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RULES AND REGULATIONS FOR THE CONSTRUCTION AND CLASSIFICATION OF STEEL SHIPS

RULES CHANGE NOTICE NO. 2

December 2024

General Information

This Rules Change Notice gives amendments to the 'Rules and Regulations for the Construction and Classification of Steel Ships'.

These amendments are to be read in conjunction with the requirements given in the July, 2024 edition of the Rules and 'Rules Change Notice No.1 dated September 2024'.

The Part / Chapters where amendments are made and their effective dates are indicated in **TABLE 1**. The actual requirements, arranged in the order of Part / Chapter / Section / Sub-section / Clause, have been given subsequently.

Corrigenda issued with this Rules Change Notice are given in **TABLE 2.**

For ease of reference, the newly added text has been highlighted by underlining and the deleted text by striking through.

RULES AND REGULATIONS FOR THE CONSTRUCTION AND CLASSIFICATION OF STEEL SHIPS – July 2024

RULES CHANGE NOTICE No. 2 – December 2024

TABLE 1 – AMENDMENTS INCORPORATED IN THIS NOTICE

These amendments will come into force as indicated in the Table

Section / Clause	Subject/ Amendments
Part 1 Chapter 1: General *The amendments are applicable from 1 January 2025.*	
Appendix 1	Class Notations **DSA(SEA)** and **DSA(CH)** are added to the list of notations. The requirements for assigning **DSA** notation are better clarified.
The amendments are applicable from 1 July 2025.	
Appendix 1	Additional Class Notation **WELL TESTING VESSEL** is added to the list of notations.
Part 1 Chapter 2: Periodical Surveys	
These amendments are applicable for ships contracted for construction on or after 01 July 2024.	
2/ 1.2.8	Amendments are made to clarify the term 'substantial corrosion' in structural members (except for those structural members designed as per the gross scantlings approach, where earlier requirements apply) for ships contracted for construction on or after 1 July 2024.
The amendments are applicable from 1 January 2025.	
2/ 24.1.2 b) (deleted)	The restriction for vessels under condition improvement/ condition monitoring programme of IRS for assignment of **REMOTE SURVEY** notation, is removed.
Part 2 Chapter 4: Steel Castings *The amendments are applicable to ships contracted for construction on or after 1 January 2025*	
2/ 2.6.2	It is clarified that test blocks may be either attached to the castings, cast integrally, or cast separately
2/ 2.6.3 (new)	Requirements for the preferred test block arrangement are specified.
2/ 2.6.4 (new)	Test block arrangements for castings where mechanical properties need to be demonstrated are specified.
2/ 2.6.5, 2.6.6	Test block requirements for different types of castings are amended.
2/ Fig 2.6.1 & 2.6.2	Illustrative figures are deleted.
Part 3 Chapter 1: General, Definitions, Documentation *This amendment is applicable for ships contracted for construction on or after 01 July 2024.*	
3/ 3.3.2 (new) & 3.4.1	Requirement to indicate both the 'as-built' and 'renewal thickness' for each structural element on structural plans is clarified.
Part 3 Chapter 5: Design Loads *The amendments are applicable to ships contracted for construction on or after 1 January 2025.*	
3/ 3.3.1.2	Amendments are made to clarify that the envelope of permissible still water bending moment and shear force in flooded condition is to be provided for Dry Bulk Cargo Carriers as well as General Dry Cargo Ships of length L≥80[m].

Section / Clause	Subject/ Amendments
Part 3 Chapter 6: Hull Girder Strength *The amendments are applicable to ships contracted for construction on or after 1 January 2025.*	
1/ 1.1.5	The reference to "other than container ships" is deleted, making the clause applicable to all ships with large deck openings. Further, amendments are made to clarify that torsional strength requirements are also to be considered for bending and shear strength calculations in ships with large deck openings.
1/ 1.1.6	It is clarified that longitudinal strength requirements (longitudinal and shear stress due to still water and wave moments) given in Section 2 do not apply to Container Ships, and instead requirements in Part 5, Chapter 5 are to be complied with.
Part 3 Chapter 7: Hull Local Scantlings *The amendments are applicable to ships contracted for construction on or after 1 January 2025.*	
4/ 4.1.3.1	Greater clarity is provided on the area to be considered as 'bilge plating' based on the note introduced at the end of Cl. 4.1.3.1.
4/4.1.3.2	Guidance for determining thickness in bilge plating with multiple strakes is provided.
Part 3 Chapter 8: Finite Element Analysis *The amendments are applicable to ships contracted for construction on or after 1 January 2025.*	
1/ 1.2.1.1, 1.2.1.2, 1.4.1	Editorial amendments are made for better clarity.
2/ 2.1.1 & 2.1.2	Cases when direct strength assessment involving full ship strength analysis may be performed are better clarified.
2/ 2.1.3 (new)	It is specified that when direct strength assessment involving a full ship strength analysis is performed additional class notations will be assigned such as **DSA** or **DSA(SEA)**.
2/ 2.3.1 & 2.3.3	Loads to be applied for **DSA** and **DSA(SEA)** notations are better clarified.
3/ 3.2.7 (new)	Additional class notation **DSA(CH)** is introduced for cargo hold analysis.
Part 3 Chapter 9: Buckling *The amendments are applicable to ships contracted for construction on or after 1 January 2025.*	
1/ 1.2.3	Requirement for enlarged stiffeners used for Permanent Means of Access (PMA) are better clarified.
1/ 1.2.3.2 & 1.2.3.4	Cross-references are updated.
2/ 2.4.1.1	Additional flexibility is introduced by allowing a lower value of yield strength R_{eH} for web plates, provided additional structural criteria are complied with.
Part 3 Chapter 10: Fatigue *The amendments are applicable to ships contracted for construction on or after 1 January 2025.*	
4/ 4.5.5.1	Hot spot stress at inner hull/ hopper sloping plate is specified in addition to inner bottom/ hopper sloping plate for completeness.
Part 3 Chapter 11: Special Hull Requirements *The amendments are applicable to ships contracted for construction on or after 1 January 2025.*	
Section 8 (new)	New section is introduced to provide requirements for steel coil loading.
Part 4 Chapter 4: Prime Movers and Propulsion Shafting Systems *The amendments are applicable to ships contracted for construction on or after 1 July 2025.*	
4/ 4.9.2.9 c)	It is clarified that the air consumption of consumers other than engine starting, that are connected to starting air receivers is to be considered while sizing the total air receiver capacity.

Section / Clause	Subject/ Amendments
Part 4 Chapter 7: Control Engineering *The amendments are applicable to ships contracted for construction on or after 1 January 2025.*	
2/ 2.6.2	Cross-references are provided to the requirements in Part 5, Chapter 22 for better clarity.
2/ 2.6.9 & 2.6.10 (new)	
Part 5 Chapter 4: Liquefied Gas Carriers *The amendments are applicable from 1 July 2025.*	
Introduction/ IR2.1	Amendments are made to allow a list of approved cargoes to be attached to the Class Certificate in lieu of mentioning them as part of Class Notation.
Part 5 Chapter 5: Container Ships *The amendments are applicable to ships contracted for construction on or after 1 January 2025.*	
4/ 4.5.2	Amendments are made to clarify that for container ships, longitudinal warping stresses and warping shear stresses due to torsion are also to be considered for bending and shear strength calculations.
Part 5 Chapter 22: Vessels with Unattended Machinery Spaces *The amendments are applicable to ships contracted for construction on or after 1 January 2025.*	
2/ 2.2.4 & 2.2.11	Amendments are made to align with requirements in SOLAS II-1/ Reg. 49.3 & Reg. 49.1.2.
2/ 2.2.13	A note is added to specify that for attended machinery spaces, the slow turning device for steam turbines may be arranged to be operated manually.
2/ 2.3.7	Design requirements for the bridge control system in non-SOLAS ships are specified.
Part 5 Chapter 41: Well Testing Vessels *The amendments are applicable to ships contracted for construction on or after 1 July 2025.*	
New Chapter	Requirements in this Chapter are applicable to vessels which are arranged and equipped for testing of wells for production of oil and/ or gas.
Part 6 Chapter 3: Suppression of Fire *The amendments are applicable to ships contracted for construction on or after 1 July 2025.*	
3/ IR3.7.2 & IR3.7.5.1 (new)	It is clarified that for determining fire insulation for trunks and ducts which pass through an enclosed space, the term '*pass through'* pertains to the part of the trunk/ duct contiguous to the enclosed space.
5/ IR5.4.1 (new), Fig. 5.4.1 (new)	This Clause provides an interpretation for the term *'crowns'* of machinery spaces as used in SOLAS regulation II-2/11.4.1.
Part 6 Chapter 4: Escape *The amendments are applicable to ships contracted for construction on or after 1 July 2025.*	
2/ IR2.4.1.1 & IR2.4.2.1	Interpretations of vague requirements for means of escape from machinery spaces on passenger and cargo ships as required by SOLAS II-2/ 13.4.1 and 13.4.2 respectively are provided. The term *'safe position'* is better clarified.
Part 6 Chapter 7: Special Requirements *The amendments are applicable to ships contracted for construction on or after 1 January 2025.*	
2/ IR 2.3.4.5	It is clarified that where the IMSBC code requires continuous ventilation or ventilation at all times for certain cargoes, the ventilation openings are to comply with the relevant requirements of Part 3 of the Rules. It is further specified that the requirements for mechanical surface ventilation at all times apply to DIRECT REDUCED IRON (D) (By-product fines with moisture content of at least 2%)

TABLE 2 – CORRIGENDA INCORPORATED IN THIS NOTICE

Section / Clause	**Subject/ Corrigenda**
Part 1 Chapter 1: General	
Appendix I	Cross references for corresponding requirements for **Load Comp (2)**, **CM**, **DWA** notations are corrected.
Part 3 Chapter 1: General, Definitions, Documentation	
1/ 1.5.4	Revision no. of Rec.34 is updated.
Part 3 Chapter 13: Rudders	
4/ 4.2.1	Cross reference corrected.
Part 3 Chapter 17: Hull Inspection, Workmanship and Testing	
3/ Table 3.4.1	Cross reference of Note 8) is corrected.
Part 4 Chapter 1: General Requirements for the Design and Construction of Machinery	
2/ IR2.4.2	Cross reference corrected
Part 4 Chapter 3: Pumping and Piping	
2/ 2.13.1	Cross reference corrected
3/ 3.2.16	Cross reference corrected
3/ 3.5	Cross reference corrected
4/ 4.2.1, 4.4.13	Cross reference corrected
Part 4 Chapter 6: Steering Gear	
1/ 1.7.1, 1.7.5, 1.7.7	Cross reference corrected
Part 4 Chapter 7: Control Engineering	
2/ 2.7.6	Cross reference corrected
Part 4 Chapter 8: Electrical Installations	
10/ 10.2.4	Cross reference corrected

Part 1

Regulations

Chapter 1

General

Appendix 1
Table of characters of class and type notations of IRS, their expanded form and significance

Abbreviation	Expanded Form	Significance
Load Comp (2)	LOADING COMPUTER (2)	Denotes that in addition to the requirements for Load Comp (1) mentioned above, the ship's loading computer is capable of performing intact stability calculations for any loading condition to verify compliance with the applicable requirements indicated in ~~Pt.3, Ch.1~~Part 3, Chapter 4 of the Rules
DWA		This notation will be assigned to ships complying with the requirements of ~~Pt.3, Ch.15, Sec.8~~Part 3, Chapter 14, Section 8 for anchoring in deep and unsheltered waters.
CM	CONSTRUCTION MONITORING	This additional class notation will be assigned to ships, whose quality of construction is closely monitored by IRS in accordance with the relevant requirements of Part 3, Chapter 17 ~~Pt. 3, Ch. 18~~.

Ship Type Notation	Significance
WELL TESTING VESSEL	This notation will be assigned to well testing vessels constructed in accordance with the applicable requirements of Part 5, Chapter 41.

Class Notation : General		
Abbreviation	**Expanded Form**	**Significance**
DSA	DIRECT STRENGTH ASSESSMENT	~~The additional class notation DSA will be assigned to vessels where a direct strength assessment has been carried out in accordance with the 'Guidelines on Application of Direct Seakeeping Loads in Structural Analysis of Ships' and the 'Guidelines on Structural Assessment of Ships based on Finite Element Method'.~~ These additional class notations will be assigned to ships where a full ship strength analysis using finite element method has been carried out in accordance with the relevant requirements of Part 3 Chapter 8 of the Rules. For **DSA** notation, loads are to be in accordance with the relevant requirements of Part 3, Chapter 8. For **DSA(SEA)** notation, loads are to be obtained from hydrodynamic seakeeping analysis.
DSA(SEA)	DIRECT STRENGTH ASSESSMENT (SEAKEEPING LOADS)	
DSA(CH)	DIRECT STRENGTH ASSESSMENT (CARGO HOLD)	This additional class notation will be assigned to ships where a cargo hold analysis using finite element method has been carried out in accordance with the relevant requirements of Part 3 Chapter 8 of the Rules. This notation is mandatory for ships with length ≥ 150[m] and having cargo hold or cargo tank arrangements.

End of Chapter

Part 1

Regulations

Chapter 2

Periodical Surveys

Section 1

General Requirements

1.2 Definitions

1.2.8 **Substantial corrosion** is an extent of corrosion such that assessment of corrosion pattern indicates a wastage in excess of 75 per cent of allowable margins, but within acceptable limits.

For vessels contracted for construction on or after 1 July 2024, except for structural members designed as per the gross scantlings approach as indicated in Part 3, Chapter 2, Section 4.3.1 built under the IACS Common Structural Rules, substantial corrosion is an extent of corrosion such that the assessment of the corrosion pattern indicates a gauged (or measured) thickness between t_{ren} + 0.5 [mm] and t_{ren}.

't_{ren}' is the renewal thickness, which is defined as the minimum allowable thickness [mm], below which renewal of structural members is to be carried out.

Section 24

Remote Surveys

24.1 Application

24.1.1 This Section indicates requirements to be complied with for satisfactory conduct of remote surveys.

Remote Survey Notation

24.1.2 The additional class notation **REMOTE SURVEY** will be assigned to ships considered capable by IRS, for carrying out classification surveys remotely, subject to the following:

a) provided with suitable equipment/ hardware/ software that are acceptable to IRS

b) vessel not under condition improvement/ condition monitoring programme of IRS

c)b) procedures available for training and familiarity of on-board personnel/ crew in use of equipment/ hardware/ software

d)c) satisfactory completion of sample remote survey(s)

End of Chapter

Part 2

Inspection and Testing of Materials

Chapter 4

Steel Castings

Section 2

Hull and Machinery Steel Castings for General Applications

2.6 Mechanical tests

2.6.2 At least one test block is to be provided for each casting or batch of castings. Unless otherwise agreed these test blocks are to be either attached to the castings, cast integrally on the castings or cast separately. integrally cast or gated to the castings.

2.6.3 The preferred test block arrangement, where practical, is for the manufacturer to provide at least one 30 [mm] test block either attached to the castings or cast integrally on the castings[1].

Note 1: The test results represent the material from which the castings have been poured and the subsequent heat treatment process and may not necessarily represent the properties of the castings. These properties can be affected by solidification conditions and the rate of cooling during heat treatment, which are in turn influenced by casting thickness, size, complexity and shape. The purpose of the test block is to provide a qualitative check to demonstrate the effective control of existing heat treatment processes and procedures.

2.6.4 For castings where it is required that the mechanical properties need to be demonstrated for specific section thicknesses and when agreed upon between the manufacturer and the purchaser, then proposals[2] for alternative test block arrangements (in terms of size and type) are to be submitted to IRS for approval.

Note 2: The size of the test blocks for mechanical testing may be determined by the ruling section of the casting that they are representative of the casting's heat treatment and microstructure. ISO 4885,2018; ISO683-1:2016 and ISO 683-2: 2016 may also be referred. Alternatively, determination of test block size and type may be supported by historical and statistical test data, production of a representative test block or a component, simulation software, or a combination of all these items.

The size of the test blocks for mechanical testing is to be such that the heat treatment and microstructure is representative for the section of the casting with the ruling section, i.e. the section for which the specified mechanical properties apply, (see also ISO 683-1:2018 and ISO 683-2:2018).

For C, C-Mn steel castings this is in general to be achieved as follows:

The test block is to have a thickness (t_S) of not less than the ruling section of the casting, or 30 mm, whichever is larger.

For large thickness castings other than stern tube, stern frame, anchor and rudder horn, t_S normally need not exceed 150 mm. Length and width of the test block is normally to be at least three times t_S, unless otherwise agreed with IRS, as shown in Fig. 2.6.1 (Note that longer or wider test blocks may be necessary to accommodate the required test specimens).

For castings for stern tube, stern frame, anchor and rudder horn the test block thickness t_S is to represent the ruling section.

Guidance:

Shorter width or length may be accepted for test blocks where actual casting width or length (t_A) is in the range between t_S and $3t_S$.

~~Example 1: For a general casting with dimensions 140 x 160 x 1250 mm the required test block size would typically be 140 x 160 x 420 mm (that is: t_S x t_A x $3t_S$).~~

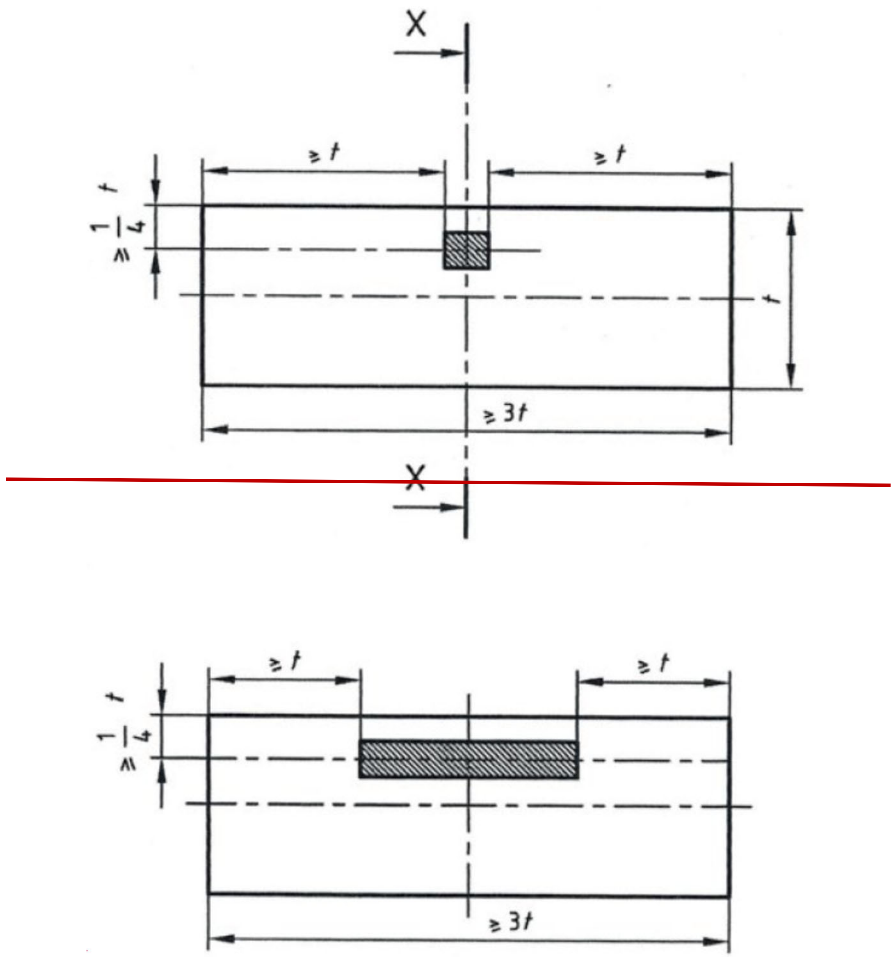
~~Example 2: For a stern tube casting with ruling section t_S = 170 mm and width/height/length $t_{A2}/t_{A1}/t_{A3}$ = 1000/600/1800 mm, the required test block size would typically be 170 x 510 x 510 mm (i.e. t_S x $3t_S$ x $3t_S$) see Fig. 2.6.2.~~

~~For alloy steel castings, the manufacturer is to propose dimensions for the test block and demonstrate the representative nature of it.~~

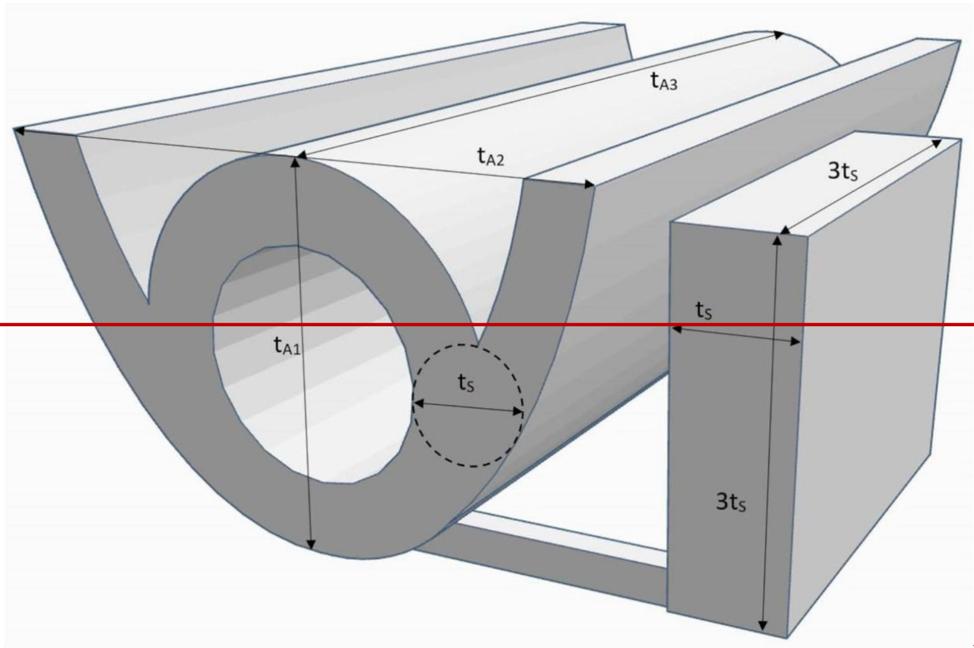
~~2.6.4 For test blocks with thickness ≤ 56 mm, the longitudinal axis of the test specimens is to be located at ≥ 14 mm from the surface in the thickness direction. For test blocks with thickness > 56 mm, the longitudinal axis of the test specimens is to be located at ≥ ¼ t_S from the surface. Test specimens are to be taken in such a way that no part of the gauge length is machined from material closer than t_S to any of the other surfaces. For impact testing, this requirement applies to the complete test specimen (refer Fig. 2.6.1 for location of test specimens in relation to the test block).~~

2.6.5 Where the casting is of complex design or where the finished mass exceeds 10 tonnes, two cast on test blocks are to be provided~~ from the heaviest section~~, located as far as practicable from each other.

2.6.6 Where large castings are made from two or more casts, which are not mixed in a ladle prior to pouring, two or more test blocks are to be provided corresponding, the number of the casts involved. These are to be attached to the casting or cast integrally on the castings ~~integrally cast~~ at locations as widely separated as possible.



~~**Fig. 2.6.1: Specimen positions relative to the test block in accordance with ISO 4990:2015***~~



~~**Fig. 2.6.2: Example 2: test block gated to stern tube casting**~~

2.7 Mechanical properties

2.7.3 The mechanical properties are to comply with the requirements[3] of Table 2.7.1 and Table 2.7.2, respectively, appropriate to the specified minimum tensile strength or, where applicable, the requirements of the approved specification.

Note 3: See 2.6.3 and 2.6.4

End of Chapter

Part 3

General Hull Requirements

Chapter 1

General, Definitions, Documentation

Section 1

General

1.5 Design Basis

1.5.4 Environmental conditions

1.5.4.1 The requirements are based on wave induced loads covering the worst anticipated wave environment and related long-term sea state spectrum. The minimum environmental conditions to be used in the rules for unrestricted service are the North Atlantic wave environment according to IACS Rec.34, Rev.1 standard wave data.

Section 3

Documentation

3.3 Plans for Approval

3.3.2 The structural plans are to indicate both the as-built and the renewal thickness for each structural element, as indicated in Part 1, Chapter 2, Cl.1.2.8. For structural members designed as per the gross scantling approach (see Part 3, Chapter 2, Section 4.3.1), renewal thickness need not be indicated on the plans.

If any voluntary addition thickness, (as defined in Chapter 4, Section 2), is included in the as-built thickness, this is to be clearly indicated on the plans.

3.4 Plans to be kept on board

3.4.1 A set of as built construction drawings (indicating for each structural element, both the as-built and renewal thickness as indicated in Part 1, Chapter 2, Cl.1.2.8) and other plans showing any subsequent structural alterations are to be kept on board. For structural members designed as per the gross scantling approach (see Part 3, Chapter 2, Section 4.3.1), renewal thickness need not be indicated on the plans. The set of plans are to include the following:

(a) Main plan includes:

- (i) General arrangement
- (ii) Capacity plan
- (iii) Hydrostatic curves
- (iv) Loading manual, where required

(b) Structural plans include:

- (i) Midship section
- (ii) Scantling profile
- (iii) Decks
- (iv) Shell expansion
- (v) Transverse bulkheads
- (vi) Rudder and rudder stock
- (vii) Cargo hatch covers, when applicable

(c) Bilge ballast and cargo piping diagrams.

An additional set of such drawings are to be kept ashore by the company responsible for the operation of the ship.

End of Chapter

Part 3

General Hull Requirements

Chapter 5

Design Loads

Section 3

Hull girder loads

3.3 Still water hull girder loads **3.3.1 General** 3.3.1.2 Flooded condition	The designer is to provide the envelope of permissible still water bending moment and shear force in flooded condition as required in Part 5, Chapter 1 (Dry Bulk Cargo Carriers). The above information is also to be provided for General Dry Cargo ships of length L≥80[m].

End of Chapter

Part 3

General Hull Requirements

Chapter 6

Hull Girder Strength

Section 1

Strength characteristics of hull girder transverse sections

1.1 Application

1.1.5 For ships with large deck openings (Refer Cl.1.3.2), other than container ships the combined effects of hull girder bending and torsion related possible local bending and shear stresses may have to be specially considered as given in Cl.3.3.1.

The longitudinal warping stress (σ_{st}, σ_{wt-LC}) and warping shear stresses (τ_{st}, τ_{wt-LC}) induced by still water and wave hull girder torsion as specified in Cl.3.3, are also to be considered for bending and shear strength calculations.

Refer to IRS Guidelines "*Assessment of Hull Girder Stresses due to Torsion in Ships with large deck openings*" for further details of the calculations.

1.1.6 Longitudinal strength requirements (longitudinal and shear stress due to still water and wave moments) given in this sSection 2 do not apply to Container Ships. Requirements given in Part 5, Chapter 5, Section 4 are applicable to container ships.

End of Chapter

Part 3

General Hull Requirements

Chapter 7

Hull Local Scantlings

Section 4

Plating

4.1.3 Bilge plating

4.1.3.1 The thickness of plating in bilge area as defined below (Refer Note) ~~in Chapter 1, Section 2, Cl.2.6.6~~ is to be equal or greater than the lesser of Section 3, Cl.4.1.1.1~~3.1.1~~ and Cl.4.1.3.3, and also to satisfy Cl.4.1.3.2.

Note: The bilge plating area is the curved plating between the bottom shell and side shell. It is to be taken as follows:

- Within the cylindrical/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 cylindrical/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.

4.1.3.2 The net thickness of transversely stiffened bilge plating is not to be taken less than the ~~offered~~ net required thickness for the adjacent bottom shell or adjacent side shell plating, by Chapter 7 and Chapter 9, Section 2 and Section 3, whichever is greater.

When bilge plating is divided into two or more strakes, in accordance with this requirement, the net thicknesses of lower and upper strakes are to be determined in comparison with the net required thicknesses of adjacent bottom shell plating and side shell plating respectively.

End of Chapter

Part 3

General Hull Requirements

Chapter 8

Finite Element Analysis

Contents

Section

Section 1

General

1.2 Types of FE analysis

1.2.1 Rule covers the following types of FE analyses:

1.2.1.1 Direct strength assessment involving Ffull ship strength analysis for assessing the hull girder strength and scantlings and to provide the correct boundary conditions to partial ship structural models or to local FE models, wherever applicable.

1.2.1.2 Direct strength assessment involving Ccargo hold analysis for assessing the strength of longitudinal hull girder structural members, primary supporting structural members and bulkheads.

1.4 Net scantling approach

1.4.1 FE models for ~~full ship strength analysis, cargo hold analysis~~ direct strength assessment, local fine mesh analysis and very fine mesh analysis, are to be based on the net scantling approach, as defined in Chapter 2, Section 4, Table 4.6.2.

Section 2

Direct Strength Assessment - Full Ship Strength Analysis

2.1 Scope

2.1.1 The purpose of the direct strength assessment involving a full ship strength analysis is to evaluate the overall hull girder stiffness and to assess the global stresses and deformations of primary hull members.

2.1.2 Direct strength assessment involving Ffull ship strength analysis covers the whole ship and ~~is~~may be performed when the structural response of the hull girder cannot otherwise be sufficiently determined by prescriptive calculations, or it may be undertaken voluntarily. ~~for~~ This assessment may be applied in situations such as :

~~2.1.2.5 For specific class notation **FST** (Full Ship Strength Analysis)~~

2.1.3 When direct strength assessment involving a full ship strength analysis is performed following additional class notations will be assigned:

a) **DSA**

b) **DSA(SEA)**

2.1.43 According to the hull shape and ship type notation, the full ship strength analysis is to be performed to assess and verify compliance with the criteria as specified in Section 2.4. Additional requirements for specific ship types are given in Part 5.

2.3 Loading conditions

2.3.1 For **DSA** notation prescriptive rule loads are to be used. For **DSA(SEA)** notation the Lloads ~~for full ship strength analysis~~ are to be determined by sea-keeping analysis/ direct hydrodynamic calculations.

2.3.3 For **DSA(SEA)** notation, Lload application is to be performed as described in IRS Guidelines on *Application of Direct Seakeeping Loads in Structural Analysis of Ships*.

Section 3

Direct Strength Assessment - Cargo Hold Analysis

3.1 General

3.1.1 Definitions

3.1.1.1 Cargo hold analysis: For ships with cargo hold or cargo tank arrangement, the analysis performed to assess the strength of longitudinal hull girder structural members, primary supporting structural members and bulkheads.

3.2 Application

3.2.7 When direct strength assessment involving a cargo hold analysis is performed an additional class notation **DSA(CH)** will be assigned.

End of Chapter

Part 3

General Hull Requirements

Chapter 9

Buckling

Section 1

General

1.2 Application

1.2.3 Enlarged stiffeners:

~~Enlarged stiffeners, with or without web stiffening, used in platforms for Permanent Means of Access (PMA) are to be considered as primary supporting members (PSM) and are to comply with the following requirements:~~ Enlarged stiffeners used for Permanent Means of Access (PMA), whose net web height are above 700[mm], and net offered section modulus are 3 times greater than the smaller one of adjacent surrounding stiffeners not used for PMA, are to comply with the following requirements:

1.2.3.2 Buckling strength for prescriptive requirements is as follows:

- For enlarged stiffener webs, Refer to Section 3, ~~Cl.3.2~~Cl.3.3.2.

- For web stiffeners fitted on enlarged stiffeners, Refer to Section 3, ~~Cl.3.1~~Cl.3.3.1 and Section 3, ~~Cl.3.3~~Cl.3.3.3.

1.2.3.4 Buckling strength of longitudinal PMA platforms without stiffeners fitted on enlarged stiffener web is to be checked using the criteria for local supporting members in Section 3, ~~Cl.3.1~~Cl.3.3.1 and Section 3, ~~Cl. 3.3~~Cl.3.3.3.

Section 2

Slenderness Requirements

2.4 Primary Supporting Members

2.4.1 Proportions and stiffness

2.4.1.1 Proportions of web plate and flange

The net thicknesses of the web plates and flanges of primary supporting members are to satisfy the following criteria:

(i) Web Plate

$$t_w \geq \frac{s_w}{C_w}\sqrt{\frac{R_{eH}}{235}}$$

(ii) Flange

$$t_f \geq \frac{b_{f-out}}{C_f}\sqrt{\frac{R_{eH}}{235}}$$

where,

s_w = Plate breadth, in [mm], taken as the spacing of the web stiffeners. (See web-plate idealisation also)

C_w = Slenderness coefficient for the web plate taken as:
= 125 for double-skin construction
= 100 elsewhere
C_f = Slenderness coefficient for the flange taken as 12

R_{eH} = Specified minimum yield stress of the plate material, in [N/mm^2].

For the web plates, a lower R_{eH} may be used in this slenderness criterion provided the requirements specified in Section 3 and Section 4, if applicable, are satisfied for the structure assumed in the same lower R_{eH}.

End of Chapter

Part 3

General Hull Requirements

Chapter 10

Fatigue

Section 4

Finite Element Stress Analysis

4.5.5 Hot spot stress for bent hopper knuckle details

4.5.5.1 The hot spot stress at the inner bottom/hopper sloping plate and inner hull/hopper sloping plate in transverse, vertical and longitudinal directions of a bent hopper knuckle is to be taken as the surface principal stress read out from a point shifted away from the intersection line between the considered member and abutting member by the weld leg length.

The procedure for calculation of hot spot stress at flange such as inner bottom /hopper sloping plate and inner hull/hopper sloping plate is the same that for web-stiffened cruciform joints as described in Cl.4.6.2.2. The procedure that applies for hot spots on the ballast tank side of the inner bottom/hopper plate and inner hull/hopper sloping plate in way of a bent hopper knuckle is in principle the same as that applied on the cargo tank side of the inner bottom plate for welded knuckle in Figure 4.6.2.1 and Figure 4.6.2.2. The intersection line is taken at the mid thickness of the joint assuming median alignment. The plate angle correction factor and the reduction of bending stress as applied for a web-stiffened cruciform joint in Cl.4.6.2.3 are not to be applied for the bent hopper knuckle type.

4.5.5.2 The stress at hot spots located in way of the web (such as transverse web, side stringer and side girder) of a bent hopper knuckle type is to be derived as described for web-stiffened cruciform joints in Cl.4.6.3.

End of Chapter

Part 3

General Hull Requirements

Chapter 11

Special Hull Requirements

Contents

Section

Section 8

Steel Coil Loading

Symbols

For symbols not defined in this section, Refer to Chapter 1, Section 2.

d_{sc} = Diameter in [m], of a steel coil.

l_{st} = Length in [m], of a steel coil.

M_{sc-ib} = Equivalent mass of a steel coil in [t], on inner bottom, as defined in Cl.8.3.1.

M_{sc-hs} = Equivalent mass of a steel coil in [t], on hopper side, as defined in Cl.8.3.2.

n_1 = Number of tiers of steel coil.

n_2 = Number of load points per EPP of the inner bottom, Refer Cl.8.1.3.

n_3 = Number of dunnages supporting one row of steel coils.

W = Mass in [t] of a steel coil.

8.1 General

8.1.1 Application

8.1.1.1 Steel coil requirements specified in this section are applicable to all ships loaded by steel coils on wooden dunnage. For Bulk carriers (with CSR notation) refer to IRS *Rules for Bulk Carriers and Oil Tankers* instead of this section.

8.1.1.2 A typical example of the standard means of securing steel coils loaded on wooden dunnage is given in Figure 8.1.1. It is assumed that all the steel coils have the same characteristics. In cases where steel coils are lined up in two or more tiers, formulae in Cl.8.1.3 and Cl.8.2 can be applied by assuming that only the lowest tier of steel coils is in contact with hopper sloping plate or inner side plate. In other cases, scantling requirements are to be determined on a case-by-case basis.

8.1.1.3 The details of steel coil loads in cargo holds are indicated in Section 8.2 while the requirements related to hull local scantlings are detailed in Section 8.5.

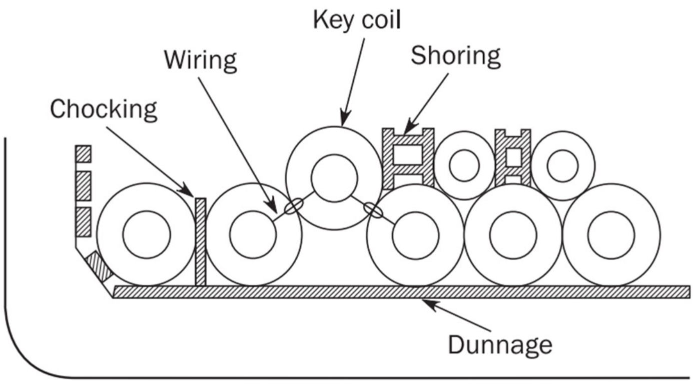


Figure 8.1.1: Inner bottom loaded by steel coils

8.1.2 Arrangement of steel coil loads on the inner bottom

The two following arrangements of steel coils on the inner bottom are considered:

- The steel coils are positioned independent of the location of the inner bottom floors, as shown in Figure 8.1.2.1. In this case, n_2 and l_{lp} are given in Tables 8.1.1 and 8.1.2.
- The steel coils are positioned with respect to the location of the inner bottom floors, as shown in Figure 8.1.2.2.

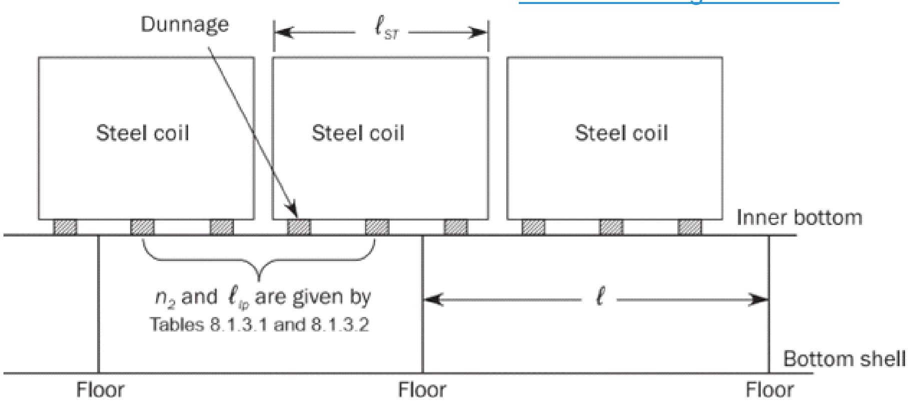


Figure 8.1.2.1: Steel coils loaded independently of inner bottom floors locations

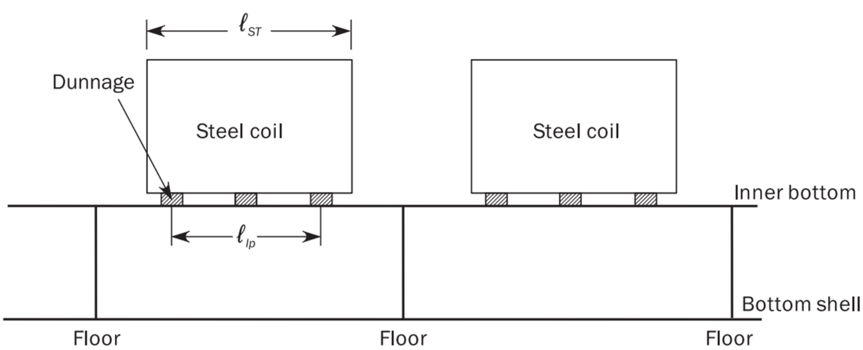


Figure 8.1.2.2: Steel coils loaded between inner bottom floors

8.1.3 Arrangement of steel coil loads independently of the floor locations

For steel coils loaded independent of the location of floors in the inner bottom. (Refer Figure 8.1.2.1).

- The number n_2 of load point dunnage's per elementary plate panels (EPP's) is to be taken from Table 8.1.3.1.
- The distance l_{lp}, in [m], between the outermost load point dunnages per elementary plate panel is to be taken from Table 8.1.3.2.

Table 8.1.3.1: Number n_2 of load point dunnages per elementary plate panel

n_2 (1),(2)	n_3 (3)				
	2	3	4	5	6
1	$0 < \frac{l}{l_{st}} \leq 0.50$	$0 < \frac{l}{l_{st}} \leq 0.33$	$0 < \frac{l}{l_{st}} \leq 0.25$	$0 < \frac{l}{l_{st}} \leq 0.20$	$0 < \frac{l}{l_{st}} \leq 0.17$
2	$0.50 < \frac{l}{l_{st}} \leq 1.20$	$0.33 < \frac{l}{l_{st}} \leq 0.67$	$0.25 < \frac{l}{l_{st}} \leq 0.50$	$0.20 < \frac{l}{l_{st}} \leq 0.40$	$0.17 < \frac{l}{l_{st}} \leq 0.33$
3	$1.20 < \frac{l}{l_{st}} \leq 1.70$	$0.67 < \frac{l}{l_{st}} \leq 1.20$	$0.50 < \frac{l}{l_{st}} \leq 0.75$	$0.40 < \frac{l}{l_{st}} \leq 0.60$	$0.33 < \frac{l}{l_{st}} \leq 0.50$
4	$1.70 < \frac{l}{l_{st}} \leq 2.40$	$1.20 < \frac{l}{l_{st}} \leq 1.53$	$0.75 < \frac{l}{l_{st}} \leq 1.20$	$0.60 < \frac{l}{l_{st}} \leq 0.80$	$0.50 < \frac{l}{l_{st}} \leq 0.67$
5	$2.40 < \frac{l}{l_{st}} \leq 2.90$	$1.53 < \frac{l}{l_{st}} \leq 1.87$	$1.20 < \frac{l}{l_{st}} \leq 1.45$	$0.80 < \frac{l}{l_{st}} \leq 1.20$	$0.67 < \frac{l}{l_{st}} \leq 0.83$
6	$2.90 < \frac{l}{l_{st}} \leq 3.60$	$1.87 < \frac{l}{l_{st}} \leq 2.40$	$1.45 < \frac{l}{l_{st}} \leq 1.70$	$1.20 < \frac{l}{l_{st}} \leq 1.40$	$0.83 < \frac{l}{l_{st}} \leq 1.20$
7	$3.60 < \frac{l}{l_{st}} \leq 4.10$	$2.40 < \frac{l}{l_{st}} \leq 2.73$	$1.70 < \frac{l}{l_{st}} \leq 1.95$	$1.40 < \frac{l}{l_{st}} \leq 1.60$	$1.20 < \frac{l}{l_{st}} \leq 1.37$
8	$4.10 < \frac{l}{l_{st}} \leq 4.80$	$2.73 < \frac{l}{l_{st}} \leq 3.07$	$1.95 < \frac{l}{l_{st}} \leq 2.40$	$1.60 < \frac{l}{l_{st}} \leq 1.80$	$1.37 < \frac{l}{l_{st}} \leq 1.53$
9	$4.80 < \frac{l}{l_{st}} \leq 5.30$	$3.07 < \frac{l}{l_{st}} \leq 3.60$	$2.40 < \frac{l}{l_{st}} \leq 2.65$	$1.80 < \frac{l}{l_{st}} \leq 2.00$	$1.53 < \frac{l}{l_{st}} \leq 1.70$
10	$5.30 < \frac{l}{l_{st}} \leq 6.00$	$3.60 < \frac{l}{l_{st}} \leq 3.93$	$2.65 < \frac{l}{l_{st}} \leq 2.90$	$2.00 < \frac{l}{l_{st}} \leq 2.40$	$1.70 < \frac{l}{l_{st}} \leq 1.87$

Note (1): In case l/l_{st} is greater than the value given in Table 8.1.3.1, n_2 is to be considered as greater than 10.

Note (2): For plating, n_2 is to be based on l. For stiffener, n_2 is to be derived with l replaced by l_{bdg}.

Note (3): The number of dunnages, n_3, considered at the design stage is to reflect the intended operation conditions. Unusual arrangements with 5 or more dunnages per row of steel coil need to be carefully considered by the designer and ship owner.

Table 8.1.3.2: Distance between outermost load point dunnages per EPP, l_{lp}, in [m]					
n_2 (1)	n_3				
	2	3	4	5	6
1	Actual breadth of dunnages				
2	$0.50\ l_{st}$	$0.33\ l_{st}$	$0.25\ l_{st}$	$0.20\ l_{st}$	$0.17\ l_{st}$
3	$1.20\ l_{st}$	$0.67\ l_{st}$	$0.50\ l_{st}$	$0.40\ l_{st}$	$0.33\ l_{st}$
4	$1.70\ l_{st}$	$1.20\ l_{st}$	$0.75\ l_{st}$	$0.60\ l_{st}$	$0.50\ l_{st}$
5	$2.40\ l_{st}$	$1.53\ l_{st}$	$1.20\ l_{st}$	$0.80\ l_{st}$	$0.67\ l_{st}$
6	$2.90\ l_{st}$	$1.87\ l_{st}$	$1.45\ l_{st}$	$1.20\ l_{st}$	$0.83\ l_{st}$
7	$3.60\ l_{st}$	$2.40\ l_{st}$	$1.70\ l_{st}$	$1.40\ l_{st}$	$1.20\ l_{st}$
8	$4.10\ l_{st}$	$2.73\ l_{st}$	$1.95\ l_{st}$	$1.60\ l_{st}$	$1.37\ l_{st}$
9	$4.80\ l_{st}$	$3.07\ l_{st}$	$2.40\ l_{st}$	$1.80\ l_{st}$	$1.53\ l_{st}$
10	$5.30\ l_{st}$	$3.60\ l_{st}$	$2.65\ l_{st}$	$2.00\ l_{st}$	$1.70\ l_{st}$
Note (1): When $n_2 > 10$, l_{lp} is to be taken equal to l.					

8.1.4 Arrangement of steel coils between floors

For steel coils loaded with respect to the locations of floors. (Refer Figure 8.1.2.2).

- The number n_2 of load point dunnages per EPP is to be $n_2 = n_3$
- The distance l_{lp}, in [m], between the outermost load point dunnages per EPP is to be taken equal to the distance between the outermost dunnage supporting one row of steel coils.

8.1.5 Centre of gravity of steel coil cargo

8.1.5.1 The centre of gravity of the steel coil cargo of the considered cargo hold is to be taken at the following position:

a) Longitudinal position

x_{Gsc} is the x-coordinate, in [m], of the volumetric centre of gravity of the considered cargo hold with respect to the reference coordinate system defined in Chapter 1, Section 2.5.

b) Transverse position

$$y_{Gsc} = \frac{\epsilon B_H}{4}$$

c) Vertical position

$$z_{Gsc} = h_{DB} + \left[1 + (n_1 - 1)\frac{\sqrt{3}}{2}\right]\frac{d_{sc}}{2}$$

where,

ϵ = Coefficient to be taken as:

$\epsilon = 1$ when a port side structural member is assessed

$\epsilon = -1$ when a starboard side structural member is assessed

8.2 Total loads

8.2.1 Total load on the inner bottom

8.2.1.1 The total load F_{sc-ib}, in [kN], due to steel coil cargoes on the inner bottom is to be taken as:

$$F_{sc-ib} = \cos(C_{XG}\theta)\cos(C_{YG}\emptyset)\,F_{sc-ib-s} + F_{sc-ib-d}$$

but not less than 0.

where,

$F_{sc-ib-s}$ = Static load, in [kN], on the inner bottom, given in Cl.8.3.1.

$F_{sc-ib-d}$ = Dynamic load, in [kN], on the inner bottom, given in Cl.8.4.2.

C_{XG}, C_{YG} = Load combination factors, as defined in Chapter 5, Section 2, Cl.2.2.

8.2.1.2 For ships with length L< 90 [m], F_{sc-hs} is to be taken as the maximum of F_{sc-ib_1} and F_{sc-ib_2} but not less than 0.

where,

$$F_{sc-ib\_1} = \cos(\theta)\ F_{sc-ib-s} + F_{sc-ib-d\_1}$$
$$F_{sc-ib\_2} = \cos(\emptyset)\ F_{sc-ib-s} + F_{sc-ib-d\_2}$$

8.2.2 Total load on the hopper side and the inner hull

8.2.2.1 The total load F_{sc-ib}, in [kN], due to steel coil cargoes on the hopper side and the inner hull is to be taken as:

$$F_{sc-hs} = \frac{\cos(\theta_h + \epsilon C_{YG}\emptyset)\cos(C_{XG}\theta)}{\cos\theta_h} F_{sc-hs-s} + F_{sc-hs-d}.$$

but not less than 0.

where,

$F_{sc-hs-s}$ = Static load, in [kN], on the hopper side and the inner hull, given in Cl.8.3.2.

$F_{sc-hs-d}$ = Dynamic load, in [kN], on the hopper side and the inner hull, given in Cl.8.4.3.

C_{XG}, C_{YG} = Load combination factors, as defined in Chapter 5, Section 2, Cl.2.2.

8.2.2.2 For ships with length L< 90 [m], F_{sc-hs} is to be taken as the maximum of F_{sc-hs_i} (where subscript 'i' varies from 1 to 6) but not less than 0. $F_{sc-hs-d\_i}$ is to be evaluated for the six load combinations as detailed in Cl.8.4.3 and Table 8.4.3.1.

$$F_{sc-hs\_i} = \frac{\cos(\theta_h + \epsilon\,\emptyset)}{\cos\theta_h} F_{sc-hs-s} + F_{sc-hs-d\_i}$$

where,

$F_{sc-hs-d-i}$= Dynamic load on the hopper side and the inner hull due to steel coils for the 'i'-th load combination evaluated as per Section 8.4.3 using the load combination factors C_{YR_i} , C_{YS_i} as given in Table 8.4.3.1.

8.3 Static loads

8.3.1 Static load on the inner bottom

8.3.1.1 The total load $F_{sc-ib-s}$, in [kN], on the inner bottom due to steel coils is to be taken as:

$$F_{sc-ib-s} = M_{sc-ib} . g$$

where,

M_{sc-ib} = Equivalent mass of steel coils, in [t], to be taken as:

$M_{sc-ib} = K_s W \frac{n_1 n_2}{n_3}$ for $n_2 \le 10$

$M_{sc-ib} = K_s W\, n_1 \frac{l}{l_{st}}$ for $n_2 > 10$, for plating

$M_{sc-ib} = K_s W\ n_1 \frac{l_{bdg}}{l_{st}}$ for $n_2 > 10$, for stiffeners

where,

K_s = Coefficient to be taken as:

$K_s = 1.4$ when steel coils are lined up in one tier with a key coil.

$K_s = 1.0$ in other cases.

8.3.2 Static load on the hopper side

8.3.2.1 The total load $F_{sc-hs-s}$, in [kN], on the hopper side due to steel coils is to be taken as:

$$F_{sc-hs-s} = \cos\theta_h\, M_{sc-hs} . g$$

where,

M_{sc-hs} = Equivalent mass of steel coils, in [t], to be taken as:

$M_{sc-hs} = C_k W \frac{n_2}{n_3}$ for $n_2 \le 10$

$M_{sc-hs} = C_k W \frac{l}{l_{st}}$ for $n_2 > 10$, for plating

$M_{sc-hs} = C_k W \frac{l_{bdg}}{l_{st}}$ for $n_2 > 10$, for stiffeners

where,

C_k = Coefficient to be taken as:

$C_k = 3.2$ when steel coils are lined up two or more tiers, or when steel coils are lined up one tier and key coil is located second or 3rd from hopper sloping plate or inner hull plate.

$C_k = 2.0$ in other cases.

8.4 Dynamic loads

8.4.1 Tangential roll acceleration

8.4.1.1 The tangential roll acceleration a_R, in m/s[2], is to be taken as:

$$a_R = \emptyset \frac{\pi}{180}\left(\frac{2\pi}{T_r}\right)^2 \sqrt{y_{Gsc}^2 + (R - z_{Gsc})^2}$$

where,

y_{Gsc} = Y co-ordinate, in [m], of the centre of gravity of the steel coil cargo of the considered cargo hold, given in Cl.8.1.5.1.

z_{Gsc} = Z co-ordinate, in [m], of the centre of gravity of the steel coil cargo of the considered cargo hold, given in Cl.8.1.5.1.

8.4.2 Dynamic load on the inner bottom

8.4.2.1 The dynamic load $F_{sc-ib-d}$, in [kN], on the inner bottom due to steel coils is to be taken as:

$$F_{sc-ib-d} = M_{sc-ib}\, a_z$$

where,

a_z = Vertical acceleration, in [m/s[2]], calculated at the centre of gravity of the steel coil cargo of the considered cargo hold, given in Cl.8.1.5.1.

8.4.2.2 For ships with L< 90[m],

$$F_{sc-ib-d\_1} = M_{sc-ib}\,(0.5a_{heave} + a_{pitch\_z})$$
$$F_{sc-ib-d\_2} = M_{sc-ib}\,(a_{heave} + a_{roll\_z})$$

where,

a_{heave} = heave acceleration as given in Chapter 5, Section 2, Cl.2.2.3.3.

a_{pitch_z} = Vertical acceleration due to pitch as given in Chapter 5, Section 2, Cl.2.2.3.3.

a_{roll_z} = Vertical acceleration due to roll as given in Chapter 5, Section 2, Cl.2.2.3.3.

8.4.3 Dynamic load on the hopper side and the inner hull

8.4.3.1 The dynamic load $F_{sc-hs-d}$, in [kN], on the hopper side and the inner hull due to steel coils is to be taken as:

$$F_{sc-hs-d} = \epsilon\, M_{sc-hs}\left[C_{YR}\, a_R \sin\left(\tan^{-1}\left|\frac{y_{Gsc}}{R - z_{Gsc}}\right| - \theta_h\right) - C_{YS}\, a_{sway} \sin\theta_h\right]$$

where,

C_{YR} , C_{YS} = Load combination factors, defined in Chapter 5, Section 2, Cl.2.4.2.

ϵ = Coefficient defined in Cl.8.1.5.1.

a_{sway} = Sway acceleration, in [m/s[2]], as defined in Chapter 5, Section 2, Cl.2.1.3.2.

a_R = Tangential acceleration, in [m/s[2]], as defined in Cl.8.4.1

y_{Gsc} = Y co-ordinate, in [m], of the centre of gravity of the steel coil cargo of the considered cargo hold, given in Cl.8.1.5.1.

z_{Gsc} = Z co-ordinate, in [m], of the centre of gravity of the steel coil cargo of the considered cargo hold, given in Cl.8.1.5.1.

8.4.3.2 For ships with length L< 90 [m], $F_{sc-hs-d\_i}$ for each of the six load combinations (subscript 'i' varies from 1-6) are to be evaluated using the formulation below with corresponding values of C_{YR-i} , C_{YS_i} to be taken from Table 8.4.3.1.

$$F_{sc-hs-d\_i} = \epsilon\, M_{sc-hs}\left[C_{YR\_i}\, a_R \sin\left(\tan^{-1}\left|\frac{y_{Gsc}}{R - z_{Gsc}}\right| - \theta_h\right) - C_{YS\_i}\, a_{sway} \sin\theta_h\right]$$

Table 8.4.3.1: Load Combination Factors to be used for ships with L<90[m]

i	C_{YR_i}	C_{YS_i}
1	0.3	0.9
2	-0.3	-0.9
3	-0.3	0.9
4	0.3	-0.9
5	1	0
6	-1	0

8.5 Hull local scantling

8.5.1 General

The net thickness of inner bottom plating, hopper side plating and inner hull plating for ships intended to carry steel coils needs to comply with Cl.8.5.3.1 and Cl.8.5.4.1 up to a height not less than the one corresponding to the top of upper tier in contact with the hopper or the inner hull plating.

The net section modulus and the net web thickness of longitudinal stiffeners on inner bottom, hopper tank top and inner hull for ships intended to carry steel coils needs to comply with Cl.8.5.3.2 and Cl.8.5.4.2 up to a height not less than the one corresponding to the top of the upper tier in contact with the hopper or the inner hull plating.

8.5.2 Load application

The design load sets for steel coil loading are given in Table 8.5.2. Radius of gyration, k_{r}, and metacentric height, GM, is to be in accordance with Chapter 5, Section 2, Table 2.1.2 for the considered loading condition specified in the design load set.

Table 8.5.2: Design load sets for steel coil loading						
Structural member	**Design load set**	**Design load scenario**	**Load component**	**Draught**	**Acceptance criteria**	**Loading condition**
Inner bottom, Hopper sloping plate and inner hull	BC-SC-1	1	$F_{sc-ib-s}$ or $F_{sc-hs-s}$	T_{SC}	AC-I	Steel coil condition
Inner bottom, Hopper sloping plate and inner hull	BC-SC-2	2	F_{sc-ib} or F_{sc-hs}	T_{SC}	AC-II	Steel coil condition

8.5.3 Inner bottom

8.5.3.1 Inner bottom plating

The net thickness 't,' in [mm], of the plating of longitudinally stiffened inner bottom is not to be taken less than:

- For design load set BC-SC-1

$$t = K_1\sqrt{\frac{F_{sc-ib-s}.10^3}{C_a.R_{eH}}}$$

- For design load set BC-SC-2

$$t = K_1\sqrt{\frac{F_{sc-ib}.10^3}{C_a.R_{eH}}}$$

where,
K_1 = Coefficient to be taken as:

$$K_1 = \sqrt{\frac{1.7\frac{s}{1000}.l.K_2 - 0.73\left(\frac{s}{1000}\right)^2 K_2^2 - (l - l_{lp})^2}{2\,l_{lp}\left(2\frac{s}{1000} + 2\,l\,K_2\right)}}$$

where,

K_2 = Coefficient to be taken as:

$$K_2 = -\frac{s}{1000l} + \sqrt{\left(\frac{s}{1000l}\right)^2 + 1.37\left(\frac{1000l}{s}\right)^2\left(1 - \frac{l_{lp}}{l}\right)^2 + 2.33}$$

C_a = Permissible bending stress coefficient, as defined in Chapter 7, Section 4, Cl.4.1.1.1.

8.5.3.2 Stiffeners of inner bottom plating

The net section modulus, 'Z,' in [cm³], and the net web thickness, 't_w', in [mm], of stiffeners located on inner bottom plating is not to be taken less than:

- For design load set BC-SC-1

$$Z = \frac{K_3.F_{sc-ib-s}}{8.C_s.R_{eH}}.10^3$$

$$t_w = \frac{0.5\,F_{sc-ib-s}}{d_{shr}\,C_t\,\tau_{eH}}.10^3$$

- For design load set BC-SC-2

$$Z = \frac{K_3\,F_{sc-ib}}{8\,C_s R_{eH}}.10^3$$

$$t_w = \frac{0.5\ F_{sc-ib}}{d_{shr}\ C_t\ \tau_{eH}}.10^3$$

where,
K_3 = Coefficient to be taken as defined in Table 8.5.3.

C_s = Permissible bending stress coefficient defined in as defined in Chapter 7, Section 5, Cl.5.1.1.2.

C_t = permissible shear stress coefficient for the design load set being considered, is to be:

C_t = 0.85 for acceptance criteria set AC-I

C_t = 1.00 for acceptance criteria set AC-II

n_2 = Number of load points per EPP of the inner bottom

Table 8.5.3: Coefficient 'K_3'

$n_2 = 1$	$n_2 = 2$	$n_2 = 3$	$n_2 = 4$	$n_2 = 5$	$n_2 = 6$
$K_3 = l_{bdg}$	$K_3 = l_{bdg} - \frac{l_{lp}^2}{l_{bdg}}$	$K_3 = l_{bdg} - \frac{2\ l_{lp}^2}{3\ l_{bdg}}$	$K_3 = l_{bdg} - \frac{5\ l_{lp}^2}{9\ l_{bdg}}$	$K_3 = l_{bdg} - \frac{l_{lp}^2}{2l_{bdg}}$	$K_3 = l_{bdg} - \frac{7l_{lp}^2}{15l_{bdg}}$

$n_2 = 7$	$n_2 = 8$	$n_2 = 9$	$n_2 = 10$	$n_2 > 10$
$K_3 = l_{bdg} - \frac{4\ l_{lp}^2}{9\ l_{bdg}}$	$K_3 = l_{bdg} - \frac{3\ l_{lp}^2}{7\ l_{bdg}}$	$K_3 = l_{bdg} - \frac{5\ l_{lp}^2}{12\ l_{bdg}}$	$K_3 = l_{bdg} - \frac{11\ l_{lp}^2}{27\ l_{bdg}}$	$K_3 = 2\ l_{bdg}/3$

8.5.4 Hopper tank and inner hull

8.5.4.1 Hopper sloping plating and inner hull plating

The net thickness 't,' in [mm], of the plating of longitudinally stiffened bilge hopper sloping plating and inner hull is not to be taken less than:

- For design load set BC-SC-1

$$t = K_1\sqrt{\frac{F_{sc-hs-s}.10^3}{C_a.R_{eH}}}$$

- For design load set BC-SC-2

$$t = K_1\sqrt{\frac{F_{sc-hs}.10^3}{C_a.\ R_{eH}}}$$

where,
K_1 = Coefficient to be taken as defined in Cl.8.5.3.1

C_a = Permissible bending stress coefficient, as defined in Cl.8.5.3.1.

8.5.4.2 Stiffeners of hopper sloping plating and inner hull plating

The net section modulus, 'Z,' in [cm³], and the net web thickness, 't_w', in [mm], of stiffeners located on hopper sloping plating and inner hull plating is not to be taken less than:

- For design load set BC-SC-1

$$Z = \frac{K_3\ F_{sc-hs-s}}{8\ C_s R_{eH}}.10^3$$

$$t_w = \frac{0.5\ F_{sc-hs-s}}{d_{shr}\ C_t\ \tau_{eH}}.10^3$$

- For design load set BC-SC-2

$$Z = \frac{K_3\ F_{sc-hs}}{8\ C_s R_{eH}}.10^3$$

$$t_w = \frac{0.5\ F_{sc-hs}}{d_{shr}\ C_t\ \tau_{eH}}.10^3$$

where,
K_3 = Coefficient to be taken as defined in Table 8.5.3.
C_s, C_t = Coefficient to be taken as defined in Cl.8.5.3.2

End of Chapter

Part 3

General Hull Requirements

Chapter 13

Rudders

Section 4

Rudder Blades

4.2 Double plated rudders

4.2.1 Thickness 't' of the rudder side, top and bottom plating is not to be less than:

$$t = 5.5\ s\ f_a \sqrt{k} \sqrt{\left(T_{SC} + \frac{F_r 10^{-4}}{A}\right) 10^{-3}} + 2.5\ \ [mm]$$

where,

$$f_a = \sqrt{1.1 - 0.5(s/1000\ /\ l)^2}\ ;\ \max.1.00$$

s = the smaller of the distances between the horizontal or the vertical web plates/ smallest unsupported width of plating [mm].

l = the larger of the distances between the horizontal or the vertical web plates/ greatest unsupported width of plating [m].

T_{SC} = scantling draught [m]

k = Material factor for the rudder plating.

The thickness 't' is however not to be less than the minimum side shell thickness as per Part 3, Chapter 7 ~~Pt.3, Ch.8~~.

For nose plates the thickness is to be increased to 1.25 t.

4.2.2 The thickness of the vertical and horizontal webs is not to be less than 70 per cent of the requirement given in 4.2.1 with a minimum of 8 [mm].

End of Chapter

Part 3

General Hull Requirements

Chapter 17

Hull Inspection, Workmanship and Testing

Section 3

Testing of Tanks and Tight Boundaries for SOLAS Ships

Table 3.4.1 : Test requirements for Tanks and Boundaries
Notes: 8. For vessels of L < 90 [m], the head of water above highest point of tank may be (0.02L + 0.6) [m], but not less than 1.0 [m]. However, in mechanically propelled cargo ships of 500 GT and above and passenger ships, for tanks forming part of the watertight subdivision (See Part 3, Chapter 5, Section 5.1.2.1 b) ~~Pt.3, Ch.10, 4.2.1~~), head of water above the highest point of tank is to be 2.4 [m].

End of Chapter

Part 4

Main and Auxiliary Machinery

Chapter 1

General Requirements for the Design and Construction of Machinery

Section 2

Machinery Room Arrangements

2.4 Ventilation

IR2.4.2 The openings on deck through which the air is supplied to machinery space should be suitably protected (taking into account the requirements of Part 3, Chapter 12, Section 13.5.2 and 13.5.3 ~~Pt.3, Ch.13, Sec.2.2 and Sec.2.3~~).

The machinery spaces of Category A and other machinery spaces are as defined in Pt.6, Ch.1, Clauses 3.31 and 3.30 respectively.

End of Chapter

Part 4

Main and Auxiliary Machinery

Chapter 3

Pumping and Piping

Section 2

Bilge and Ballast Piping Systems

2.13 Additional requirements for passenger ships

2.13.1 All passenger ships are to have at least three power bilge pumps connected to the bilge main, one of which may be attached to the propelling unit. Where the bilge pump numeral is 30 or more, one additional independent power pump is to be provided. Sanitary, ballast and general service pumps may be accepted as independent power bilge pumps if fitted with necessary connections to the bilge pumping system.

The bilge pump numeral is to be calculated as follows:

When P_1 is greater than P : bilge pump numeral

$$= 72\left[\frac{M + 2P_1}{V + P_1 - P}\right]$$

in other cases: bilge pump numeral

$$= 72\left[\frac{M + 2P}{V}\right]$$

where,

L_L = the load line length of the ship (metres), as defined in ~~Pt.3, Ch.1, Cl.2.1.9~~Part 3, Chapter 1, Cl 2.1.1.5;

M = the volume of the machinery space (cubic metres), as defined in Pt.6, Ch.1, Sec.3 that is below the bulkhead deck; with the addition thereto of the volume of any permanent oil fuel bunkers which may be situated above the inner bottom and forward of, or abaft, the machinery space;

P = the whole volume of the passenger and crew spaces below the bulkhead deck (cubic metres) which are provided for the accommodation and use of passengers and crew, excluding baggage, store, and provision rooms;

V = the whole volume of the ship below the bulkhead deck (cubic metres);

P_1 = KN,

where,

N = the number of passengers for which the ship is to be certified, and

K = $0.056L_L$

However, where the value of KN is greater than the sum of P and the whole volume of the actual passenger spaces above the bulkhead deck, P_1 is to be taken as the above sum (i.e. the sum of P and the whole volume of the actual passenger spaces above the bulkhead deck) or two-thirds KN, whichever is the greater.

Section 3

Vents, Sounding, Overflow and Scuppers and Discharges Piping Systems

3.2 Vent pipes

3.2.16 The thickness of the exposed portion of the vent pipes are to be as required in ~~Pt.3, Ch.13, 3.2.5~~Part 3, Chapter 12, Section 13.6.2.6.

3.5 Scuppers and discharges (Also refer ~~Pt.3, Ch.13)~~Part 3, Chapter 12)

Section 4

Fuel Oil Systems

4.2 Oil fuel tanks

4.2.1 Oil fuel tanks are to be separated from fresh water and lubricating oil tanks by means of cofferdams. For requirements in respect of protective location of fuel oil tanks, see ~~Pt.3, Ch.1, Sec.1.6~~Part 3, Chapter 3, Section 3.5.

4.4 Arrangement of valves, cocks, pumps and fittings

4.4.13 Where MARPOL Regulation I/12A for protective location of fuel oil tanks applies (see Part 3, Chapter 3, Section 3.5~~Pt.3, Ch.1, Sec.1.6~~), the fuel oil lines, suction wells and valves are to satisfy the requirements of paragraph 9 and 10 of the above MARPOL Regulation.
Valves for such fuel oil tanks are to be located above the bottom at distances not less than that required for suction wells` in paragraph 10 of MARPOL Regulation I/12A. Plan showing the location of tanks, suction wells and valves, indicating the distances are to be submitted for approval.

The requirements for locations of oil fuel lines do not apply to fuel oil air escapes and overflow pipes.

End of Chapter

Part 4

Main and Auxiliary Machinery

Chapter 4

Prime Movers and Propulsion Shafting Systems

Section 4

Internal Combustion Engines

4.9 Engine starting arrangements

4.9.2 Compressed air starting systems:

4.9.2.9 The total air receiver capacity is to be sufficient to provide, without replenishment, number of starts as per Table 4.9.1.

a) If starting system serves two or more of the above specified purposes, the capacity of the system is to be the sum of the capacity required.

b) At least two air receivers of about equal capacity are to be provided.

~~b)~~c) When consumers other than engine starting such as, control systems, whistle, other essential services onboard (see also 4.17.2), etc., are to be connected to starting air receivers, their air consumption is also to be taken into account.

Table 4.9.1 : Number of starts of engines	
Duty of engine	**No. of starts**
Propulsion engines – reversible	12 consecutive starts alternating between Ahead and Astern of each engine
Propulsion engines - non-reversible, connected to a controllable pitch propeller or other device enabling the start without opposite torque	6 starts for each engine
Engines for driving electric generators and emergency generators and engines for other purposes	3 starts for each engine

4.17 Capacity and availability of compressed air for essential services onboard ships other than the supply of compressed air for engine starting

4.17.2 Where compressed air is supplied from the engine starting air system, either continuously in normal operation, or periodically during maintenance or in the event of a failure of the compressed air system, the required compressed air demand is not to reduce the capacity and availability of the engine starting air required by 4.9.2.

End of Chapter

Part 4

Main and Auxiliary Machinery

Chapter 6

Steering Gear

Section 1

General

1.7 Rudder, rudder stock, vanes, tiller and quadrant

1.7.1 For the requirements regarding rudder, rudder stock, See ~~Pt.3, Ch.14~~Part 3, Chapter 13.

1.7.5 Co-efficient of friction for shrink fitting is to be taken as specified in ~~Pt.3, Ch.14, Sec.6.3~~Part 3, Chapter 13, Section 6.3.

1.7.7 The dimensions of the key are to comply with the requirements of ~~Pt.3, Ch.14, Sec.6.2~~Part 3, Chapter 13, Section 6.2.

End of Chapter

Part 4

Main and Auxiliary Machinery

Chapter 7

Control Engineering

Section 2

Control - System Characteristics

2.6 Bridge control for main propulsion machinery

2.6.1 Where a bridge control system for main propulsion machinery is to be fitted, the requirements of 2.6.2 to 2.6.108 are to be complied with.

2.6.2 Means are to be provided to ensure satisfactory control of propulsion from the bridge in both the ahead and astern directions. The requirements in Part 5, Chapter 22, Section 2.2.9 are also to be complied with.

2.6.9 In addition to the above, requirements in Part 5, Chapter 22, Section 2.2.5, 2.2.8, 2.2.12, 2.2.13 and 2.3.7 are also to be complied with.

2.6.10 For non-SOLAS ships, requirements in Part 5, Chapter 22, Section 2.3.7 are to be complied with.

2.7 Valve control system

2.7.6 For requirements applicable to closing appliances on scuppers and sanitary discharges, see Pt.3, Ch.13Part 3, Chapter 12.

End of Chapter

Part 4

Main and Auxiliary Machinery

Chapter 8

Electrical Installations

Section 10

Ship Safety Systems

10.2 Shell doors, loading doors and other closing appliances	10.2.4 For the requirements of side shell doors, stern doors and bow doors, also refer to ~~Pt.3, Ch.12, Sections 5 and 6~~Part 3, Chapter 12, Section 11 and 12.

End of Chapter

Part 5

Special Ship Types

Chapter 4

Liquefied Gas Carriers

Introduction

IR2.0 Classification and class notations

IR2.1 The regulations for classification and the assignment of class notations are given in Pt.1 of the Rules, to which reference is to be made. In general, the class notation to be assigned would be "**SUL Liquefied gas carrier**" where the vessel is designed and constructed primarily for the carriage of liquefied gases in bulk in integral, membrane or independent tanks. Ships complying with the requirements of this chapter as applicable will be eligible to be assigned the following class notations:

LIQUEFIED GAS CARRIER

in association with a Ship Type notation (Type 1G, 2G, 2PG or 3G) and type of tanks (Independent/ Integral).

IR 2.2 The assignment of a Ship Type does not imply that the ship is suitable for all cargoes listed in Section 19 which require that Ship Type. The cargoes from Sections 17 and 19 for which the ship has been approved will be listed as defined cargoes in the Classification Certificate. This list will include the following details:

- Name(s) of cargo(es);
- Maximum vapor pressure (at sea and in harbour); minimum and, where necessary, maximum cargo temperature;
- Design ambient temperatures (indicating when the ship is suitable for continuous service in high and/or low temperature climatic conditions).

IR2.2 Additional class notation in respect of following items will be assigned as appropriate:

- Ship Type, i.e. 1G, 2G, 2PG or 3G;
- Type of Tanks;
- Name(s) of gas(es);
- Maximum vapour pressure (at sea and in harbor); minimum and (where necessary) maximum cargo temperature;
- Design ambient temperatures (when the ship is suitable for continuous service in high and/or low temperature climatic conditions).

End of Chapter

Part 5

Special Ship Types

Chapter 5

Container Ships

Section 4

Hull Girder Strength

4.5 Hull girder stress

4.5.2 The longitudinal warping stress (σ_{st}, σ_{wt-LC}) and warping shear stresses (τ_{st}, τ_{wt-LC}) induced by still water and wave hull girder torsion as specified in Part 3, Chapter 6, Section 3, Cl.3.3, are also to be considered for bending and shear strength calculation.
Refer to IRS Guidelines *"Assessment of Hull Girder Stresses due to Torsion in Ships with large deck openings"* for further details of the calculations.

End of Chapter

Part 5

Special Ship Types

Chapter 22

Vessels with Unattended Machinery Spaces

Section 2

System Design

2.2 Control locations

2.2.4 Remote control of propulsion machinery and associated equipment is to be possible from only one location at a time; at such locations interconnected control positions are permitted. At each location there is to be an indicator showing which location is in control of the propulsion machinery. The transfer of control between the navigating bridge and machinery spaces is to be possible only in the main machinery space or in the main machinery control room. Changeover between control locations is to be arranged so that it may be effected with the acceptance of the location taking control. The system is to be provided with interlocks or other suitable means to ensure effective transfer of control. The system is to include means to prevent the propelling thrust from altering significantly when transferring control from one location to another.

2.2.5 Under all sailing conditions, including maneuvering, the speed, direction of thrust and, if applicable, the pitch of the propeller ~~are~~is to be fully controllable from the bridge. Such remote control is to be performed by a single control device for each independent propeller, with automatic performance of all associated services, including, where necessary, means of preventing overload and prolonged running in critical speed ranges of propelling machinery.

2.2.8 The bridge control system is to be independent from the other transmission system; however, one control lever for both system may be accepted.

2.2.9 Operations following any setting of the bridge control device including reversing from the maximum ahead service speed in case of emergency are to take place in an automatic sequence and with time intervals acceptable to the machinery.

2.2.11 The main propulsion machinery is to be provided with an emergency stopping device on the bridge which is to be independent of the bridge control system.~~Means of control, independent of bridge control system, are to be provided on bridge to enable the watchkeeper to stop the propulsion machinery in an emergency.~~

2.2.12 Remote starting of the propulsion machinery is to be automatically inhibited if conditions exist which may hazard the machinery, e.g. shaft turning gear engaged, drop of lubricating oil pressure.

2.2.13 For steam turbines a slow-turning device ~~should~~ is to be provided which operates automatically if the turbine is stopped longer than admissible. Discontinuation of this automatic turning from the bridge must be possible.

Note: For attended machinery spaces, the slow turning device may be arranged to be operated manually.

2.3 Control systems

2.3.7 The design of the remote automatic control system is to be such that in the case of its failure an alarm will be given. Unless IRS considers it impracticable, the preset speed and direction of thrust of the propeller is to be maintained until local control is in operation.

For non-SOLAS ships, the design of the bridge control system is to be such that in case of its failure an alarm is given. In this case the speed and direction of the propeller thrust is to be maintained until local control is in operation, unless this is considered impracticable. In particular, lack of power (electric, pneumatic, hydraulic) is not to lead to major and sudden change in propulsion power or direction of propeller rotation.

End of Chapter

Part 5

Special Ship Types

Chapter 41

Well Testing Vessels

Contents

Section 1

General

1.1 Application

1.1.1 The requirements in this Chapter are applicable to vessels which are arranged and equipped for testing of wells for production of oil and or gas. The requirements are supplementary to those given for assignment of main class.

1.2 Classification and Class Notations

1.2.1 Vessels built and equipped according to the requirements in this Chapter may be assigned additional class notation "**WELL TESTING VESSEL**".

1.2.3 Any additional requirements of the Flag Administration and/or the Coastal State are also to be complied with.

1.3 Definitions

1.3.1 Well Test Systems

Well test systems are the facilities installed on vessels to evaluate the quality and/or quantity of the well fluid in the exploration and appraisal phase or during well intervention in the field production phase. Well test systems include well control equipment, process pressure vessels, piping and electrical components, control systems, burners and gas flares and burner/flare booms.

1.4 Scope of Classification

1.4.1 The following matters related to well testing are subject to Classification:

a) Position keeping of the vessel.

b) Safety aspects related to well test systems installed on board.

1.5 Plans and Documentation

1.5.1 In addition to plans listed in Part 1, Ch 1, Sec 3, plans/documents given in 1.5.2 to 1.5.6, are to be submitted for information/ approval, as appropriate:

1.5.2 The following plans/documentation are to be submitted for information:

i) Project Specifications

ii) Equipment Layout Drawings and equipment documentation

iii) Information regarding loading arrangement of deck equipment and tanks, weights, and centers of gravity

1.5.3 The following plans/ documentation are to be submitted for approval:

i) Structural details and arrangements of the structures in way of deck equipment and tanks.

ii) Drawings showing the securing details and arrangements along with supporting calculations; if equipment modules are stacked, full details are to be submitted

iii) Details of integral liquid tanks including venting and/or inerting.

iv) Details of independent liquid and/or dry tanks with support and fastening arrangement.

v) Piping and Instrument Diagrams (P & ID's) to show integration and/or interfaces with the vessel's piping system.

vi) Spill Containment and Drain Systems.

vii) Hazardous Area Plan.

viii) Electrical line diagrams to show integration and/or interfaces with the vessel's electrical systems, including power required, protection provided for well test facilities.

ix) Instrumentation and Control Systems to show control station arrangements, integration and/or interfaces with the vessel's monitoring and control systems.

x) Fire Fighting System

1.6 Operation Manual

1.6.1 Operation manual for well testing procedure is to be submitted for approval and the same is to be readily available on board. The manual is to provide instructions and information on safety aspects related to well testing operations.

Section 2

Position Keeping

2.1 Position Keeping

2.1.1 It is essential that well testing vessels are capable of maintaining their positions safely during well testing operations.

2.1.2 If position mooring is undertaken with anchors, they are to fulfill the requirements for position keeping systems in Ch 10 of the *Rules and Regulations for Construction and Classification of Mobile Offshore Drilling Units*. Precautions are to be taken to prevent damage to seabed equipment and installations by anchors.

2.1.3. Dynamic positioning systems, where used to maintain the vessel's position during well testing operations, are to comply with the requirements for the class notation **DP (2)** or **DP (3)**.

Section 3

Well Test Equipment and Systems

3.1 General

3.1.1 The design of the well testing equipment is to be carried out in accordance with recognized National/International Standards, acceptable to IRS and the same are to be specified by the designer. The equipment and systems used only for well testing operations are in general not subject to classification by IRS, unless requested by the client. Manufacturer's certificate affirming compliance with applicable recognized standards is to be submitted to IRS. Their installations and onboard testing are to be supervised in the aspects of operational safety to reduce to a minimum any danger to persons on board and marine pollution, due regard to be paid to moving parts, hot surfaces and other hazards. Consequences of failure of systems and equipment essential to the safety of the vessel are to be considered.

3.2 Arrangements of Well Test Equipment and Systems

3.2.1 The detailed system and equipment arrangements plans are to comply with Chapter 8 of *Rules and Regulations for the Construction and Classification of Floating Offshore Units*.

3.3 Deck Supporting Structure

3.3.1 The deck supporting structures are to be provided in accordance with the following requirements:

.1 The maximum deck loading for the well test system and its components is to be predetermined, either by a uniformly distributed load or by localized loads, if the footprint of the deck connections is known.

.2 Deck structures that will support the well test system, when installed, are to be appropriately reinforced and analyzed based on the maximum loading conditions in compliance with Part 3, Chapter 5 of the Rules, as applicable. The maximum deck loading used in the structural analysis is to be clearly reflected in the deck structural drawing.

.3 A description of the specific locations where the well testing equipment will be placed and the maximum deck loading at those locations are to be reflected in the Operating Manual (see Chapter 1, Section 4, 4.6 of the *Rules and Regulations for the Construction and Classification of Mobile Offshore Drilling Units*).

.4 Well test equipment is to be securely attached to the hull structure of the vessel using suitable means of fastening such as welding or bolting in accordance with the approved securing manual (see 1.5.3 ii)). Due consideration is to be given such that equipment operation, emergency response, and personnel escape are not to be adversely affected by fastening arrangements.

.5 Deck foundations and fastening arrangements are to permit relative movement of pressure vessels and large gas storage cylinders due to internal pressure variations that may cause them to expand or contract.

3.4 Hydrocarbon Storage Tanks and Piping

3.4.1 Integral Tanks

3.4.1.1 Integral tanks designated for storage of well fluid are to comply with following requirements.

3.4.1.2 Hydrocarbon storage tanks, used for well fluids with unknown properties, are to be located in areas that minimize the risk of fire. The tanks should also be positioned to reduce the likelihood of leakage.

3.4.1.3 Integral hull tanks, designated for hydrocarbon storage during well testing operations, are to comply with the structural requirements specified in Part 3.

3.4.1.4 Storage tanks for hydrocarbons or other flammable liquids are to be located away from designated wellheads. They should also be positioned at a safe distance from potential ignition sources. These ignition sources include gas and diesel engines, fired vessels, and buildings that are designated as unclassified areas. Additionally, tanks should not be near areas used as workshops or welding locations.

3.4.1.5 Hydrocarbon storage tanks and tanks containing flammable liquids with low flash points constructed as integral tanks, are to be separated from machinery spaces, service spaces, and other similar spaces that contain ignition sources.

3.4.1.6 Potable water tanks are also to be segregated from these storage tanks. The segregation is to be achieved using cofferdams that are at least 0.76 meters wide. Pump rooms, ballast tanks, and fuel oil tanks may also be used as cofferdams for this purpose.

3.4.1.7 Hydrocarbon and low flash point flammable liquid storage tanks are to be located outside of stability damage zones with respect to type of vessel.

3.4.1.8 If storage tanks on a vessel are intended for transporting stowed well fluids and have an aggregate capacity exceeding

1200 [m^3], they are to meet the protection requirements in MARPOL 73/78 Annex I Regulation 19.

3.4.2 Independent Tanks

3.4.2.1 Storage tanks on deck, used for the receipt of well fluids or other flammable liquids, are to be located as far as possible from flowheads. These tanks are also to be placed at a safe distance from potential ignition sources. Potential ignition sources include gas and diesel engines, fired vessels, and buildings designated as unclassified areas. Additionally, independent tanks are to be located away from areas used as workshops or welding locations.

3.4.2.2 Precautions are to be taken to prevent falling objects from impacting the tanks. Protective measures are to be in place to safeguard the tanks against such hazards.

3.4.2.3 Tanks are to be securely fastened on deck.

3.4.3 Pumping and Piping arrangements

3.4.3.1 Pumping, piping and venting are to comply with the relevant requirements in Chapter 8 of the *Rules and Regulations for the Construction and Classification of Floating Offshore Units*.

3.4.3.2 Transfer pumps and piping, including those used for filling, discharging, venting, and sounding, are not to pass through machinery spaces. These components are also not to be located within machinery spaces.

3.4.3.3 When inert gas is required for purging and blanketing hydrocarbon storage tanks, the inert gas systems are to be properly designed. The inert gas systems are to maintain the oxygen content in any part of the storage tanks at or below 8% by volume.

3.5 Safety and shutdown System

3.5.1 Process safety system is to be designed and implemented in accordance with the relevant requirements in Chapter 8 of *Rules and Regulations for the Construction and Classification of Floating Offshore Units*.

3.5.2 Process shutdown system is to be arranged in accordance with the relevant requirements in Chapter 8 of *Rules and Regulations for the Construction and Classification of Floating Offshore Units*.

3.5.3 Where well fluid is received on the installation directly from the subsea well, means are to be provided to detect the actuation of ESD system, which will enable all subsea valves to shut-off.

3.6 Electrical Components and Installations

3.6.1 Electrical components are to be certified for use for their intended service. Electrical installations are to be provided in accordance with the relevant requirements in Chapter 8 of *Rules and Regulations for the Construction and Classification of Floating Offshore Units*.

3.7 Spill Containment

3.7.1 Spill containment is to be provided in areas that could be exposed to hydrocarbon liquid or chemical spills during the installation of the well test system. These include areas around process vessels, heat exchangers, storage tanks with drain or sample connections, pumps, valves, manifolds, metering and data recording units, and chemical storage and dispensing areas.

3.7.2 Spill containment is to use curbing or drip edges at deck level, recessed drip pans, floor gutters, firewalls, protective walls, or similar methods to prevent the spread of discharged liquids to other areas and avoid spillover to lower levels.

3.7.3 Where equipment is protected by a fixed foam fire extinguishing system, a minimum coaming height of 150 mm is to be provided.

3.7.4 Each containment area, along with any plated deck or skid area prone to rainwater or liquid accumulation, is to be equipped with drains connected to an open drain system, and installed in a way that prevents standing liquid accumulation.

3.7.5 Suitable drainage systems are to be provided for the process systems to collect any leaked fluids. Adequate arrangements are to be made for safe processing/ disposal/ storage of the fluids collected. The drainages from hazardous areas are to be segregated from those in non-hazardous areas.

3.8 Communication

3.8.1 Hardwired voice communication systems are to be provided between the central control station for the well test operation and the vessel's position-keeping control stations.

Section 4

Hazardous Areas

4.1 General

4.1.1 In general, hazardous area classification for Well Test Systems is to comply with the requirements in Chapter 11 of the *Rules and Regulations for the Construction and Classification of Mobile Offshore Drilling Units*, IEC 61892-7, and IMO MODU Code section 6.2. Alternatively, classifications based on recognized standards such as API RP 500 or API RP 505 are also acceptable.

4.2 Hydrocarbon storage tanks

4.2.1 Vessels with integral hydrocarbon storage tanks are not required to comply with requirements in Pt.5, Ch.2 of the Rules for hazardous area classification, if they comply with the following:

a) Decks over hydrocarbon storage tanks, which are fully ventilated and gas-tight, are classified as Zone 2. This applies to the entire width of the ship and extends 3 [m] fore and aft of the cargo block, up to a height of 2.4 [m] or the production deck.

b) Semi-enclosed or enclosed spaces directly next to hydrocarbon storage tanks are classified as Zone 1.

c) Cargo pump rooms with continuous ventilation (20 air changes per hour) are classified as Zone 1, provided ventilation failures trigger alarms in a manned area.

d) Spaces separated from hydrocarbon storage tanks by a single bulkhead are classified as Zone 1.

e) Areas with unrestricted ventilation around tank vents are classified as Zone 1 within a 3 [m] radius, and as Zone 2 for an additional 7 [m].

4.3 Equipment Installations in Vicinity of Hazardous Areas

4.3.1 Areas around equipment, extending 3 [m] from its perimeter, are classified as Zone 2.

4.3.2 Electrical equipment in hazardous areas is to be of certified type and is to be suitable for that specific environment.

4.3.3 Equipment installed in exterior locations that remains operational or electrically energized after a gas detection shutdown is to be suitable for Zone 2 locations.

4.4 Fired Heater, Internal Combustion Engines and Hot Surfaces

4.4.1 Air intakes for fired heaters and internal combustion engines are to be located at least 3 [m] from any classified hazardous area, while exhaust outlets for these units are to discharge outside all classified areas. Exhaust outlets of internal combustion engines are to be equipped with spark arrestors. Hot surfaces that may ignite flammable vapours are to be protected through insulation, cooling, gas-tight enclosures, or similar methods. Additionally, power packages in working areas are to be certified for operation in Zone 2 environments.

End of Chapter

Part 6

Fire Safety Requirements

Chapter 3

Suppression of Fire

Section 3

Containment of Fire

3.7 Ventilation systems

3.7.2 Arrangement of ducts

3.7.2.5 For the purposes of paragraphs 3.7.2.4.1.4 and 3.7.2.4.2.2, ducts are to be insulated over their entire cross-sectional external surface. Ducts that are outside but adjacent to the specified space, and share one or more surfaces with it, are to be considered to pass through the specified space, and are to be insulated over the surface they share with the space for a distance of 450 [mm] past the duct.

~~IR3.7.2.5 For determining the extent of insulation when the duct passes through an enclosed space, See Fig. 3.7.2.5.~~

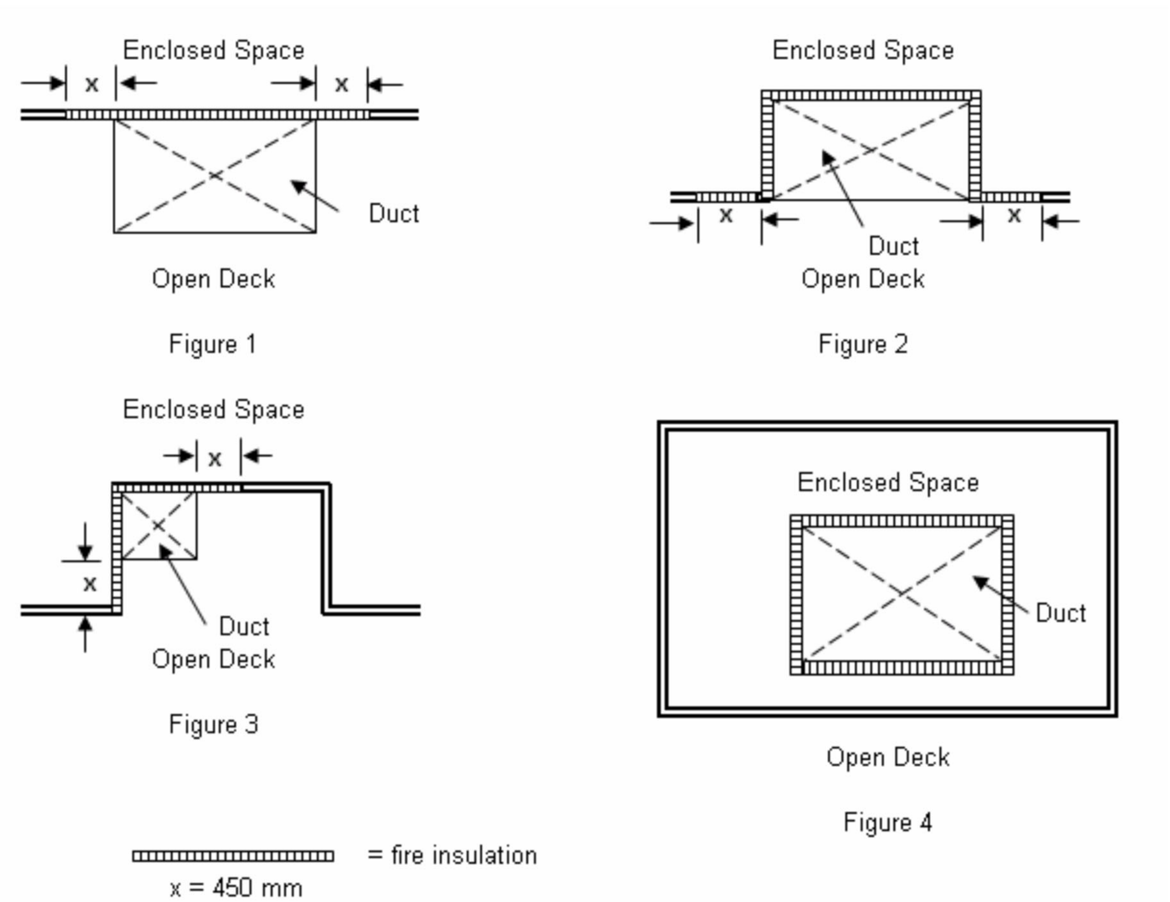


Fig.3.7.2~~.5~~ : Examples of galley ducts contiguous to enclosed spaces

3.7.2.6 Where it is necessary that a ventilation duct passes through a main vertical zone division, an automatic fire damper is to be fitted adjacent to the division. The damper is also to be capable of being manually closed from each side of the division. The control location is to be readily accessible and be clearly and prominently marked. The duct between the division and the damper is to be constructed of steel in accordance with paragraphs 3.7.2.4.1.1 and 3.7.2.4.1.2 and insulated to at least the same fire integrity as the division penetrated. The damper is to be fitted on at least one side of the division with a visible indicator showing the operating position of the damper.

IR3.7.2.6 When the galley is served by a duct from a common ventilation unit and not from an independent unit, automatic fire damper is to be provided outside the galley, irrespective of the size of the duct.

IR3.7.2 With respect to the application of 3.7.2, for determining fire insulation for trunks and ducts which pass through an enclosed space, the term "pass through" pertains to the part of the trunk/duct contiguous to the enclosed space. See Fig. 3.7.2.

3.7.5 Exhaust ducts from galley ranges

3.7.5.1 Requirements for passenger ships carrying more than 36 passengers

3.7.5.1.1 In addition to the requirements in sections 3.7.1, 3.7.2 and 3.7.3, exhaust ducts from galley ranges are to be constructed in accordance with paragraphs 3.7.2.4.2.1 and 3.7.2.4.2.2 and insulated to "A-60" class standard throughout accommodation spaces, service spaces, or control stations they pass through. They are also to be fitted with:

.1 a grease trap readily removable for cleaning unless an alternative approved grease removal system is fitted;

.2 a fire damper located in the lower end of the duct at the junction between the duct and the galley range hood which is automatically and remotely operated and, in addition, a remotely operated fire damper located in the upper end of the duct close to the outlet of the duct;

.3 a fixed means for extinguishing a fire within the duct*;

(*Refer to the recommendations published by the International Organization for Standardization, in particular publication ISO 15371:2009, Ships and marine technology – Fire-extinguishing systems for protection of galley cooking equipment.)

.4 remote-control arrangements for shutting off the exhaust fans and supply fans, for operating the fire dampers mentioned in paragraph 3.7.5.1.1.2 and for operating the fire-extinguishing system, which is to be placed in a position outside the galley close to the entrance to the galley. Where a multi-branch system is installed, a remote means located with the above controls shall be provided to close all branches exhausting through the same main duct before an extinguishing medium is released into the system; and

.5 suitably located hatches for inspection and cleaning, including one provided close to the exhaust fan and one fitted in the lower end where grease accumulates.

3.7.5.1.2 Exhaust ducts from ranges for cooking equipment installed on open decks are to conform to paragraph 3.7.5.1.1, as applicable, when passing through accommodation spaces or spaces containing combustible materials.

IR3.7.5.1 With respect to the application of 3.7.5.1, refer Cl. IR3.7.2.

Section 5

Structural Integrity

5.4 Machinery spaces of category A

5.4.1 Crowns and casings

Crowns and casings of machinery spaces of category A are to be of steel construction and are to be insulated as required by Table 3.5a and Table 3.7, as appropriate.

IR5.4.1 The crown of a machinery space of category A is to be understood to mean the underside of the deck and the uppermost horizontal part of the main space of the machinery space. If the upper side bulkheads are sloping, the sloping parts of the bulkheads should be included in the crown. See Fig. 5.4.1.

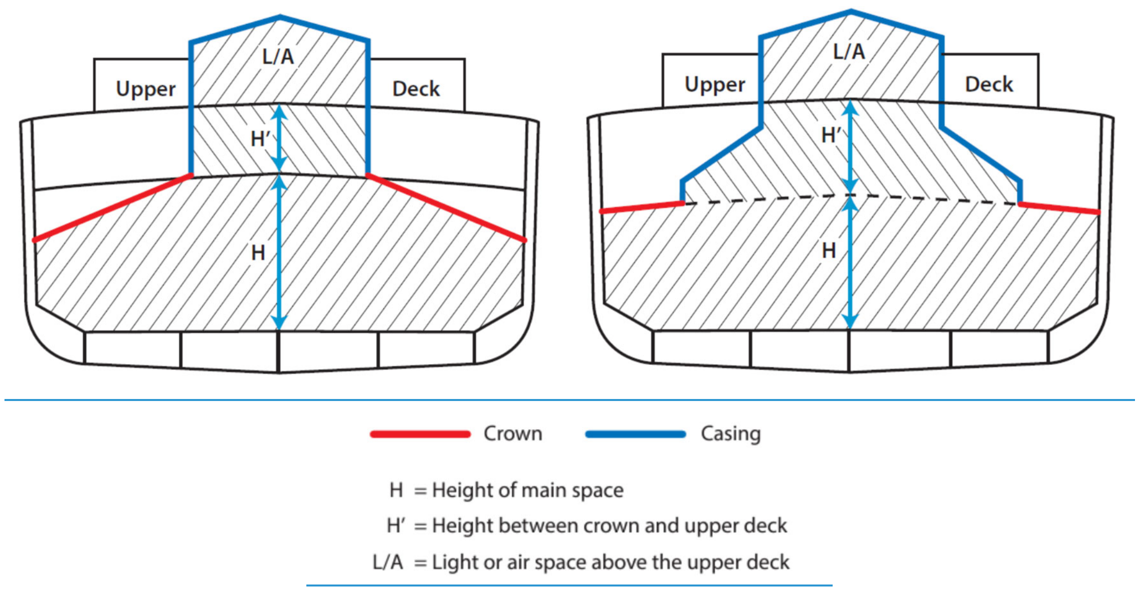


Fig. 5.4.1 : Examples of crowns and casings

End of Chapter

Part 6

Fire Safety Requirements

Chapter 4

Escape

Section 2

Means of Escape

2.4 Means of escape from machinery spaces

2.4.1 Means of escape on passenger ships

Means of escape from each machinery space in passenger ships are to comply with the following provisions.

2.4.1.1 *Escape from spaces below the bulkhead deck*

Where the space is below the bulkhead deck the two means of escape is to consist of either:

.1 two sets of steel ladders as widely separated as possible, leading to doors in the upper part of the space similarly separated and from which access is provided to the appropriate lifeboat and liferaft embarkation decks. One of these ladders are to be located within a protected enclosure that satisfies Ch.3, 3.2.2.3, category (2), or Ch.3, 3.2.2.4, category (4), as appropriate, from the lower part of the space it serves to a safe position outside the space. Self-closing fire doors of the same fire integrity standards are to be fitted in the enclosure. The ladder is to be fixed in such a way that heat is not transferred into the enclosure through non-insulated fixing points. The protected enclosure is to have minimum internal dimensions of at least 800 [mm] x 800 [mm], and is to have emergency lighting provisions; or

.2 one steel ladder leading to a door in the upper part of the space from which access is provided to the embarkation deck and additionally, in the lower part of the space and in a position well separated from the ladder referred to, a steel door capable of being operated from each side and which provides access to a safe escape route from the lower part of the space to the embarkation deck.

2.4.1.2 *Escape from spaces above the bulkhead deck*

Where the space is above the bulkhead deck, the two means of escape are to be as widely separated as possible and the doors leading from such means of escape are to be in a position from which access is provided to the appropriate lifeboat and liferaft embarkation decks. Where such means of escape require the use of ladders, these are to be of steel.

2.4.1.4 *Escape from machinery control rooms*

Two means of escape are to be provided from a machinery control room located within a machinery space, at least one of which will provide continuous fire shelter to a safe position outside the machinery space.

IR2.4.1 The above clauses (2.4.1.1, 2.4.1.2 & 2.4.1.4) are to be interpreted as follows:

.1 A "safe position" can be any space, such as steering gear spaces where hydraulic oils for the steering gear equipment are stowed, and special category spaces and ro-ro spaces, from which access is provided and maintained clear of obstacles to the embarkation decks. This excludes lockers and storerooms, cargo spaces and spaces where flammable liquids are stowed.~~excluding lockers and storerooms irrespective of their area, cargo spaces and spaces where flammable liquids are stowed, but including special category spaces and ro-ro spaces, from which access is provided and maintained clear of obstacles to the embarkation decks (Cl. 2.4.1.1 and 2.4.1.4)~~

2.4.2 Means of escape on cargo ships

Means of escape from each machinery space in cargo ships are to comply with the following provisions.

2.4.2.1 *Escape from machinery spaces of category A*

Except as provided in 2.4.2.2, two means of escape are to be provided from each machinery space of category A. In particular, one of the following provisions is to be complied with:

.1 two sets of steel ladders as widely separated as possible leading to doors in the upper part of the space similarly separated and from which access is provided to the open deck. One of these ladders is to be located within a protected enclosure that satisfies Ch.3, 3.2.3.3, category (4), from the lower part of the space it serves to a safe position outside the space. Self-closing fire doors of the same fire integrity standards are to be fitted in the enclosure. The ladder is to be fixed in such a way that heat is not transferred into the enclosure through non-insulated fixing points. The enclosure is to have minimum internal dimensions of at least 800 [mm] x 800 [mm], and is to have emergency lighting provisions; or

.2 one steel ladder leading to a door in the upper part of the space from which access is provided to the open deck and, additionally, in the lower part of the space and in a position well separated from the ladder referred to, a steel door capable of being operated from each side and which provides access to a safe escape route from the lower part of the space to the open deck.

2.4.2.3 *Escape from machinery spaces other than those of category A*

From machinery spaces other than those of category A, two escape routes are to be provided except that a single escape route may be accepted for spaces that are entered only occasionally, and for spaces where the maximum travel distance to the door is 5 [m] or less.

IR2.4.2 The above clauses (2.4.2.1 & 2.4.2.3) are to be interpreted as follows:

.1 A “safe position” can be any space, such as steering gear spaces where hydraulic oils for the steering gear equipment are stowed, and vehicle and ro-ro spaces, from which access is provided and maintained clear of obstacles to the open deck. This excludes cargo spaces, lockers and storerooms, cargo pump-rooms and spaces where flammable liquids are stowed.~~excluding cargo spaces, lockers and storerooms irrespective of their area, cargo pump-rooms and spaces where flammable liquids are stowed, but including vehicle and ro-ro spaces, from which access is provided and maintained clear of obstacles to the open deck (Cl. 2.4.2.1.1).~~

End of Chapter

Part 6

Fire Safety Requirements

Chapter 7

Special Requirements

Section 2

Carriage of Dangerous Goods*

2.3 Special requirements

2.3.4 Ventilation arrangement

IR2.3.4.5 Where the IMSBC Code requires continuous ventilation or ventilation at all times -in cargo holds, the ventilation openings are to comply with the requirements of Pt.3, Ch.1312, Sec.132 for openings not fitted with means of closure. This does not prevent ventilators from being fitted with a means of closure as required for fire protection purposes as per Pt.6, Ch.2, Cl. 2.2.1.1 provided the minimum height to the ventilator opening is in accordance with Pt.3, Ch.1213, Sec.132 (4.5. [m] for Position 1 and 2.3 [m] for Position 2).

The requirements for continuous ventilation apply to the following cargoes as per the IMSBC code:

ALUMINIUM FERROSILICON POWDER
UN 1395
ALUMINIUM SILICON POWDER, UNCOATED UN 1398
ALUMINIUM SMELTING/REMELTING BY-PRODUCTS, PROCESSED
ALUMINIUM SMELTING BY-PRODUCTS
or ALUMINIUM REMELTING BYPRODUCTS
UN 3170
FERROPHOSPHORUS (including BRIQUETTES)
FERROSILICON (25% ≤ Silicon ≤ 30% or ≥ 90% Silicon)
FERROSILICON UN 1408 (30% ≤ Silicon < 90%)
ZINC ASHES UN 1435

The requirements for mechanical surface ventilation at all times apply to the following cargoes as per the IMSBC Code: DIRECT REDUCED IRON (D) (By-product fines with moisture content of at least 2%).

End of Chapter