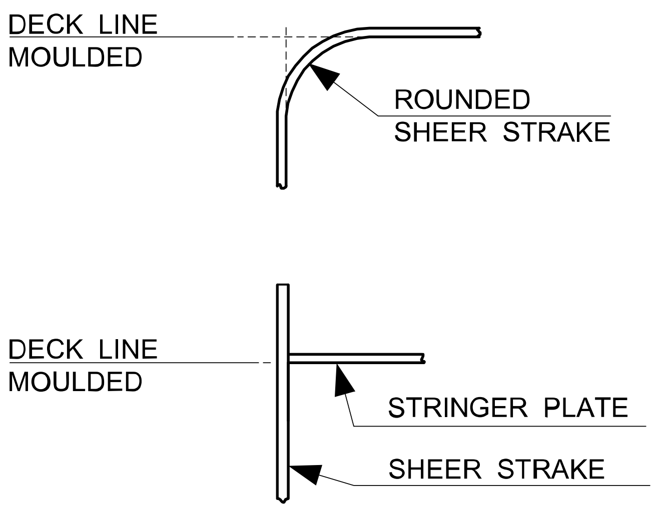

Figure 2 Deck corners

3.1.5 Moulded freeboard depth

The moulded freeboard depth D_{LL} is the least moulded depth taken as the vertical distance, in m, from the top of the keel to the top of the freeboard deck beam at the side. Where the freeboard deck is stepped and the raised part of the deck extends over the point at which the moulded depth shall be determined, the moulded depth shall be measured to a line of reference extending from the lower part of the deck along a line parallel with the raised part.

3.1.6 Draughts

T, the draught in m, is the summer load line draught, measured from the moulded baseline at midship. Note that this may be less than the maximum permissible scantling 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} shall not be 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 shall 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 for any ballast conditions in the loading manual including both departure and arrival conditions.

$T_{BAL\text{-}H}$ is the minimum design heavy ballast draught amidships, in m, at which the strength requirements for the scantlings of the ship are met. This heavy ballast draught shall be considered for ships having heavy ballast condition.

T_{Design} is the design draught, in m, that is considered representative for frequently expected loading conditions.

Guidance note:

If the minimum design ballast draught amidships is not available in the initial design stage, T_{BAL} may be taken according to the table below. When T_{BAL} taken from the table below is used for strength assessment, it should be confirmed that all ballast conditions in the final loading manual are covered.

Ship type	T_{BAL}
Ship carrying liquid cargoes in bulk	$2 + 0.02L$
Ship carrying dry cargoes	$0.35T_{SC}$
RoRo ships	$0.5T_{SC}$
Passenger ships	$0.75T_{SC}$

---e-n-d---o-f---g-u-i-d-a-n-c-e---n-o-t-e---

3.1.7 Moulded displacement

Moulded displacement, in t, corresponds to the underwater volume of the ship, at a draught, in seawater with a density of 1.025 t/m^3.

3.1.8 Maximum service speed

V, the maximum ahead service speed, in knots, means the greatest speed which the ship is designed to maintain in service at her deepest seagoing draught at the maximum propeller r/min and corresponding engine MCR (maximum continuous rating).

3.1.9 Block coefficient

C_B, the block coefficient at the draught, T_{SC} is defined in the following equation:

$$C_B = \frac{\Delta}{1.025 L B T_{SC}}$$

where:

Δ = moulded displacement of the ship, in t, at draught T_{SC}.

3.1.10 Lightweight
Lightweight is the ship displacement, in t, as defined in the *Introduction to IMO 2008 Intact Stability Code* (IMO Res. MSC.267(85)) in Definitions 2.23.

3.1.11 Deadweight
The deadweight DWT is the difference, in t, between the displacement, at the summer draught in seawater of density ρ = 1.025 t/m^3, and the lightweight.

3.1.12 Fore end
The fore end (FE) of the rule length L, see Figure 3, is the perpendicular to the scantling draught waterline at the forward side of the stem.

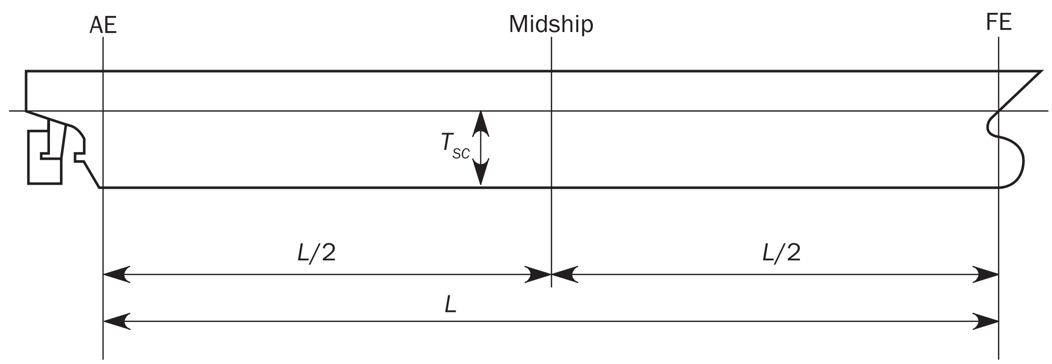

Figure 3 Ends and midship

3.1.13 Aft end
The aft end (AE) of the rule length L, see Figure 3, is the perpendicular to the scantling draught waterline at a distance L aft of the fore end.

3.1.14 Midship
The midship is the perpendicular to the scantling draught waterline at a distance 0.5 L aft of the fore end.

3.1.15 Midship part
The midship part of a ship is the part extending 0.4 L amidships, unless otherwise specified.

3.1.16 Forward freeboard perpendicular
The forward freeboard perpendicular, FP_{LL}, shall be taken at the forward end of the length L_{LL} and shall coincide with the foreside of the stem on the waterline on which the length L_{LL} is measured, see [3.1.2].

3.1.17 After freeboard perpendicular
The after freeboard perpendicular, AP_{LL}, shall be taken at the aft end of the length L_{LL}.

3.2 Position 1 and position 2

3.2.1 Position 1
Position 1 includes:

— exposed freeboard and raised quarter decks

— exposed superstructure decks situated forward of 0.25 L_{LL} from FP_{LL}.

3.2.2 Position 2

Position 2 includes:

— exposed superstructure decks situated aft of 0.25 L_{LL} from FP_{LL} and located at least one standard height of superstructure above the freeboard deck

— exposed superstructure decks situated forward of 0.25 L_{LL} from FP_{LL} and located at least two standard heights of superstructure above the freeboard deck.

3.3 Standard height of superstructure

3.3.1 The standard height of superstructure is defined in Table 6.

Table 6 Standard height of superstructure

Freeboard length L_{LL}, in m	*Standard height h_S, in m*	
	Raised quarter deck	*All other superstructures*
$L_{LL} \leq 30$	0.9	1.8
75	1.2	1.8
$L_{LL} > 125$	1.80	2.30

The standard heights at intermediate lengths of ships shall be obtained by linear interpolation.

3.3.2 A tier is defined as a measure of the extent of a deckhouse. A deckhouse tier consists of a deck and external bulkheads.

3.4 Type 'A' and type 'B' freeboard ships

3.4.1 Type 'A' ship

Type 'A' ship is one which:

— is designed to carry only liquid cargoes in bulk

— has a high integrity of the exposed deck with only small access openings to cargo compartments, closed by watertight gasketed covers of steel or equivalent material

— has low permeability of loaded cargo compartments.

Type 'A' ship shall be assigned a freeboard following the requirements specified in the ICLL.

3.4.2 Type 'B' ship

All ships which are not type 'A' ships stated in [3.4.1] shall be considered as type 'B' ships.

Type 'B' ship shall be assigned a freeboard following the requirements specified in ICLL.

3.4.3 Type 'B-60' ship

Type 'B-60' ship is any type 'B' ship of over 100 m in length which, according to applicable requirements of ICLL is assigned with a value of tabular freeboard which can be reduced up to 60% of the difference between the ‘B’ and ‘A’ tabular values for the appropriate ship lengths.

3.4.4 Type 'B-100' ship

Type 'B-100' ship is any type 'B' ship of over 100 m in length which, according to applicable requirements of ICLL is assigned with a value of tabular freeboard which can be reduced up to 100% of the difference between the ‘B’ and ‘A’ tabular values for the appropriate ship lengths.

3.4.5 Type 'B+' ship

Cargo ship with increased freeboard on account of hatch cover arrangement.

3.5 Operation definition

3.5.1 Multiport

Multiport corresponds to short voyage with loading and unloading in multiple ports.

3.5.2 Sheltered water

Sheltered waters are generally calm stretches of water, i.e. harbours, estuaries, roadsteads, bays, lagoons.

3.6 Reference coordinate system

The ship’s geometry, motions, accelerations and loads are defined with respect to the following right-hand coordinate system, see Figure 4:

origin	=	at the intersection among 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 port side
Z axis	=	vertical axis, positive upwards.

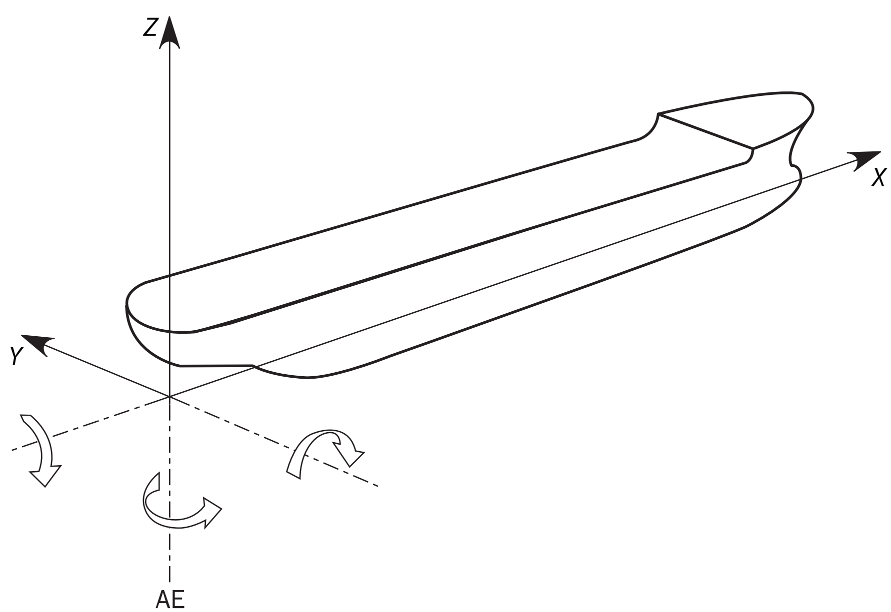

Figure 4 Reference coordinate system

3.7 Naming convention

Figure 5 to Figure 7 show the common structural nomenclature used within these rules, also applicable to other ship types.

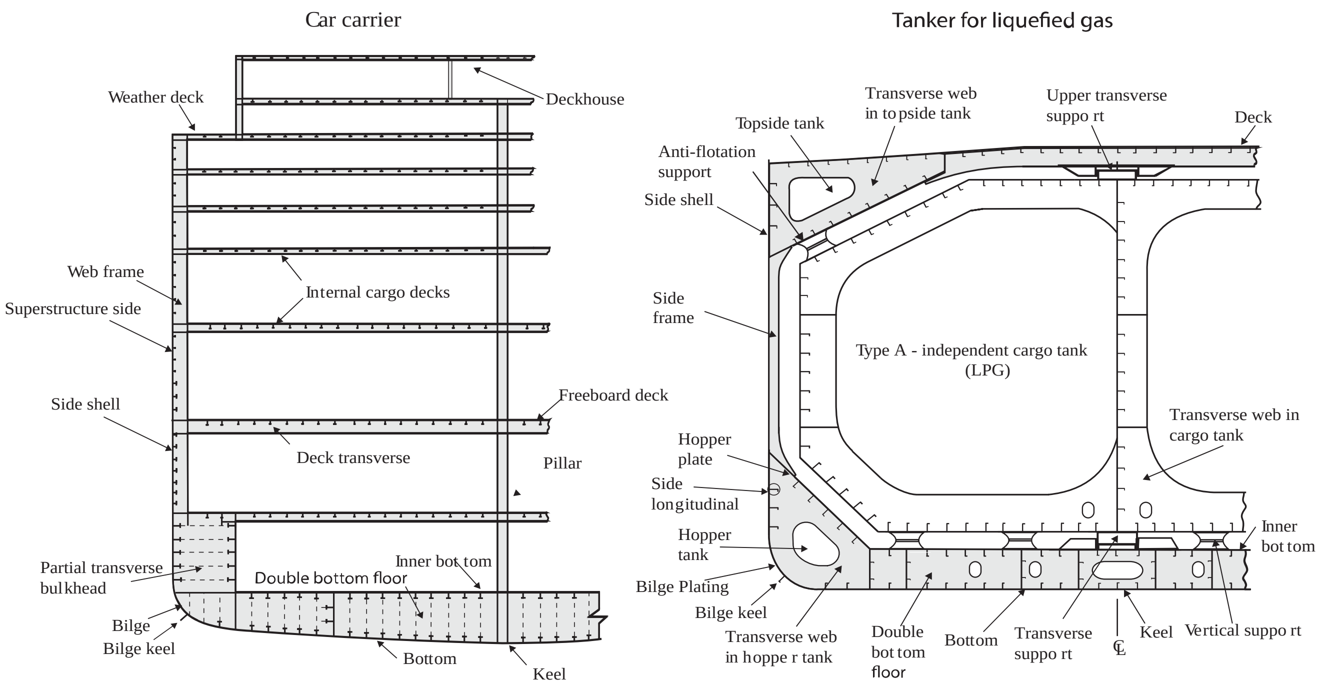

Figure 5 Midship section

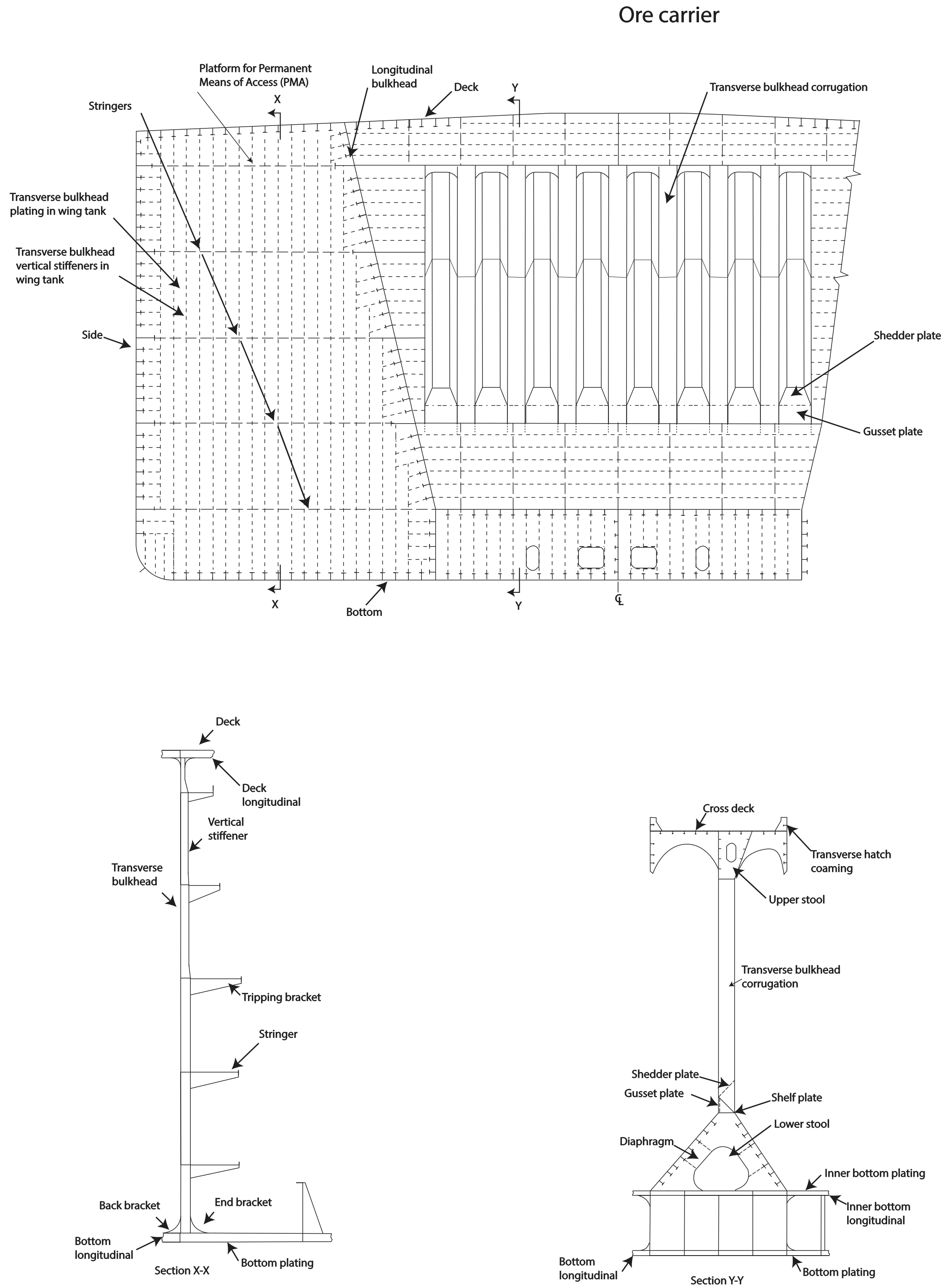

Figure 6 Transverse bulkhead

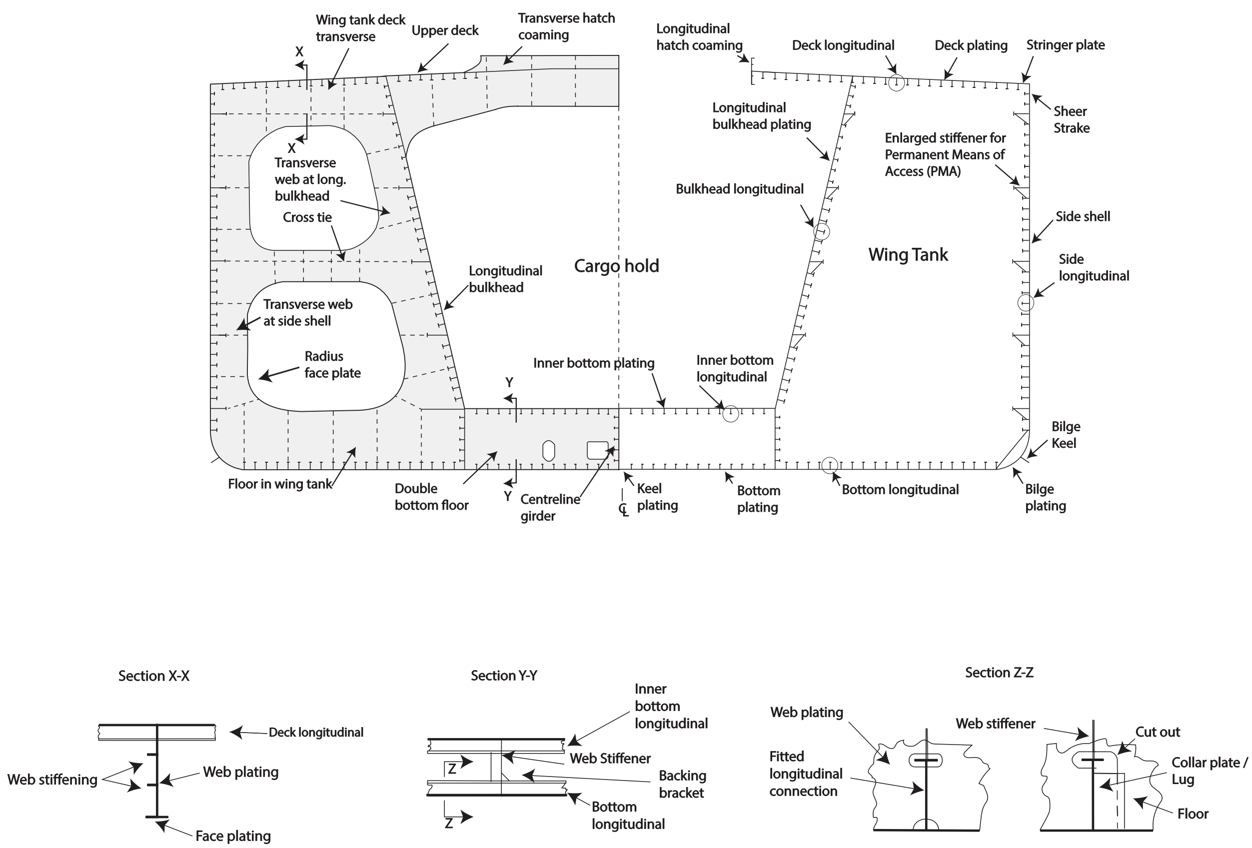

Figure 7 Mid cargo hold transverse section

3.8 Glossary

Table 7 Definition of terms

Terms	*Definition*
accommodation deck	deck used primarily for the accommodation of the crew or passengers, including deck in public area of passenger vessels
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
amidships	middle of the length *L*

Terms	*Definition*
anchor	device which is 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, usually made of heavy casting or casting.
ballast hold	dry bulk cargo hold that may be used for the storage of water ballast
ballast tank	compartment used for the storage of water ballast
bay	area between adjacent transverse frames or transverse bulkheads
bilge hopper tank	tank used for ballast or for stability when carrying certain cargoes in bulk carriers
bilge keel	plate/profile perpendicular to a ship’s shell along the bilges to reduce the rolling motion
bilge plating	curved plating between the bottom shell and side shell It shall be taken as follows: — within the parallel 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 parallel 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	lower strake of bilge plating
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
bow door	collective term for the outer and the inner bow door normally leading to a complete or long forward enclosed superstructure
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
breast hook	plate bracket joining port and starboard side structural members at the stem
bridge	elevated deckhouse or 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	party contracted by the owner to build a ship in compliance with the specifications including rules
bulb profile	stiffener utilizing an increase in steel mass on the outer end of the web instead of a separate flange
bulkhead	structural partition wall sub-dividing the interior of the ship into compartment

Terms	*Definition*
bulkhead deck	uppermost continuous deck to which transverse watertight bulkheads and shell are carried watertight In cargo ships the freeboard deck may be taken as the bulkhead deck.
bulkhead stool	lower or upper base of a corrugated bulkhead
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 area	part of the ship that contains cargo holds, cargo tanks and slop tanks
cargo hold	generic term for spaces intended to carry cargo, liquid or dry bulk
cargo tank	tank carrying cargoes
cargo tank bulkhead	boundary bulkhead separating cargo tanks
carlings	stiffening member used to supplement the regular stiffening arrangement
casing	covering or bulkhead around or about any space for protection
cellular construction	structural arrangement where there are two closely spaced boundaries and internal diaphragm plates arranged in such a manner to create small compartments
centreline girder	longitudinal member located on the centreline of the ship
chain	connected metal rings or links used for holding anchor, fastening timber cargoes, etc.
chain locker	compartment usually at the forward end of a ship which is 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
cleats	devices for pre-compression of packings and steel to steel contact (not load carrying devices)
coaming	vertical boundary structure of a hatch or skylight
cofferdams	see Ch.2 Sec.3 [1]
collar plate	patch used to completely close a hole cut for a longitudinal or transverse stiffener passing through a primary structural member
collision bulkhead	foremost main transverse watertight bulkhead
companionway	weathertight entrance leading from a ship’s 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

Terms	*Definition*
containerized equipment	equipment connected to the vessel systems, enclosed by a structural unit located on the freeboard deck or above
continuous stiffener	stiffener with both web and flange continuous through primary support member web or bulkhead plating
convention vessel	vessel which due to its tonnage, usage or dimensions would, if trading in international waters or on international voyages, fall within the requirements of any, or any part, of the IMO and / or ILO conventions
corrugation	plating arranged in a corrugated fashion
cross deck	area between cargo hatches
cross ties	large transverse structural members joining longitudinal bulkheads or joining a longitudinal bulkhead with double side structures and used to support them against hydrostatic and hydrodynamic loads
deck	horizontal structure element that defines the upper or lower boundary of a compartment
deckhouse	deckhouse is a decked structure on the freeboard deck which does not comply with the definition of a superstructure
deck structure	deck plating with stiffeners, girders and supporting pillars
deck transverse	transverse PSM at the deck
deep tank	any tank which extends between two decks or the shell/inner bottom and the deck above or higher
designer	party who creates documentation submitted to the Society necessary for approval or for information The designer can be the builder or a party contracted by the builder or 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	shell plating with stiffeners below the top of the inner bottom and other elements below and including the inner bottom plating Note that sloping hopper tank topside shall be regarded as longitudinal bulkhead
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	double skin member is defined as a structural member where the idealized beam comprises webs, with top and bottom flanges formed by attached plating
duct keel	a keel built of plates in box form extending the length of the cargo tank. It is used to house ballast and other piping leading forward which otherwise would have to run through the cargo tanks
enclosed superstructure	superstructure with bulkheads forward and/or aft fitted with weather tight doors and closing appliances
engine room	spaces containing propulsion machinery and machinery for generation of electrical power, see also Pt.4 Ch.1 Sec.1

Terms	*Definition*
engine room bulkhead	transverse bulkhead 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.
exposed deck	deck directly exposed to weather loads (wind, rain, snow, ice) or green sea loads
face plate	section of a stiffening member attached to the plate via a web and is usually parallel to the plated surface
flange	section of a stiffening member, typically attached to the web, but is sometimes formed by bending the web over. It is usually parallel to the plated surface
flat bar	stiffener comprised only of a web
floor	bottom transverse member
flush deck ship	ship which has no superstructure on the freeboard deck
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
foundation	device transferring loads from a heavy or loaded object to the vessel structure
freeboard deck	generally the uppermost complete deck exposed to weather and sea, which has permanent means of closing all exposed openings In a ship having a discontinuous freeboard deck, the lowest line of the exposed deck and the continuation of that line parallel to the upper part of the deck is taken as the freeboard deck. At the option of the owner and subject to the approval of the flag administration, a lower deck may be designated as the freeboard deck provided it is a complete and permanent deck continuous in a fore and aft direction at least between the machinery space and peak bulkheads and continuous athwart ships. When this lower deck is stepped the lowest line of the deck and the continuation of that line parallel to the upper part of the deck is taken as the freeboard deck. When a lower deck is designated as the freeboard deck, that part of the hull which extends above the freeboard deck is treated as a superstructure so far as concerns the application of the conditions of assignment and the calculation of freeboard. It is from this deck that the freeboard is calculated
freeing port	opening in the bulwarks to allow water shipped on deck to run freely overboard
gangway	raised walkway between superstructure, such as between the forecastle and bridge, or between the bridge and poop
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 and allows the rudder to swing
gunwale	upper edge of the ship’s sides
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 ship’s hold

Terms	*Definition*
hatchways	openings, generally rectangular, in a ship’s deck affording access into 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
hawser	large steel wire or fibre rope used for towing or mooring
hopper plating	plating running the length of a compartment sloping between the inner bottom and vertical portion of inner hull longitudinal bulkhead
HP	bulb profile in accordance with the Holland profile standard
IACS	International Association of Classification Societies
ICLL	International Convention on Load Lines, 1966, as amended
IMO	International Maritime Organisation
independent tank	self supporting tank
inner hull	innermost plating forming a second layer to the hull of the ship
intercostal	non continuous member between stiffeners or PSM
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	keel line is the line parallel to the slope of the keel intersecting the top of the keel at amidships
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 plate to prevent water or oil from collecting
local supporting members	local stiffening members which only influence the structural integrity of a single panel, e.g. deck beams
locking arrangement	preventive measures ensuring that cleats and supports as applicable always remain in position when engaged
longitudinal centreline bulkhead	longitudinal bulkhead located on the centreline of the ship
longitudinal hull girder structural members	structural members that contribute to the longitudinal strength of the hull girder, including: deck, side, bottom, inner bottom, inner hull longitudinal bulkheads including upper sloped plating where fitted, hopper, bilge plate, longitudinal bulkheads, double bottom girders and horizontal girders in wing ballast tanks
longitudinal hull girder shear structural members	structural members that contribute to strength against hull girder vertical shear loads, including: side, inner hull longitudinal bulkheads, hopper, longitudinal bulkheads and double bottom girders
lug plate	patch used to partly close a hole cut for a longitudinal or transverse stiffener passing through a primary structure member

Terms	Definition
machinery space	spaces containing propulsion machinery, boilers, oil fuel units, steam and internal combustion engines, generators and major electrical machinery, oil filling stations, refrigerating, stabilizing, ventilation and air conditioning machinery, and similar spaces, and trunks to such spaces, see also Pt.4 Ch.1 Sec.1
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.3 [2]
non-convention vessel	vessel other than a convention vessel
notch	discontinuity in a structural member caused by welding
offshore crane	offshore cranes are lifting appliances onboard ships and similar units intended for cargo handling outside the deck area at open sea, e.g. loading and discharging of offshore support vessels, barges, or from the seabed
oil fuel tank	tank used for the storage of fuel oil
outer shell	same as shell envelope
owner	registered owner and/or manager of the vessel and/or any other organization and/or person who has assumed the responsibility for operation of the vessel and who on assuming such responsibility has agreed to take over all the duties and responsibilities related to the vessel
pillar	vertical support placed between decks where the deck is unsupported by the shell or bulkhead
pipe tunnel	void space running in the midships fore and aft lines between the inner bottom and shell plating forming a protective space for bilge, ballast and other lines extending from the engine room to the tanks
plate panel	unstiffened plate surrounded and supported by structural members, such as stiffeners, PSM, bulkheads, etc. See also EPP
plating	sheet of steel supported by stiffeners, primary supporting members or bulkheads
poop	space below an enclosed superstructure at the extreme aft end of a ship
primary supporting members (PSM)	members of the beam, girder or stringer type which provide the overall structural integrity of the hull envelope and tank boundaries, e.g. double bottom floors and girders, transverse side structure, deck transverses, bulkhead stringers and vertical webs on longitudinal bulkheads
ro-ro space	spaces not normally subdivided in any way and normally extending to either a substantial length or the entire length of the ship in which motor vehicles with fuel in their tanks for their own propulsion and/or goods (packaged or in bulk, in or on rail or road cars, vehicles (including road or rail tankers), trailers, containers, pallets, demountable tanks or in or on similar stowage units or other receptacles) can be loaded and unloaded normally in a horizontal direction
safe working load (SWL)	maximum load which the lifting appliance is certified to lift at any specified outreach

<table>
<tr><th>Terms</th><th>Definition</th></tr>
<tr><td>scallop</td><td>hole cut into a stiffening member to allow continuous welding of a plate seam</td></tr>
<tr><td>scarfing bracket</td><td>bracket used between two offset structural items</td></tr>
<tr><td>scantlings</td><td>physical dimensions of a structural item</td></tr>
<tr><td>scupper</td><td>any opening for carrying off water from a deck, either directly or through piping</td></tr>
<tr><td>scuttle</td><td>small opening in a deck or elsewhere, usually fitted with a cover or lid or a door for access to a compartment</td></tr>
<tr><td>securing device</td><td>device used to keep the door closed by preventing it from rotating about its hinges</td></tr>
<tr><td>shedder plates</td><td>slanted plates that are fitted to minimize pocketing of residual cargo in way of corrugated bulkheads</td></tr>
<tr><td>sheer strake</td><td>top strake of a ship’s side shell plating</td></tr>
<tr><td>shelf plate</td><td>horizontal plate located on the top of a bulkhead stool</td></tr>
<tr><td>shell envelope plating</td><td>shell plating forming the effective hull girder exclusive of the strength deck plating</td></tr>
<tr><td>ship with large deck openings</td><td>ship is regarded as one with large deck openings if one of the following conditions applies:
$$\frac{b_L}{B_M} > 0.7$$
$$\frac{\ell_L}{\ell_M} > 0.8$$
where:
b_L = breadth of hatchway in m, in case of multi-hatchways, b_L is the sum of the individual hatchway breadths
B_M = breadth of deck measured in m at the mid length of hatchway
ℓ_L = length of hatchway in m
ℓ_M = distance between centres of transverse deck strips at each end of hatchway in m. Where there is no further hatchway beyond the one under consideration, ℓ_M will be specially considered</td></tr>
<tr><td>shipboard crane</td><td>lifting appliance onboard ships and similar units intended for use within harbours areas and when at sea within the cargo deck area</td></tr>
<tr><td>side frame</td><td>vertical member attached to the side shell in bulk carriers</td></tr>
<tr><td>side shell</td><td>shell envelope plating forming the side portion of the shell envelope above the bilge plating</td></tr>
<tr><td>single bottom structure</td><td>shell plating with stiffeners and girders below the upper turn of bilge or the top of bottom girders, whichever is the highest</td></tr>
<tr><td>single skin member</td><td>structural member where the idealized beam comprises a web, with a top flange formed by attached plating and a bottom flange formed by a face plate</td></tr>
<tr><td>skylight</td><td>deck opening fitted with or without a glass port light and serving as a ventilator for machinery space, quarters, etc.</td></tr>
<tr><td>slop tank</td><td>tank in an oil tanker which is used to collect the oil and water mixtures from cargo tanks after tank washing</td></tr>
</table>

Terms	*Definition*
SOLAS	IMO International Convention for the Safety of Life at Sea, 1974 as amended
spaces	separate compartments including tanks
special category spaces	those enclosed spaces above or below the bulkhead deck, into and from which vehicles can be driven and to which passengers have access Special category spaces may be accommodated on more than one deck provided that the total overall clear height for vehicles does not exceed 10 m
stay	bulwark and hatch coaming brackets
stem	piece of bar or plating at which a ship's outside plating terminates at forward end
stern frame	heavy strength member in single or triple screw ships, combining the rudder post
stern tube	tube through which the shaft passes to the propeller, and acts as an after bearing for the shafting It may be water or oil lubricated
stiffener	collective term for secondary supporting structural members
stool	structure supporting tank bulkheads
strake	course, or row, of shell, deck, bulkhead, or other plating
strength deck	strength deck is in general defined as the uppermost continuous deck. A superstructure deck which within 0.4 *L* amidships has a continuous length, in m, equal to or greater than $3\left(\frac{B}{2}+H\right)$ shall be regarded as the strength deck instead of the covered part of the uppermost continuous deck H = height in m between the uppermost continuous deck and the superstructure deck in question. Another deck may be defined as the strength deck after special consideration of its effectiveness
stringer	type of girder or transverse member with horizontally positioned web, supporting vertical stiffeners/frames, connected to web frames, verticals or bulkheads
stringer plate	outside strake of deck plating
superstructure	a superstructure is a decked structure on the freeboard deck extending from side to side or with the side plating not being inboard of the shell plating more than 0.04 *B* A long forward superstructure is defined as an enclosed forward superstructure with length *S* equal to or greater than 0.25 *L*. The length of a superstructure (*S*) is the mean length of the part of the superstructure which lies within the length (*L*)
support	load carrying devices designed for transfer of acting forces from door- to hull structures. These may include hinges, welded supports, bolts/eye plates, etc.
supporting device	device used to transmit external or internal loads from a door, hatch or ramp to a securing device and from the securing device to the ship’s structure, or a device other than a securing device, such as a hinge, stopper or other fixed device, that transmits loads from the door, hatch or ramp to the ship’s structure

Terms	*Definition*
supporting structure	strengthening of the vessel structure, e.g. a deck, in order to accommodate loads and moments from a heavy or loaded object
tank	generic term for spaces intended to carry liquid, such as, seawater, fresh water, oil, liquid cargoes, FO, DO, etc.
tank top	horizontal plating forming the bottom of a cargo tank
towing pennant	long rope which is used to effect the tow of a ship
topside tank	tank that normally stretches along the length of the ship’s side and occupies the upper corners of the cargo hold in bulk carriers
transom	structural arrangement and form of the aft end of the ship
transverse ring	all transverse material appearing in a cross-section of the ship's hull, in way of a double bottom floor, vertical web and deck transverse girder
transverse web frame	primary transverse girders which join the ships longitudinal structure
tripping bracket	bracket used to strengthen a structural member under compression against torsional forces
trunk	decked structure similar to a deckhouse, but not provided with a lower deck
tween deck	abbreviation of between decks, placed between the upper deck and the tank top in the cargo tanks
ullage	quantity represented by the unoccupied space in a tank
void	enclosed empty space in a ship
wash bulkhead	perforated or partial bulkhead in a tank
watertight	watertight means capable of preventing the passage of water in any direction under a head of water calculated from the most critical situation of damaged condition at equilibrium, including intermediate stages of flooding
wave breaker	inclined and stiffened plate structure on a weather deck to break and deflect the flow of water coming over the bow
weather deck	deck or section of deck exposed to the elements which has means of closing weathertight, all hatches and openings
weathertight	weathertight means that in any sea conditions water will not penetrate into the ship
web	section of a stiffening member attached perpendicular to the plated surface
web frame	transverse PSM including deck transverse
wind and water strakes	strakes of a ship's side shell plating between the ballast and the deepest load waterline
windlass	winch for lifting and lowering the anchor chain
wing tank	space bounded by the inner hull longitudinal bulkhead and side shell

SECTION 5 LOADING MANUAL AND LOADING INSTRUMENTS

1 General requirements

1.1 Application

1.1.1 This section contains minimum requirements for loading guidance information.

1.1.2 All ships covered by Reg. 10 of the *International Convention on Load Lines* shall be provided with an approved loading manual.

The requirements given in [2] are considered to fulfil Reg. 10(1) of the *International Convention on Load Lines* for all classed ships of 65 m in length and above. However, a loading manual, considering longitudinal strength, is not required for a category II ship with length less than 90 m where the maximum deadweight does not exceed 30% of the maximum displacement, see Sec.4 [3.1.7].

All ships of category I of 100 m length and above, see [3], shall in addition to the loading manual be provided with a loading instrument system approved and certified for calculation and control of hull strength in accordance with the requirements given in Pt.6 Ch.4 Sec.6.

1.1.3 A ship may in actual operation be loaded differently from the loading conditions specified in the loading manual, provided limitations for longitudinal and local strength as defined in the loading manual and loading instrument onboard and applicable stability requirements are not exceeded.

1.1.4 The requirements concerning the loading manual are given in [2] and those concerning the loading instruments in [3].

2 Loading manuals

2.1 General requirements

2.1.1 Definition

A loading manual is a document which describes:

— the loading conditions on which the design of the ship has been based for seagoing and harbour/sheltered water, including permissible limits of still water bending moment and shear force. Additionally, where applicable, shear force correction values and permissible limits for still water torsional moment and lateral loads to be included. The conditions specified in the ballast water management procedure and dry docking procedure shall be included in the loading manual
— the results of the calculations of still water bending moments, shear forces and still water torsional moments if unsymmetrical loading conditions with respect to the ship's centre line
— the allowable local loading for the structure, e.g. hatch covers, decks, double bottom, where applicable
— the relevant operational limitations.

Guidance note:

Permissible torsional still water moment limits are generally applicable for ships with large deck openings as given in Ch.5 Sec.1 and class notation **Container** or **Container ship**.

---e-n-d---o-f---g-u-i-d-a-n-c-e---n-o-t-e---

For bulk carriers of 150 m in length and above additional requirements as given in Pt.5 Ch.1 also apply.

2.1.2 Condition of approval

The approved loading manual shall be based on the final data of the ship.

Modifications resulting in changes to the main data of the ship, e.g. lightship weight, buoyancy distribution, tank volumes or usage, require the loading manual to be updated and re-approved, and subsequently the loading computer system to be updated and re-approved. However, new loading guidance and an updated loading manual is not required to be resubmitted, provided that the resulting draughts, still water bending moments and shear forces do not differ from the originally approved data by more than 2%.

The loading manual shall be prepared in a language understood by the users. If this language is not English, a translation into English shall be included.

2.1.3 Loading conditions

The loading manual shall include the design (cargo and ballast) loading conditions, subdivided into departure and arrival conditions, and ballast exchange at sea conditions, as appropriate, upon which the approval of the hull scantlings is based, as defined in Ch.4 Sec.8.

Loading conditions for specific ship types as given in Pt.5 also apply.

2.1.4 Operational limitations

The loading manual shall describe relevant operational limitations:

— scantling draught
— load specifications for cargo decks
— design minimum ballast draught at midships
— minimum slamming draught forward with forward double bottom ballast tanks filled
— minimum slamming draught forward with any of the forward double bottom ballast tanks empty
— maximum allowable cargo density
— maximum cargo density and filling heights in any loading condition in loading manual
— restrictions in cargo mass- and angle of repose
— maximum service speed
— envelope results and permissible limits of still water bending moments and shear forces, and still water torsional moments if applicable
— restrictions to GM-value
— restrictions to filling of tanks in seagoing conditions
— restrictions to ballast holds which may not be partially filled in seagoing conditions
— restrictions to double bottom ballast tanks which may be filled in alternate loaded seagoing conditions.

3 Loading instrument

3.1 General requirements

3.1.1 Definition

A loading computer system is a system by means of which it can be easily and quickly ascertained that, at specified read-out points, relevant operational limitations, such as the still water bending moments, shear forces, and still water torsional moments and lateral loads, where applicable, in any load or ballast condition do not exceed the specified permissible values.

All ships of category I of 100 m in length and above shall be provided with a loading instrument system approved and certified for calculation and control of hull strength, in addition to the loading manual.

The loading instrument is ship specific onboard equipment and the results of the calculations are only applicable to the ship for which it has been approved.

If a loading instrument system is installed on board a ship, the system shall be approved in accordance with requirements in Pt.6 Ch.4 Sec.6.

An approved loading instrument can not replace an approved loading manual.

Single point loading instruments are not acceptable.

Category I ships:

- ships with large deck openings where combined stresses due to vertical and horizontal hull girder bending and torsional and lateral loads shall be considered
- ships liable to carry non-homogeneous loadings, where the cargo and or ballast may be unevenly distributed
- chemical tankers and gas carriers.

Category II ships:

- ships with arrangement giving small possibilities for variation in the distribution of cargo and ballast
- ships on regular and fixed trading pattern where the loading manual gives sufficient guidance
- ships less than 120 m in length, when their design takes into account uneven distribution of cargo or ballast, belong to category II.

3.1.2 Conditions of approval of loading instruments

The loading instrument is subject to approval based on the rules of the Society. The approval shall be in accordance with Pt.6 Ch.4 Sec.6.

An operational manual is always to be provided for the loading instrument. The operation manual and the instrument output shall be prepared in a language understood by the users. If this language is not English, a translation into English shall be included.

The operation of the loading instrument shall be verified upon installation. It shall be documented that the agreed test conditions and the operation manual for the instrument are available on board.

CHANGES – HISTORIC

July 2023 edition

Changes July 2023, entering into force 1 January 2024

Topic	*Reference*	*Description*
General principles - minimum requirements	Sec.2 [5.2]	Modified the rule principles to allow case-by-case evaluation of minimum requirements.
Requirement	Sec.3 Table 1	Replaced 'masts and rigging' with 'lifting masts and rigging'.
Chain Stopper	Sec.3 Table 2	Removed the option with material declaration (MD) in case of type approval.
Aluminium	Sec.3 Table 2	Clarified the compliance documents for aluminium.
Watertight doors	Sec.3 Table 3	Updated to include light watertight doors and semi-watertight doors.

July 2021 edition

Changes July 2021, entering into force 1 January 2022

Topic	*Reference*	*Description*
Rebranding to DNV	All	This document has been revised due to the rebranding of DNV GL to DNV. The following have been updated: the company name, material and certificate designations, and references to other documents in the DNV portfolio. Some of the documents referred to may not yet have been rebranded. If so, please see the relevant DNV GL document.

July 2020 edition

Changes July 2020, entering into force 1 January 2021

Topic	*Reference*	*Description*
Editorial changes and corrections	Sec.3 [2.2.2]	Documentation requirements for emergency towing arrangements are only applicable for tankers and are moved to Pt.5.

July 2019 edition

Changes July 2019, entering into force 1 January 2020

Topic	*Reference*	*Description*
Implementation IACS UR S6 Rev9	Sec.2 [3.5.4]	Lowest mean daily average temperature in air, MDAT, is changed from -20ºC to -10ºC as design temperature limit for cold temperature.
	Sec.2 [3.7.2]	Minimum and maximum cargo temperatures are changed to -10 ºC and 100 ºC respectively.
Documentation requirements	Sec.3 Table 1	Documentation requirements are updated for consistency with the rules.
	Sec.3 Table 2	Material certificate requirements for mooring equipment are changed.
Loading instrument	Sec.5 [3.1.1]	It is clarified that loading instrument is not required for category I ships with L<100 m.

July 2018 edition

Changes July 2018, entering into force 1 January 2019

Topic	*Reference*	*Description*
Special operations	Sec.2 Table 1	Added rule requirements for special operations load scenario.
Weather and water tight doors	Sec.3 [3.1.3] Sec.3 Table 3	Change of the subsection title and update of the table with certification requirements.
	Sec.3 Table 1	Added the requirement of C030 - Detail drawing for external watertight integrity.

July 2016 edition

Amendments January 2018

• General

— Only editorial corrections have been made.

Amendments July 2017

• General

— References have been updated.

Amendments January 2017

• Sec.3 Verification of compliance

— Sec.3 [2]: The text has been clarified.

Main changes July 2016, entering into force as from date of publication

• Sec.1 Application

— Sec.1 [1]: Scope of documentation and certification for CSR ships clarified.

• Sec.3 Verification of compliance

— Sec.3 [2] and Sec.3 [3]: The requirement to VL material certificate for hull structure is clarified for CSR and non-CSR ships. Scope of documentation for CSR ships clarified.

— Sec.3 Table 1: Modified documentation requirements.

October 2015 edition

This is a new document.

The rules enter into force 1 January 2016.

Amendments January 2016

• Sec.3 Verification of compliance

— Sec.3 Table 1: Modified documentation requirements.

• Sec.4 Symbols and definitions

— Sec.4 [3.1.6]: A guidance note for T_{BAL} has been added.

About DNV
DNV is the independent expert in risk management and assurance, operating in more than 100 countries. Through its broad experience and deep expertise DNV advances safety and sustainable performance, sets industry benchmarks, and inspires and invents solutions.

Whether assessing a new ship design, optimizing the performance of a wind farm, analyzing sensor data from a gas pipeline or certifying a food company’s supply chain, DNV enables its customers and their stakeholders to make critical decisions with confidence.

Driven by its purpose, to safeguard life, property, and the environment, DNV helps tackle the challenges and global transformations facing its customers and the world today and is a trusted voice for many of the world’s most successful and forward-thinking companies.

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