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RULES AND REGULATIONS FOR THE CONSTRUCTION AND CLASSIFICATION OF **STEEL SHIPS**

RULES CHANGE NOTICE NO. 3

March 2025

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, 'Rules Change Notice No.1 dated September 2024' and 'Rules Change Notice No.2 dated December 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. 3 – March 2025

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 2: Periodical Surveys	
20/ 20.1.1.1(new)	It is clarified that surveys on ships with **LFPF(ML)** notation are to be carried out in accordance with the requirements in IRS *Guidelines on Methanol Fueled Vessels*.
Part 3 Chapter 2: Materials of Construction and Corrosion Additions *The amendments are applicable to ships contracted for construction on or after 1 July 2024.*	
5/ 5.2.2	Amendments introduced to specify corrosion addition requirements for structural members with gross offered thickness greater than 10mm and those with less than or equal to 10mm.
5/ 5.3.4(New)	It is clarified that for stiffeners, the total corrosion addition, as determined in Clause 5.2.2, applies to both the web and flange.
Part 3 Chapter 5: Design Loads *The amendments are applicable to ships contracted for construction on or after 1 July 2024.*	
2/ Symbols	The upper limit for a_0 'common acceleration parameter' has been revised from 0.7 to 0.52.
2/ 2.1.3.5	A modified pitch acceleration formula is introduced for ships with L<90m
2/ 2.2.3.1	The formula for longitudinal acceleration is amended.
5/ 5.1.2.1	The phrase "cargo tanks filled with liquid cargo" is deleted for correctness of applicability of the formula.
Part 3 Chapter 6: Hull Girder Strength *The amendments are applicable to ships contracted for construction on or after 1 July 2024.*	
3/ 3.5.1.2	Amended formulae for longitudinal stresses induced by vertical and horizontal wave bending moments in ships of L<90 m are introduced.
Part 3 Chapter 7: Hull Local Scantlings *The amendments are applicable to ships contracted for construction on or after 1 July 2024.*	
7/ 7.1.2	Amendments are made for better clarity regarding the acceptability of cutouts.
Part 4 Chapter 1: General Requirements for the Design and Construction of Machinery *The amendments are applicable to ships contracted for construction on or after 1 January 2026.*	
1/ Table 1.7.1	Appropriate cross-references to Part 5, Chapter 3 and 4 are introduced in Note 3.
Part 4 Chapter 7: Control Engineering *The amendments are applicable to ships contracted for construction on or after 1 January 2026.*	
1/ 1.10.18 & Table 1.10.18 (both new)	Monitoring requirements for electric propulsion systems is better clarified.
Part 4 Chapter 8: Electrical Installations *The amendments are applicable to ships contracted for construction on or after 1 January 2026.*	
1/ Table 1.13.1	Table 1.13.1 is completely revised to update ingress protection requirements.
3/ 3.19.1	Existing requirements are shifted from Sec.8, Cl 8.5.3 to better clarify the short circuit withstanding capability of cable end connectors or sockets.

7 /7.1.6.1	Editorial changes are made.
Section 8	Section 8 is completely revised to elaborate and provide better clarity on requirements for electric propulsion systems in ships.
Section 11	Section 11 is completely revised to elaborate and provide better clarity regarding requirements for electrical equipment used in explosive gas/ combustible atmospheres.
Part 5 Chapter 2: Oil Tankers *The amendments are applicable to ships contracted for construction on or after 1 January 2026.*	
1/ 1.4.1	Amendments made to align with the text of the SOLAS regulations.
1/ IR1.4.1 (new)	Interpretation is provided regarding the spaces referred to in Cl. 1.4.1.
2/ 2.2.6 (new)	Specifies requirements for fore peak ballast tanks and adjacent spaces, covering ballast system integration, access routes, ventilation, gas freeing, hazard classification, and safety measures for preventing gas exposure and ignition risks.
6/ 6.2.7	Few requirements in Cl. 6.2.7 are deleted as they are now covered under newly added Cl. 2.2.6.
Appendix C/ C.1 (new)	Examples of the interpretations referred to in IR.1.4.1 are provided.
Appendix C/ C.2 (new)	Examples of the requirements referred to in Cl. 2.2.6.1 and Cl. 2.2.6.2 are provided.
Part 5 Chapter 3: Chemical Carriers *The amendments are applicable to ships contracted for construction on or after 1 January 2026.*	
1/ 1.3.6 & 3 /3.9(new)	Appropriate cross-references to the requirements in Part 5, Chapter 2 are provided along with exclusions applicable to chemical tankers.
Part 5 Chapter 4: Liquefied Gas Carriers *The amendments are applicable to ships contracted for construction on or after 1 January 2026.*	
4/ 4.23.1.1	The intent of the minimum design pressure defined in Cl. 4.23.1.2 is clarified.
4/ IR 4.23.4.1 (new)	Requirements for additional fatigue verification of large Type C independent tanks are specified.
4/ IR4.28.4(new)	Guidance on finite element analysis (FEA) for Type C tanks is provided.
4/ IR4.28.5(new)	Buckling assessment criteria for Type C tanks are specified.
Part 5 Chapter 8: Offshore Support Vessels *The amendments are applicable to ships contracted for construction on or after 1 July 2025.*	
1/Table 1.2.2	Additional class notation WTV for well testing capability is added to the table.
Part 5 Chapter 11: Barges and Pontoons *The amendments are applicable to vessels contracted for construction on or after 1 July 2024.*	
2/ 2.1.2(new), 2.1.3(new) & 2.1.4(new)	New clauses outline general requirements for barges and pontoons, specifying that simplified rules for ships under 90m apply with exceptions, a modified acceleration parameter (a_0) is to be used instead of standard values, and compressed air overpressure replaces P_{pv} in pressure calculations for tanks emptied by compressed air.
Part 5 Chapter 22: Vessels with Unattended Machinery Spaces *The amendments are applicable to ships contracted for construction on or after 1 January 2026.*	
3/ 3.1.10(new)	It is specified that the monitoring requirements for electric propulsion systems are to comply with Part 4, Chapter 7, Section 1, Table 1.10.18.
Part 5 Chapter 35: Gaseous Fuel or other Low Flash Point Fueled Ships *The amendments are applicable to ships contracted for construction on or after 1 January 2026.*	
6/ 6.4.15.3.1.1	The intent of the minimum design pressure defined in Cl. 6.4.15.3.1.2 is clarified.
6/ IR 6.4.15.3.4.1	Requirements for additional fatigue verification of large Type C independent tanks are specified.
6/ IR 6.4.17.1(new)	Guidance on finite element analysis (FEA) for Type C tanks is provided.

6/ IR 6.4.17.3(new)	Buckling assessment criteria for Type C tanks are specified.
Part 6 Chapter 1: General *The amendments are applicable to ships constructed on or after 1 January 2026.*	
1/ 1.3.5, 1.3.10(new)	Cross references are updated to clarify the applicability of the relevant requirements to existing and new ships.
3/ 3.59, 3.60, 3.61 (all new)	Definitions of “Confirmed case (flashpoint)”, “Representative sample” and “Oil Fuel” are added
Part 6 Chapter 2: Prevention of Fire and Explosion *The amendments are applicable to ships constructed on or after 1 January 2026.*	
1/1.2.1.6(new)	Requires ships carrying oil fuel before bunkering to have a signed declaration certifying compliance with flashpoint standards (ISO 2719:2016) or confirming it is ≥ 70°C (per MARPOL Annex VI/18).
1/1.2.1.7(new)	A new clause is added to emphasize that delivered oil fuel is not to jeopardize ship safety, adversely affect machinery performance, or be harmful to personnel.
Part 6 Chapter 3: Suppression of Fire *The amendments are applicable to ships constructed on or after 1 January 2026.*	
1/1.5.2.1	The term “alarm system” is clarified as “fire alarm system” and other editorial changes are made for better clarity.
1/1.5.5	Title amended to clarify applicability of requirements to new ships.
1/1.5.5.1, 1.5.5.2, 1.5.5.3	It is clarified that smoke detection requirements are applicable to control stations and cargo control rooms also.
1/ 1.5.6 (new)	The existing requirements under 1.5.5 are now shifted under this new clause and they will be applicable to cargo ships constructed before 01 January 2026.
3/ 3.6.1	A note is added to clarify that Cl. 3.6.1 is applicable to ships constructed before 1 January 2026.
4/ 4.11(new)	New sub-section is added to clarify restrictions and disposal requirements for prohibited substances like perfluorooctane sulfonic acid (PFOS) in fire extinguishing media for new and existing ships.
Part 6 Chapter 3: Suppression of Fire *The amendments are applicable to ships constructed on or after 1 January 2026.*	
Section 3	The title heading is amended to expand the scope of protection to include "Open and Closed" Ro-ro Spaces and "Weather Decks Intended for the Carriage of Vehicles".
3/ 3.1.1	Editorial changes are made to expand the fire protection requirements to weather deck intended for carriage of vehicles.
3/ 3.2.1.3	Applicability of requirements to passenger ships constructed before 1 January 2026, including those built before 1 July 2012 is clarified.
3/ 3.3.1.5	The amendment clarifies that the requirements are applicable to cargo ships
3/ 3.4.1 (3.4.1.1 to 3.4.1.6) (all new)	These amendments specify requirements for fixed fire detection and alarm system in passenger and cargo ships based on construction date.
3/ 3.4.3.1	Amendments are made to clarify the requirements for existing passenger ships.
3/ 3.4.4 (new)	Video monitoring requirements on new and existing passenger ships are specified.
3/ 3.5, 3.5.1 (new)	Structural fire protection requirements for special category and ro-ro spaces on new and existing passenger ships are specified.
3/ 3.5.2 (new)	Requirements for the arrangement of openings in ro-ro and special category spaces of passenger ships are specified.
3/ 3.5.3 (new)	Fire safety requirements for weather decks intended for carriage of vehicles are specified.
3/ 3.6.2 (new)	Requirements for fixed water-based fire extinguishing system on weather decks intended for carriage of vehicles are specified.
3/ 3.7 (new)	Signage and marking requirements for fixed pressure water spraying systems in vehicle, special category and ro-ro spaces of new passenger ships are specified.
7/ 7.6.1	Editorial changes are made for better clarity.

Part 6 Chapter 8: Fire Safety Systems Code *The amendments are applicable to ships constructed on or after 1 January 2026.*	
7/ 7.2.5 (new)	This new subsection specifies fixed water-based fire-extinguishing systems for ro-ro passenger ships with weather decks intended for carriage of vehicles.
9/ 9.1.1	Clarity is provided on applicability of requirements to new and existing ships.
9/ 9.2.3.1.3 to 9.2.3.1.5	Amendments are made to provide requirements for linear heat detectors.
9/ 9.2.4.2.2.2 (new)	Specific spacing limits for linear heat detection systems are introduced.
9/ Table 9.1	Amendments are made to specify spacing requirements for combined smoke and heat detectors also.
9/ 9.2.5.1.2 (new) to 9.2.5.1.4 (new)	Audio-visual fire alarm requirements on new and existing ro-ro passenger ships are specified.

TABLE 2 – CORRIGENDA INCORPORATED IN THIS NOTICE

Section / Clause	Subject/ Corrigenda
Part 2 Chapter 4: Steel Castings	
4/ 4.15.3.5.1	'Three' macro-sections are to be there for macro-examination.
Part 2 Chapter 8: Copper Alloys	
3/ Table 3.10.2	Max. acceptable value for "a" is deleted for better clarity.
Part 3 Chapter 5: Design Loads	
5/ Table 5.1.2, Note 3)	For vessels of L < 90[m], the head of water above highest point of tank is corrected to (0.02L + 0.6) [m].
Part 3 Chapter 7: Hull Local Scantlings	
9/ 9.4.2 b)	The requirement for guard rails to be supported by stanchions spaced not more than 1.5 [m] is deleted.
9/ 9.4.2 d)	The diameter of wire rope lifeline and spacing of stanchions are corrected. Turn buckles added as an example for device to ensure tautness for wire ropes.
Part 3 Chapter 11: Special Hull Requirements	
5/ 5.2.1.1, 5.2.1.2, 5.2.2.1 & 5.2.2.2	The equations for design pressure are corrected.
5/ 5.3.2 & 5.4.1	Equations corrected
5/ 5.4.2	Cross reference updated.
5/ Table 5.4.2	Deleted.
6/ 6.5.2.3	Z_T is corrected to Z. Also, the term 'transverse' has been deleted for better understanding.
8/ 8.2.1.2	F_{sc-hs} is corrected to F_{sc-ib}
8/ 8.2.2.1	F_{sc-ib} is corrected to F_{sc-hs}
Part 3 Chapter 17: Hull Inspection, Workmanship and Testing	
3/ Table 3.4.1 Note 6)	Revision no. of the referenced MSC.1/ Circ. 1572 is updated.
Part 5 Chapter 8: Offshore Support Vessels	
2/ 2.4.5.6	Clarification provided regarding static pressure and units

Part 1

Regulations

Chapter 2

Periodical Surveys

Section 20

Surveys – Fuel Installations on Ships Utilizing Gaseous Fuel or Other Low Flash Point Fuels

20.1 Application

20.1.1 Requirements of this section apply to ships, other than those covered by Section 5, which utilize gaseous fuel or other low flash point fuels as a fuel for propulsion prime mover/auxiliary power generation arrangements and associated systems. These requirements are in addition to the requirements of Section 8.

20.1.1.1 For ships with notation **LFPF(ML)**, periodical survey requirements in IRS *Guidelines on Methanol Fueled Vessels* are to be complied with in lieu of the requirements in this section.

End of Chapter

Part 2

Inspection and Testing of Materials

Chapter 4

Steel Castings

Section 4

Steel Castings for Propellers

4.15 Welding procedure qualification test for repair of cast steel propeller

4.15.3 Examinations and tests

4.15.3.5 Macro-examination

.1 Three~~Two~~ macro-sections are to be prepared and etched on one side to clearly reveal the weld metal, the fusion line, and the heat affected zone. Cracks and lack of fusion are not permitted. Imperfections such as slag inclusions, and pores greater than 3 [mm] are not permitted.

End of Chapter

Part 2

Inspection and Testing of Materials

Chapter 8

Copper Alloys

Section 3

Castings for Propellers

3.10 Acceptance criteria for liquid penetrant testing

Table 3.10.2 : Allowable number and size of relevant indications in a reference area of 100 [cm^2], depending on severity zones[1)]

Severity zones	Max. total number of indications	Type of indication	Max. number of each type [1)2)]	Max. acceptable value for ~~"a" or~~ "l" of indications [mm]
A	7	Non-Linear Linear Aligned	5 2 2	4 3 3
B	14	Non-Linear Linear Aligned	10 4 4	6 6 6
C	20	Non-Linear Linear Aligned	14 6 6	8 6 6

Notes:

1) Singular non-linear indications less than 2 [mm] for zone A and less than 3 [mm] for the other zones are not considered relevant.

2) The total number of non-linear indications may be increased to the max. total number, or part thereof, represented by the absence of linear or aligned indications.

3.15 Manufacturer's Certificates

3.15.1 For each casting propeller the manufacturer is to supply to the Surveyor a certificate containing the following details:

a) Purchaser and order number

b) Shipbuilding project number, if known

c) Description of the casting with drawing number

d) Diameter, number of blades, pitch, direction of turning

e) Grade of alloy and chemical composition of each heat

f) Heat or casting number

g) Final weight

h) Results of non-destructive tests and details of test procedure where applicable

i) Portion of alpha-structure for CU 1 and CU 2 alloys

~~k)~~(j) Results of the mechanical tests

~~l)~~(k) Casting identification Number.

~~m)~~(l) Skew angle for high skew propellers, see 3.8.1.

End of Chapter

Part 3

General Hull Requirements

Chapter 2

Materials of Construction and Corrosion Additions

Section 5

Corrosion Additions

5.2 Corrosion addition determination

5.2.2 The total corrosion addition, t_c [mm], for both sides of the structural member are obtained by the following formula:

- for structural members with a gross offered thickness greater than 10 [mm]:

$$t_c = \text{Roundup}_{0.5}\,(t_{c1} + t_{c2}) + t_{res}$$

- for structural members with a gross offered thickness less than or equal to 10 [mm], t_c is the lesser of the following values:

$$t_c = \text{Roundup}_{0.5}\,(t_{c1} + t_{c2}) + t_{res}$$

$$t_c = 0.2t_{gr\_off}$$

$\text{Roundup}_{0.5}$ (t) means that "t" is rounded to the upper half millimeter.

For L<90[m], $\text{Roundup}_{0.5}$ (t) need not be considered in the total corrosion addition.

5.3 Stiffener

5.3.4 The total corrosion addition determined as per Cl. 5.2.2 based on the gross offered thickness of the stiffener is to be applied to both web and flange.

End of Chapter

Part 3

General Hull Requirements

Chapter 5

Design Loads

Section 2

Ship motions and Accelerations

Symbols

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

a_o = Common acceleration parameter

$$= (1.58 - 0.47C_b)\left(\frac{2.4}{\sqrt{L}} + \frac{34}{L} - \frac{600}{L^2}\right)$$

not to be taken more than ~~0.7~~0.52

2.1 Ship motions and accelerations

2.1.3.5 Pitch acceleration

The pitch acceleration, a_{pitch}, in [rad/s^2], is to be taken as:

$$a_{pitch} = \theta \frac{\pi}{180}\left(\frac{2\pi}{T_p}\right)^2 f_p$$

For L<90[m], the pitch acceleration, a_{pitch}, in [rad/s^2], is to be taken as:

$$a_{pitch} = 0.38.\left(\frac{\theta}{T_p^2}\right).f_p$$

where:

θ = pitch angle using f_p equal to 1.0

f_p = Coefficient to be taken as:

For strength assessment
$f_p = f_{ps}$

For fatigue assessment
$f_p = f_{fa}[0.28 - (5 + 6f_T)L \times 10^{-5}]$

2.2 Accelerations at any position

2.2.3 Combined accelerations

The combined accelerations in the ship's vertical, transverse, and longitudinal directions are to be taken as below:

2.2.3.1 Longitudinal acceleration

The combined longitudinal acceleration,a_ℓ in [m/s^2] at any position, (combined effect of surge and pitch) is to be taken as:

~~$a_\ell = \sqrt{a_{surge}^2 + [(g\sin\theta + a_{pitch-x})]^2}$~~

$$a_\ell = 0.7\sqrt{a_{surge}^2 + \frac{L_0}{325}[(g\sin\theta + a_{pitch-x})]^2}$$

where,

a_{surge} = surge acceleration given in Cl.2.1.3.1.

$a_{pitch-x}$ = Longitudinal acceleration due to pitch, in [m/s^2]

$$= a_{pitch}(z - R)$$

L_0 = Rule length, but not to be taken less than 110[m].

Section 5

Internal Loads

5.1 Pressures due to liquids

5.1.2 Static liquid pressure in intact conditions

5.1.2.1 Static liquid pressure for strength assessment

(a) Normal operations at sea

The static pressure due to liquid in watertight boundaries (tank and ballast holds), P_{ls-1} during normal operations at sea, in [kN/m^2], is to be taken as:

• For ~~cargo tanks filled with liquid cargo/for~~ tanks arranged with pressure relief valves

$$P_{ls-1} = f_{cd}\,\rho_L\,g(Z_{top} - Z) + P_{PV}$$

• For other cases

$$P_{ls-1} = \rho_L\,g(Z_{top} - Z + 0.5\,h_{air})$$

(b) Normal operations at harbour operations

The static pressure, P_{ls-2} due to liquid in watertight boundaries (tank and ballast holds), for harbour operations, in [kN/m2], is to be taken as:

• For ~~cargo tanks filled with liquid cargo/for~~ tanks arranged with pressure relief valves

$$P_{ls-2} = \rho_L\,g(Z_{top} - Z) + P_{PV}$$

• For other cases

$$P_{ls-2} = \rho_L\,g(Z_{top} - Z) + P_0$$

where:

P_0 = Static pressure, in [kN/m^2], to be taken as:

P_0 = 0.2L+ 6 for L < 90[m]

= 24 for L ≥ 90[m]

for ballast hold in dry cargo vessels:

P_0 = 0

Table 5.1.2: Design testing load height, Z_{ST}

where:
Z_{bd} = Z coordinate, in [m], of the bulkhead deck
Z_h = Z coordinate, in [m], of the top of hatch coaming
Z_c = Z coordinate, in [m], of the top of chain pipe.

1) Applicable to double bottom tank connected with hopper side tanks, topside tanks or double side tanks.
2) Tank test load is not applicable for cargo tanks carrying LNG.
3) 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 500GT and above and passenger ships, for tanks forming part of the watertight subdivision (See Pt.3, Ch.5, Cl.5.1.2.1(b)), head of water above the highest point of tank is to be 2.4[m].

End of Chapter

Part 3

General Hull Requirements

Chapter 6

Hull Girder Strength

Section 3

Hull Girder Yield Check

3.5 Definitions of hull girder stress components

3.5.1 Longitudinal stress

3.5.1.2 Longitudinal stresses induced by dynamic hull girder bending moment

The longitudinal stresses, in [N/mm^2], induced by vertical and horizontal wave bending moment for a dynamic load case in seagoing condition at the transverse section considered, are obtained from the following formula:

$$\sigma_{wv-LC} = \frac{M_{wv-LC}}{I_{y-n50}}(z - z_{n-n50})10^{-3}$$

$$\sigma_{wh-LC} = -\frac{M_{wh-LC}}{I_{z-n50}}\, y.\, 10^{-3}$$

For L<90[m], the longitudinal stresses, in [N/mm^2], induced by vertical and horizontal wave bending moment in seagoing condition at the transverse section considered, are obtained from the following formula:

$$\sigma_{wv} = \frac{M_{wv-LC}}{I_{y-n50}}(z - z_{n-n50})10^{-3}$$

$$\sigma_{wh} = -\frac{M_{wh-LC}}{I_{z-n50}}\, |y|.\, 10^{-3}$$

End of Chapter

Part 3

General Hull Requirements

Chapter 7

Hull Local Scantlings

Section 7

Intersection of Stiffeners and Primary Supporting Member

7.1 Cutouts

7.1.1 Cutouts for the passage of stiffeners through the web of primary supporting members, and the related collaring arrangements, are to be designed to minimize stress concentrations around the perimeter of the opening and on the attached web stiffeners.

7.1.2 The total depth of cut-outs without lug or collar plate is to be not greater than 50% of the depth of the primary supporting member. ~~A larger depth of cut-outs may be accepted given that shear strength and buckling capacity are sufficient.~~ The shear strength and buckling capacity are to be sufficient in way of cutouts for stiffeners.

Section 9

Bulwarks and Guard Rails

9.4 Gangways, walkways and passageways

9.4.2 Protection of crew requirements for specific types

(b) On or near the centreline of a ship a permanent and efficiently constructed gangway fitted at or above the level of the superstructure deck, providing a continuous platform at least 0.6[m] in width and a nonslip surface, with guard rails extending on each side throughout its length. Guard rails are to be at least 1[m] high with courses as required in Cl.9.3.1 and Cl.9.3.2.5 above ~~and supported by stanchions spaced not more than1.5 [m]~~; a foot stop are to be provided.

(d) A ~~10[mm] minimum diameter~~ wire rope lifeline not less than 10[mm] in diameter, supported by stanchions ~~about~~not more than 10[m] apart, or ~~A~~ a single handrail or wire rope attached to hatch coamings, continued and ~~adequately~~ supported between hatchways.

Alternative transverse locations to (c), (d) and (f) above: (indicated as (1) to (5) in Table 9.4.1.)

(1) at or near centre line of ship; or fitted on hatchways at or near centre line of ship

(2) fitted on each side of the ship

(3) fitted on one side of the ship, provision being made for fitting on either side

(4) fitted on one side only

(5) fitted on each side of the hatchways as near to the centre line as practicable.

Additional requirements are also to be met:

– In all cases where wire ropes are fitted, adequate devices (for example turn buckles) are to be provided to ensure their tautness.

End of Chapter

Part 3

General Hull Requirements

Chapter 11

Special Hull Requirements

Section 5

Wheel Loading

5.2 Wheel loads

5.2.1 The design pressure 'P_{wl}', in [kN/m2], from the wheels of individual vehicles on deck with specified arrangement and dimension of footprints is to be taken as:

5.2.1.1 In harbour condition:

$$P_{wl-h2} = \frac{W}{n.a a_1.b b_1}.\left(g + \frac{3}{\sqrt{W}}\right)10^6$$

5.2.1.2 In sea going condition:

$$P_{wl-s1} = \frac{W}{n.a a_1.b b_1}.(g + a_v)10^6$$

where,

$a a_1$ = Extent in [mm], of the load area parallel to the stiffeners (Refer Table 5.2.1).

$b b_1$ = Extent in [mm], of the load area perpendicular to the stiffeners (Refer Table 5.2.1).

5.2.2 If the arrangement and dimensions of footprints are not available for vehicles with pneumatic tyres, the design pressure, in [kN/m2], may normally be taken as:

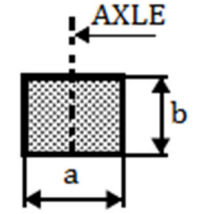
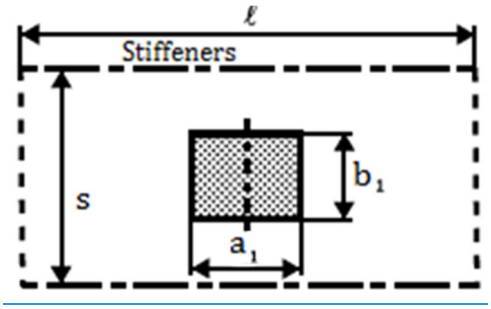
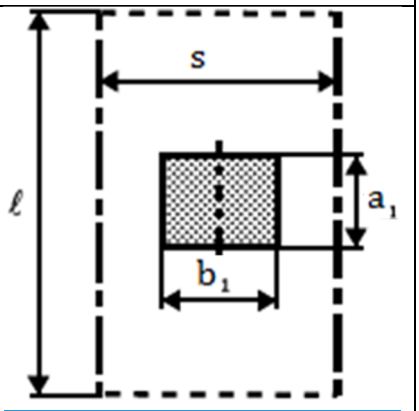
5.2.2.1 In harbour condition

$$P_{wl-h2} = \frac{P_T}{n_0}.\left(1 + \frac{3}{g\sqrt{W}}\right)$$

5.2.2.2 In sea going condition

$$P_{wl-s1} = \frac{P_T}{n_0}.\left(1 + \frac{a_v}{g}\right)$$

Table 5.2.1: Load area definition

Number of wheels in a group	Wheel print dimensions (Imprint area between tyre and deck)	Design load area Axle perpendicular to stiffeners	Design load area Axle parallel to stiffeners
Single wheel			

5.3 Tyre print area

5.3.2 The load area dimensions, in [mm], are in general to be taken as:

$$a_1 = \sqrt{kA_t}.10^3$$

$$b_1 = \sqrt{A_t/k}.10^3$$

where,
k = k1 in general

= k2 for plating when k2 < k1 and

$$\frac{n_0 W}{n\ b_s^2}10^6 \geq 100$$

$$k_2 = \frac{\sqrt{A_t}}{2b_s}10^3$$

5.4 Scantling requirements

5.4.1 Deck plating

The net thickness, 't' in [mm], of deck plating subjected to wheel loadings, is not to be less than;

$$t = 77.4.f_a\sqrt{\frac{c_2.b_s.c.P_{wl}}{m.c_a.R_{eH}}}10^{-3}$$

5.4.2 Deck stiffeners

The net section modulus 'Z' in [cm3] of deck beams and longitudinal subjected to wheel loading is not to be less than:

$$Z = \frac{c_3.c.d.\ell_{bdg}.P_{wl}}{m.R_{eH}.C_s}10^{-3}$$

C_s = Permissible bending stress coefficient for stiffeners taken as:

$$C_s = \beta_s - \alpha_s\frac{|\sigma_{hg}|}{R_{eH}}$$

$C_{s-max.}$= Maximum permissible bending stress coefficient as defined in ~~Table 5.4.2~~. Chapter 7, Section 5.

β_s = Coefficient as defined in ~~Table 5.4.2.~~ Chapter 7, Section 5.

α_s = Coefficient as defined in ~~Table 5.4.2.~~ Chapter 7, Section 5.

~~**Table 5.4.2: Definition of α_s, β_s, $C_{s-max.}$**~~

~~**Acceptance criteria set**~~	~~**Structural member**~~	~~β_s~~	~~α_s~~	~~$C_{s-max.}$~~
~~AC-I~~	~~Longitudinal strength member~~	~~0.85~~	~~1.00~~	~~0.75~~
	~~Transverse or vertical member~~	~~0.75~~	~~0.00~~	~~0.75~~
~~AC-II~~	~~Longitudinal strength member~~	~~1.00~~	~~1.00~~	~~0.90~~
	~~Transverse or vertical member~~	~~0.90~~	~~0.00~~	~~0.90~~

Section 6

Special Hull Structures

6.5 Propeller shaft brackets

6.5.2 Double arm propeller shaft brackets

6.5.2.3 Scantling requirement

The scantlings of solid or fabricated shaft brackets are to comply with the following:

$$h \geq 0.4 d_{ts} \text{ [mm]}$$

$$A \geq 0.4 d_{ts}^2 \text{ [mm}^2\text{]}$$

$$Z_T \geq 0.12 d_{ts}^3 \text{ [mm}^3\text{]}$$

where,

d_{ts} = Propeller tail shaft diameter, in [mm].

d_{ts} should be taken as the provided value with a specified minimum tensile strength of 450[N/mm^2] if it is more than the actual value.

h = Thickness of the strut section, in [mm] as given in Figure 6.5.2.

A = Gross area of the strut section, in [mm^2].

Z_T = Gross section modulus of the strut against ~~transverse~~ bending, in [mm^3]. Z_T is to be calculated with reference to the neutral axis YY as indicated in Figure 6.5.2.

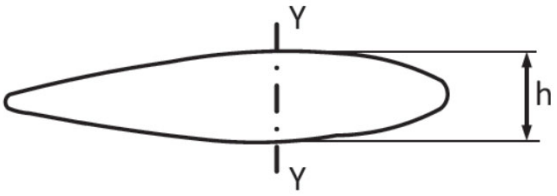


Figure 6.5.2: Sectional view of the strut

Section 8
Steel Coil Loading

8.2 Total loads

8.2.1 Total load on the inner bottom

8.2.1.2 For ships with length L< 90 [m], ~~F_{sc-hs}~~ F_{sc-ib} 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-hs}, ~~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.

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 : 6. Where water tightness of a watertight door has not been confirmed by prototype test, testing by filling watertight spaces with water is to be carried out. See SOLAS regulation II-1/16.2 and MSC.1/Circ.1572/Rev.2~~1~~.

End of Chapter

Part 4

Main and Auxiliary Machinery

Chapter 1

General Requirements for the Design and Construction of Machinery

Section 1

General

1.7 Environmental conditions

Table 1.7.1 : Machinery inclinations				
Installations/Components	**Angle of inclination [1]**			
	Athwartships		**Fore and aft**	
	Static	**Dynamic**	**Static**	**Dynamic**
Main and auxiliary machinery	15°	22.5°	5°[4]	7.5°
Safety equipment e.g. emergency power installations, emergency fire pumps and their devices Switch gear, electric and electronic appliances[2] and remote control systems	22.5°[3]	22.5°[3]	10°	10°

Notes

1 Athwartships and fore and aft inclinations occur simultaneously.

2 Switches and controls are to remain in their last set position. No undesired switching operations or operational changes are to occur.

3 In ships for the carriage of liquefied gases and of chemicals the emergency power supply ~~must also~~ is to remain operable with the ship flooded to a final athwartships inclination upto maximum of 30°.(See Part 5, Chapter 3, Section 2.9.3.2 and Part 5, Chapter 4, Section 2.7.2.2)

4 For ships where Rule length (L) exceeds 100 [m], the fore and aft static angle of inclination can be taken as 500/L degrees.

5 Any deviations from these angles of inclination taking into consideration the size and service conditions of the ship will be specially considered.

End of Chapter

Part 4

Main and Auxiliary Machinery

Chapter 7

Control Engineering

Section 1

General

1.10 Displays, indications and alarms

1.10.18 In addition to the requirements specified above, the control, alarm, and monitoring systems for electric propulsion systems are also to comply with the monitoring requirements specified in Table 1.10.18.

Table 1.10.18 : Monitoring of Electric Propulsion Systems				
Item	**Alarm**	**Indication (Bridge & Main control location)**	**Auto shutdown**	**Comments**
Generator				
Coolant temperature, high	x	x		
Coolant leakage	x	x		
Cooling pump, failure	x	x		
Stator winding temperature, high	x	x		
Bearing temperature, high	x	x	x	
Bearing lubricating oil supply pressure, level low	x	x	x	
Bearing lubricating oil temperature, high	x	x	x	
Generator running		x		
Exciter system, failure	x	x	x	
Failure of online generator	x			
Motor				
Locked rotor protection, active	x	x	x	For icebreakers special arrangements are required.
Bearing temperature, high	x	x	x	
Bearing lubricating oil supply pressure, level low	x	x	x	
Bearing lubricating oil temperature, high	x	x	x	
Motor running		x		
Motor overspeed	x	x	x	Auto shutdown for DC propulsion motors only
Motor Short-circuit	x	x	x	
Motor overcurrent[1]	x	x	x	
Exciter system, failure	x	x	x	For AC synchronous motor and DC motor
Failure of online motor	x			
Transformer				
Transformer winding temperature, high	x	x		
Transformer protection, overcurrent / short circuit	x	x	x	
Convertors and Circuits				
Earth fault monitoring, level minimum	x	x		
Convertor circuit, Mains(input) failure	x	x		Shutdown to prevent damage

Notes:

1. Where the power system has feature to limit or reduce the power to propulsion motor, the same may be accepted in lieu of overcurrent trip. An audio-visual alarm is to be provided upon activation of power limit to propulsion motor. The set points of alarm, reduction/trip should be separated or time delayed to allow crew intervention before progression to the next level of protection .

End of Chapter

Part 4

Main and Auxiliary Machinery

Chapter 8

Electrical Installations

Section 1

General Requirements

1.13 Enclosures

1.13.1 The enclosure types given in Table 1.13.1 are required as a minimum.

Table 1.13.1 : Enclosure types in relation to location
(N : Normally not accepted for installation in this location)

Location	Switchboards	Control gear and motor starters	Rotating machines	Transformers and rectifiers	Lighting fittings	Heating appliances	Socket outlets	Accessories such as switches connection boxes
Engine and boiler rooms								
above the floor	IP 22	IP 22	IP 22	IP 22	IP 22	IP 22	IP 44	IP 44
dry control rooms	IP 22	IP 22	IP 22	IP 22	IP 22	IP 22	IP 22	IP 22
below the floor	N	N	IP 44	N	IP 44	IP 44	N	IP 44
closed compartments for fuel oil and lub.oil separators	IP 44	IP 44	IP 44	IP 44	IP 44	IP 44	N	IP 44
Fuel oil tanks	N	N	N	N	N	N	N	N
Ballast and other water tanks, bilge wells	N	N	IP 68	N	N	IP 68	N	N
Ventilation ducts	N	N	IP 44	N	N	N	N	N
Deckhouses, forecastle spaces, steering gear compartments and similar spaces	IP 22	IP 22	IP 22	IP 22	IP 22	IP 22	IP 44	IP 44
Ballast pump rooms and similar rooms below the loadline	IP 44	IP 44	IP 44	IP 44	IP 44	IP 44	IP 56	IP 56
Cargo holds	N	N	IP 44	N	IP 55	N	IP 56	IP 56
Open deck, keel ducts	IP 56	IP 56	IP 56	IP 56	IP 55	IP 56	IP 56	IP 56
Battery rooms, lamp rooms, paint stores, stores for welding gas bottles	N	N	EX	N	EX	EX	N	EX
Dry accommodation spaces	IP 20	IP 20	IP 20	IP 20	IP 20	IP 20	IP 20	IP 20
Batch rooms and showers	N	N	N	N	IP 44	IP 44	N	IP 56
Galleys, laundries and similar rooms	IP 44	IP 44	IP 44	IP 44	IP 44	IP 44	IP 44	IP 44

Table 1.13.1 : Enclosure types in relation to location

Condition in location	Example of location	Switchboards, control gear, motor starters	Generators	Motors	Transformers, semi-conductors, convertors	Luminaries	Heating appliances	Cooking appliances	Accessories[1] (switches, socket outlets, boxes)
Danger of touching live parts only	Dry accommodation spaces and dry control room	IP20	N	IP20	IP20	IP20	IP20	IP20	IP20
Danger of dripping liquid and/or moderate mechanical damage	Control rooms (Navigation Bridge)	IP22	N	IP22	IP22	IP22	IP22	IP22	IP22
	Engine and boiler rooms above floor	IP22	IP22	IP22	IP22	IP22	IP22	IP22	IP44
	Steering gear rooms	IP22	IP22	IP22	IP22	IP22	IP22	N	IP44
	Refrigerating machinery rooms (excluding ammonia plants)	IP22	N	IP22	IP22	IP22	IP22	N	IP44
	Emergency machinery rooms	IP22	IP22	IP22	IP22	IP22	IP22	N	IP44
	General storerooms	IP22	N	IP22	IP22	IP22	IP22	N	IP22
	Pantries	IP22	N	IP22	IP22	IP22	IP22	IP22	IP44
	Provision rooms	IP22	N	IP22	IP22	IP22	IP22	N	IP22
Increased danger of liquid and/or mechanical damage	Bathrooms and / or showers	N	N	N	N	IP34	IP44	N	IP55
	Engine and boiler rooms below floor	N	N	IP44	N	IP34	IP44	N	IP55[1]
	Closed fuel oil and lube oil separator rooms	IP44	N	IP44	N	IP34	IP44	N	IP55[1]
Increased danger of liquid and mechanical damage	Ballast pump rooms	IP44	N	IP44	IP44	IP34	IP44	N	IP55
	Refrigerated rooms	N	N	IP44	N	IP34	IP44	N	IP55
	Galleys and laundries	IP44	N	IP44	IP44	IP34	IP44	IP44	IP44
Danger of liquid spraying, presence of cargo dust, serious mechanical damage, aggressive fumes	Shaft or pipe tunnels in double bottom	IP55	N	IP55	IP55	IP55	IP55	N	IP56
	Holds for general cargo	N	N	N	N	IP55[2]	N	N	IP55[2]
Danger of liquid in massive quantities	Open deck	IP56	N	IP56	N	IP55	IP56	N	IP56
Danger of liquid submersion	Ballast and other water tanks, bilge wells	N	N	IPX8	N	N	IPX8	N	N

"N" – Normally not recommended for installation.

Notes:

1. Socket-outlets are not to be installed in machinery spaces below the floor, closed fuel and lubricating oil separator rooms or spaces requiring certified safe-type equipment.

2. For hazardous dust, an appropriate degree of protection is IP66 or certified safe type.

Section 3

Cables and Busbar Trunking Systems

3.19 Cable ends

3.19.1 The ends of all conductors of cross-sectional area greater than 4 [mm^2] are to be fitted with soldering sockets, compression type sockets or mechanical clamps. Corrosive fluxes are not to be used. They are to be arranged and supported in a manner suitable for withstanding the electro-mechanical forces due to a short circuit.

Section 7

Miscellaneous Equipment

7.1.6 Electrical equipment

7.1.6.1 Switches, fuses and other electrical equipment liable to cause an arc should not normally be installed in battery compartments. Where such equipment is necessary for operational reasons, the equipment is to comply with Section 11.16 of this Chapter. ~~should be certified for Group II C gases and temperature Class T1 in accordance with IEC 79, "Electrical Apparatus for Explosive Gas Atmospheres" or an equivalent national standard.~~

Section 8

Electric Propulsion Systems

8.1 General

8.1.1 The requirements in this Section are to be complied with in addition to the relevant Sections of this Chapter and apply to propulsion systems, where the main propulsion is performed by electric motors.

8.1.98 Motors and generators ~~of 400 [kW] or over~~ are to be provided with means of heating the windings to prevent condensation when idle. ~~If steam pipes are used for this purpose the joints are not to be within the machine.~~

8.1.10 Propulsion motors and generators are to be provided with temperature detectors in the stator windings.

8.2 System Design

8.2.4 A power management system is to be provided. Power management system failure is to be alarmed at normally manned control location. The power management system is to prevent overloading of generator and ensure a safe distribution of power to ship services and propulsion by tripping of non-essential services and /or reduction in propulsion power~~,~~ and is to be provided with an audio-visual alarm indication.

8.2.5 Electric propulsion systems are to be designed for defined operating modes of the vessel, as described in the design philosophy document.

8.2.65 For vessels where a propulsion device driven by electric motors is proposed as the sole means of propulsion, at least two independent electric propulsion motors are to be provided. Single failure in propulsion systems (i.e. electrical propulsion motor and drives) is not to result in total loss of vessel propulsion.

8.2.7 Where separately driven direct current generators are connected electrically in series, means are to be provided to prevent reversal of the direction of rotation of any of them on the failure of the prime movers.

8.2.8 Where, on stopping or reversing the propeller, the regenerated energy transmitted by the propulsion motor is such as to cause a dangerous increase of speed in the prime mover, means are to be provided for suitably absorbing or limiting such energy.

8.3 Excitation

~~8.3.2 Where motor driven exciters, boosters, balancers or rectifiers are provided for excitation purposes, provision for an alternative supply of excitation is to be made. Where two machines are used, each of at least 50 per cent of the required power, it will be sufficient to provide one spare machine.~~

~~8.3.3 Negative boosters are to be provided with overspeed protection where necessary.~~

8.3.2 Generators are to be self-excited. Where the generator is separately excited, the exciter system is to be supplied by two independent power supplies. The arrangement is to be submitted for approval.

8.3.3 For propulsion motors, the exciter circuits are to be supplied from the same energy source supplying the stator windings.

Note: The motor stator winding and its exciter system are to be supplied from the same section of the switchboard.

8.3.4 In direct current constant pressure systems, where generators are supplying dedicated power to electrical propulsion motors, arrangements for generator and motor excitation are to be such that if the motor excitation circuit is opened by a switch or contactor, the generator excitation is simultaneously interrupted, or the generator voltage is immediately reduced to zero.

8.3.5 Where excitation is obtained from the auxiliary busbars, means are to be provided to limit the voltage induced at the busbars when the auxiliary circuit-breaker or the distribution circuit-breaker opens

8.3.6 . For the protection of field windings and cables, means are to be provided for limiting the induced voltage when the field circuits are opened or, alternatively, the induced voltage, when the field circuits are opened, is to be taken as the nominal design voltage.

8.3.7 Shunt resistors which are connected across the field circuit of synchronous propulsion motors, when they are functioning as asynchronous motors, are to be suitably insulated for the voltage induced when reversing, and are to be amply rated to allow for inadvertent delay during the reversing operation.

8.4 Controls

8.4.3 Suitable interlocks~~, operating preferably by mechanical means,~~ are to be provided to prevent damage to the plant as a result of incorrect switching, such as the opening of switches or contactors not intended to be operated while carrying current or such as the simultaneous closing of the ahead and astern circuits.

8.4.4 Local controls are to be provided, independent of any remote or automatic system, to permit effective control of the propulsion equipment.~~Provision is to be made for the manual operation, without undue manual effort, of all maneuvering contactors, switches, field regulators and controllers. Where electric, pneumatic or hydraulic aid is used for normal operation, failure of such aid is not to result in interruption of power to the propeller shaft and any such device is to be capable of purely manual operation without delay. This latter requirement does not apply to bridge control equipment.~~

8.5 Cables

8.5.1 Conductors in circuits essential for maneuvering or maintenance of propelling power are to be stranded, having not less than seven strands, and are to have a nominal cross-sectional area of not less than ~~2.5~~1.5 [mm^2].

~~8.5.3 Cable ends are to be fitted with connectors or connecting sockets of appropriate size and in such a manner as to inhibit corrosion. They are to be arranged and supported in a manner suitable for withstanding the electro-mechanical forces due to a short circuit.~~

~~**8.8 Discharge protection**~~

~~8.8.1 For the protection of field windings and cables, means are to be provided for limiting the induced voltage when the field circuits are opened or, alternatively, the induced voltage, when the field circuits are opened, is to be taken as the nominal design voltage.~~

~~8.8.2 Where excitation is obtained from the auxiliary busbars, means are to be provided to limit the voltage induced at the busbars when the auxiliary circuit-breaker or the distribution circuit-breaker opens.~~

~~8.8.3 Shunt resistors which are connected across the field circuit of synchronous propulsion motors, when they are functioning as asynchronous motors, are to be suitably insulated for the voltage induced when reversing, and are to be amply rated to allow for inadvertent delay during the reversing operation.~~

~~**8.9 Safety devices**~~

~~8.9.1 Where separately driven direct current generators are connected electrically in series, means are to be provided to prevent reversal of the direction of rotation of any of them on the failure of the prime movers.~~

~~8.9.2 Where, on stopping or reversing the propeller, the regenerated energy transmitted by the propulsion motor is such as to cause a dangerous increase of speed in the prime mover, means are to be provided for suitably absorbing or limiting such energy.~~

~~8.9.3 Contactors and switches used for reversing the rotation of the propulsion motors are to be provided with means for forcibly opening them if they should in advertently remain closed.~~

8.9~~11~~ Alarms

8.9.2 Where machines have liquid cooled systems, an audio-visual alarm device is to be provided and arranged to operate in any of the following scenarios:

- leakage of coolant
- coolant temperature high
- failure of cooling pump

8.11 Instruments

8.11.1 The main control station is to be provided with the following instruments:
8.11.1.1 AC systems:
(i) an ammeter and voltmeter for each generator, propulsion motor and propulsion transformer; wattmeter and frequency meter

for each generator and ammeter for each excitation circuit; and

(ii) a temperature indicator for each generator, propulsion transformer and propulsion motor windings and bearings, the indicator is to read stator winding temperature of the rotating machines, and cooling system temperature.

8.11.1.2 DC systems:

(i) a voltmeter and ammeter for each generator and propulsion motor; and
(ii) an ammeter for each excitation circuit.

8.11.2 Each control station is to be provided with instruments to indicate:

(i) propeller speed;

(ii) direction of rotation for a fixed pitch propeller or pitch position for a controllable pitch propeller;

(iii) visual indication of power limitation; and

(iv) indication of station in control.

Section 11

Electrical Equipment for use in Explosive Gas/Combustible Dust Atmospheres

~~**11.2 Selection of equipment**~~

~~11.2.1 When apparatus is to be installed in areas where an explosive gas atmosphere may be present, unless permitted otherwise by 11.2.2, it is to be of a 'safe type', as listed below, certified or approved by a competent authority for the gases encountered. The construction and type testing is to be in accordance with IEC Publication 79: Electrical Equipment for Explosive Gas Atmospheres or an acceptable and relevant national standard.~~

~~Intrinsically safe Ex 'i'~~

~~Increased safety Ex 'e'~~

~~Flameproof Ex 'd'~~

~~Pressurized enclosure Ex 'p'~~

~~Power filled Ex 'q'~~

~~Encapsulated Ex 'm'.~~

~~11.2.2 Consideration may be given to the use of equipment of the following types:~~

~~a) equipment such as control panels, protected by purging and pressurisation and capable of being verified by inspection as meeting the requirements of IEC 60079-2;~~

~~b) simple non-energy-storing apparatus having negligible surface temperature rise in normal operation, such as limit switches, strain gauges, etc., incorporated in intrinsically-safe circuits;~~

~~c) radio aerials having robust construction, meeting the relevant requirements of IEC 60079-15;~~

~~d) electrical apparatus with type of protection 'n' or 'N' provided it is in a well ventilated area on open deck and not within 3 [m] of any flammable gas or vapour outlet.~~

~~11.2.3 Where apparatus is to be installed in areas where combustible dusts may be present in quantities sufficient to create an explosive atmosphere, it is, when practicable, to be of a type certified or approved by a competent authority for the dusts and additionally any explosive gases encountered.~~

~~11.2.4 Electrical equipment for use in combustible dust atmospheres is to be so designed and installed as to minimize the accumulation of dust which may interfere with the safe dissipation of heat from the enclosure.~~

~~11.2.5 Where equipment certified for combustible dust, is not available, consideration will be given to the use of apparatus complying as a minimum, with the following requirements provided no explosive gases will be present:~~

~~a) the enclosure is to be at least dust protected (IP5X) having, when type tested, an ingress of fine dust within the enclosure not exceeding 10 g per [m^3] of free air space, and~~

~~b) the surface temperature of the apparatus, under the most onerous combination of normal operating conditions, but in the absence of a dust layer, is to be at least 10°C below the auto-ignition temperature of the dusts encountered, or~~

~~c) the equipment is to be certified intrinsically-safe having a temperature classification ensuring compliance with (b), or~~

~~d) pressurized and operated in accordance with procedures ensuring, prior to its reenergisation, the absence of dust within the enclosure following loss of pressurisation and consequent shutdown, and having surface temperature complying with (b), or~~

~~e) simple apparatus included in intrinsically-safe circuits or radio aerials, complying with 11.2.2 (b) or (c) respectively.~~

~~11.3 Installation of electrical equipment and cabling~~

~~11.3.1 The method of installation and application of safe type equipment is to be in accordance with IEC 79-14, or the national code of practice relevant to the standard to which the equipment has been certified. Any special requirements laid down by the equipment certification documentation are also to be observed. The ambient temperature range for which the apparatus is certified, is to be taken to be -20°C to 40°C, unless otherwise stated, and account is to be taken of this when assessing the suitability of the equipment for the auto-ignition temperature of the gases and dusts encountered.~~

~~11.3.2 All switches and protective devices from which equipment located in dangerous zones or spaces is supplied are to interrupt all poles or phases and, where practicable are to be located in non-hazardous zone or space. Such equipment, switches and protective devices are to be suitably labeled for identification purposes.~~

~~11.3.3 Metal coverings of cables installed in dangerous zones or spaces are to be effectively earthed at both ends.~~

~~11.3.4 Cables associated with intrinsically-safe circuits are to be used only for such circuits. They are to be physically separated from cables associated with non-intrinsically-safe circuits, e.g. neither installed in the same protective casing nor secured by the same fixing clip.~~

~~11.3.5 Where there is risk of intermittent contact between armour and exposed metalwork, non-metallic impervious sheath is to be applied over metallic armour of cable.~~

11.24 ~~Dangerous zones and spaces~~Hazardous areas

11.24.1 A hazardous area is an area in which an explosive gas atmosphere is or may be expected to be present, in quantities such as to require special precautions for the construction, installation and use of electrical equipment. ~~Dangerous zones or spaces~~Hazardous areas and sources of hazard for ships intended for the carriage in bulk of oil cargoes, liquefied gases and other ~~hazardous~~ flammable liquid~~s~~ cargoes, ~~and~~ the requirements for ships carrying vehicles with fuel in their tanks, and the requirements for electrical equipment allowed in paint stores, welding gas (acetylene) bottle stores, battery room and ammonia plant room are defined in 11.10~~9~~ to 11.17~~2~~. The following principles are to apply in general, and where any specific arrangement does not fall into any of the categories covered by 11.10~~9~~ to 11.17~~2~~.

11.2.2 Hazardous areas associated with flammable liquids or gases are classified into zones based upon the frequency of the occurrence and duration of an explosive gas atmosphere, as follows:

Zone 0: an area in which an explosive gas atmosphere is present continuously or for long periods or frequently.

Zone 1: an area in which an explosive gas atmosphere is likely to occur in normal operation occasionally.

Zone 2: area in which an explosive gas atmosphere is not likely to occur in normal operation but, if it does occur, will persist for a short period only.

11.2.3 Hazardous areas associated with solid substances or packaged liquids are classified into zones based upon the frequency of the occurrence and duration of an explosive atmosphere due to the presence of gas and/or combustible dust, as follows:

Hazardous area: area in which an explosive atmosphere is likely to occur in normal operation (comparable with Zone 1)

Extended hazardous area: area in which an explosive atmosphere is not likely to occur in normal operation and, if it does occur, is likely to do so only infrequently and will exist for a short period only (comparable with Zone 2).

11.2.4~~.2~~ Spaces and locations are considered as hazardous in the presence of any of the following:~~A dangerous zone or space may arise from the presence of any of the following:~~

a) spaces or tanks containing either

i) flammable liquid having a flashpoint (closed-cup test), not exceeding 60°C;

ii) flammable liquid having a flashpoint exceeding 60°C, heated or raised by ambient conditions to a temperature within 15°C of its flashpoint;

iii) flammable gas.

b) piping systems or equipment containing fluid defined by (a) and having flanged joints or glands or other openings through which leakage of fluid may occur under normal operating conditions;

c) spaces containing solids, such as coal or grain, liable to release flammable gas and/or combustible dust;

d) spaces containing dangerous goods in packaged form, of the following Classes as defined in the IMDG Code:

- **1**(with the exception of goods in division 1.4, compatibility group S),
- **2.1** (inclusive of applicable gas bottles for onboard use),
- **3** (FP<23ºC),
- **6.1** (FP<23ºC) and
- **8** (FP<23ºC)

~~c)~~e) piping systems or equipment associated with processes (such as battery charging or electrochlorination) generating flammable gas as a by-product and having openings from which the gas may escape under normal operating conditions;

~~d)~~f) piping system or equivalent containing flammable liquids not defined by (a), having flanged joints, glands or other openings through which leakage of fluid in the form of a mist or fine spray may occur under normal operating conditions.

11.2.5~~4.3~~ The following ~~zones or spaces~~areas are regarded as ~~dangerous~~hazardous, Zone 0:

a) the interiors of those spaces~~, or~~ tanks, piping systems and equipment defined by 11.2.4~~.4.2~~(a) and ~~(c)~~(b);

b) enclosed, unventilated spaces containing pipework or equipment defined by 11.2.4(b) and (e);

11.2.6 The following areas are regarded as hazardous, Zone 1:

a) unventilated spaces separated by a single bulkhead or deck from a cargo defined by 11.2.4~~.4.2~~(a);

~~a)~~b) Ventilated spaces containing pipework or equipment defined by 11.2.4 (b) and (e)

~~b) enclosed or semi-enclosed spaces containing pipework or equipment defined by 11.4.2(b) and (d);~~

c) enclosed or semi-enclosed spaces with direct opening into a Zone 1 ~~dangerous space~~hazardous location;

d) zones within a 3 [m] radius of ventilation ~~inlets or~~ outlets, hatches or doorways or other openings into ~~dangerous~~ spaces~~, and within 3 [m] of the ventilation outlets of spaces regarded by 11.5 as open areas and which contain the pipework or equipment~~ defined by ~~11.4.2(b)~~11.2.6 a) or b); space where the hazard results from flammable gas or vapour having a density

relative to that of air of more than 0.5, the ~~dangerous zone~~hazardous zone is considered to extend. ~~vertically downward to solid deck, or for a distance of 9 [m], whichever is the lesser;~~

~~d)~~e) zones on open deck within 3 [m] of the ventilation outlets of cargo tanks defined in 11.2.4 (a), which permit the flow of small volumes of vapour or gas mixtures caused by thermal variation;

~~e)~~f) zones within a 3 [m] radius of flanged joints, or glands or other openings defined by 11.2.4.~~4.2~~(b); ~~in the case of gas or vapour having a relative density of more than 0.5, the dangerous zone is considered to extend vertically downwards as described under (e);~~

~~f)~~g) zones on open deck within a 1.5 [m] radius of any opening into a space defined by 11.2.6 (a); ~~the ventilation outlets of spaces regarded as open areas containing items defined under 11.4.2(d);~~

~~g)~~h) zones within a 1.5 [m] radius of flanged joints, or glands or other openings defined by 11.2.4.~~4.2(d)~~ (e) and ~~(e)~~ (f);

i) zones within a 3 [m] radius of bunds or barriers intended to contain spillage of liquids defined by 11.2.4.~~4.2~~(a).

j) interiors of chemical lockers, gas cylinder stores and other such spaces, as defined by 11.2.4 (d), containing dangerous goods for on-board use. This includes, but is not limited to, paints, gas cylinders, chemicals and small quantities of fuel.

k) zones within a 1.5 [m] radius of ventilation inlets or other openings serving spaces defined by 11.2.6 (b); and

~~h)~~l) zones on open deck within a vertical cylinder of unlimited height and 6 [m] radius centred upon the centre of the outlet, and within a hemisphere of 6 [m] radius below the outlet which permit the flow of large volumes of vapour or gas mixtures during loading/discharging/ballasting.

11.2.7 The following areas are regarded as hazardous, Zone 2:

a) ventilated spaces separated by a single bulkhead or deck from a Zone 0 space;

b) zones on open deck extending 1.5 [m] beyond those defined by 11.2.6 (d), (f), (g) (h) and (i);

c) zones on open deck extending 2 [m] beyond those defined by 11.2.6 (d);

d) zones on open deck extending 4 [m] beyond those defined by 11.2.6 (c)

e) enclosed or semi-enclosed spaces with direct opening into a Zone 2 hazardous location.

11.3 Selection of equipment for use in explosive gas atmospheres

11.3.1 When equipment is to be installed in areas where an explosive gas atmosphere may be present, it is generally to be of a type providing protection against ignition of the gases encountered and compliant with the relevant Parts of IEC 60079: Explosive atmospheres, or an acceptable and relevant National Standards.

11.3.2 The equipment protection type permitted depends on the hazardous area where the equipment is to be located, as defined in Table 11.3.2.

Table 11.3.2 : Equipment protection type for use in hazardous areas

Type of protection	Symbol	Zone	IEC standards
Intrinsically safe type, category-a	Ex "ia"	Zone 0, Zone 1, Zone 2	IEC 60079-11
Intrinsically safe type, category-b	Ex "ib"	Zone 1, Zone 2	IEC 60079-11
Flameproof type	Ex "d"	Zone 1, Zone 2	IEC 60079-1
Increased safety type	Ex "e"	Zone 1, Zone 2	IEC 60079-7
Pressurized or purged type	Ex "p"	Zone 1, Zone 2	IEC 60079-2
Encapsulated type	Ex "m"	Zone 1, Zone 2	IEC 60079-18
Powder filled type	Ex "q"	Zone 1, Zone 2	IEC 60079-5
Oil immersed type	Ex "o"	Zone 1, Zone 2	IEC 60079-6
Non-sparking type	Ex "n"	Zone 2	IEC 60079-15
Simple apparatus[1]	-	Zone 0, Zone 1, Zone 2	IEC 60079-11 and 60079-14

Notes:

1) Simple apparatus is defined as electrical component or combination of components of simple construction with well-defined electrical parameters which is compatible with the intrinsic safety or energy-limited safety of the circuit in which it is used and includes:

- passive components, e.g. switches, junction boxes, resistors and simple semi-conductor devices;
- sources of stored energy consisting of single components in simple circuits with well-defined parameters, e.g. capacitors or inductors, whose values are considered when determining the overall safety of the system;
- sources of generated energy, e.g. thermocouples and photocells, which do not generate more than 1.5 [V], 100 [mA] and 25 [mW].

11.4 Selection of equipment for use in the presence of combustible dusts

11.4.1 Where equipment is to be installed in hazardous areas, as defined by 11.2.3, associated with the presence of combustible dusts, it is, to be of a type certified by a National or other competent authority for the combustible dusts and, additionally, any explosive gases encountered.

11.4.2 Where optical fibre transmission equipment located in a hazardous area, extended hazardous area or non-hazardous area provides energy to, or passes optical energy through, a hazardous area with combustible dusts, then the optical energy levels are to be:

- restricted in hazardous area to 5 [mW/mm^2] or 35 [mW] maximum for constant wave sources or 0.1 [mJ/mm^2] for pulsed sources;
- restricted in extended hazardous area to 10 [mW/mm^2] or 35 [mW] maximum, for constant wave sources or 0.5 [mJ/mm^2] for pulsed sources;

Note: Where a pulsed source has a pulse interval less than 5 seconds, it is to be considered constant wave source.

11.4.3 Electrical equipment for use in hazardous areas is to be designed and installed to minimise the accumulation of dust which may interfere with the safe dissipation of heat from the enclosure.

11.4.4 Where equipment is to be installed in extended hazardous areas, as defined by 11.2.3, associated with the presence of combustible dust and, additionally, any explosive gases encountered, the following may be considered:

a) equipment permitted within a hazardous area as defined in 11.4.1;

b) equipment having degree of protection IP5X, or better, and having a surface temperature under normal operating conditions, but in the absence of a combustible dust layer, not exceeding two-thirds of the minimum ignition temperature in degrees celsius of the combustible dust/air mixture(s) that can be present and appropriate for any explosive gases encountered; and

c) equipment of a type which ensures absence of sparks or arcs and hot spots during normal operation.

11.4.5 Where equipment certified for combustible dusts is not available, consideration will be given to the use of equipment complying as a minimum, with the following requirements provided no explosive gases will be present:

a) the enclosure is to be at least dust protected (IP5X) having, when tested in accordance with IEC 60529, an ingress of fine dust within the enclosure not exceeding 10 [g/m^3] of free air space, and

b) the surface temperature of the equipment, under normal operating conditions, but in the absence of a combustible dust layer, is not to exceed two-thirds of the minimum ignition temperature in degrees Celsius of the combustible dust/air mixture(s) that can be present, or

c) the equipment is to be certified intrinsically safe “ia” or “ib” having a temperature classification ensuring compliance with Ex “n”, or

d) pressurised and operated in accordance with procedures ensuring, prior to its re-energisation, the absence of combustible dust within the enclosure following loss of pressurisation and consequent shutdown, and having surface temperature complying with (b), or

e) simple apparatus included in intrinsically safe circuits or radio aerials, complying with selection of equipment for use in hazardous Zone 1 or Zone 2 (refer Table 11.3.2) respectively.

11.5 Installation of electrical equipment

11.5.1 The method of installation and application of electrical equipment suitable for use in explosive gas atmospheres or in the presence of combustible dusts is to be in accordance with:

- IEC 60079-14: Explosive atmospheres– Part 14: Electrical installations design, selection and erection; or

- the national code of practice relevant to the standard with which the equipment complies.

11.5.2 The ambient temperature range for which the equipment is certified, is to be taken to be –20°C to 40°C, unless otherwise specified, this is to be taken into account when assessing the suitability of the equipment for the auto-ignition temperature of the gases and combustible dusts encountered.

11.5.3 Any special requirements laid down by the equipment certification documentation are also to be complied with.

11.5.4 All switches and protective devices from which electrical equipment located in hazardous areas is supplied are to be located in non-hazardous areas. Where it is not practicable to locate the switches and protective devices in non- hazardous area, then the applicable requirements of this section are to be applied to that equipment.

11.5.5 All switches and protective devices from which electrical equipment located in hazardous areas is supplied are to interrupt all poles or phases.

11.5.6 Electrical equipment in hazardous areas, switches and protective devices are to be clearly labelled for identification purposes.

11.6~~5~~ Semi-enclosed spaces

11.6~~5~~.1 Semi-enclosed spaces are considered to be spaces limited by decks and/or bulkheads in such a manner that the natural conditions of ventilation are ~~sensibly~~ different from those obtained on open deck.

11.8~~7~~ Pressurisation

11.8~~7~~.1 A space having access to a ~~dangerous space or zone~~hazardous area ~~as~~ defined ~~under~~ as Zone 1 and Zone 2 (11.2.6 and 11.2.7)~~11.4.3(c) to (i)~~ may be regarded as non-~~dangerous~~ hazardous if fulfilling all the following conditions:

a) access is by means of an air-lock, having gas-tight steel doors, the inner of which as a minimum, is self-closing without any hold-back arrangement;

b) it is maintained at an overpressure relative to the external hazardous area by ventilation from a non-dangerous area;

c) the relative air pressure within the space is continuously monitored and, so arranged, that in the event of loss of overpressure an alarm is given and the electrical supply to all equipment not of a safe type suitable for Zone 1 is automatically disconnected. Where the shut-down of equipment could introduce a hazard, an alarm may be given, in lieu of shutdown, upon loss of overpressure, and a means of disconnection of non-safe type electrical equipment, capable of being controlled from a manned station, provided in conjunction with an agreed operational procedure; where the means of disconnection is located within the space then it is to be effected by equipment of a safe type;

d) any electrical equipment required to operate upon loss of overpressure, lighting fittings and equipment within the air-lock, is to be of a safe type for Zone 1;

e) means are to be provided to prevent electrical equipment other than of a safe type suitable for Zone 1, being energized until the atmosphere within the space is made safe, by air renewal of at least 10 times the capacity of the space.

11.9~~8~~ Cable and cable installation

11.9~~8~~.1 Electric cables are not to be installed in ~~dangerous zones or spaces~~hazardous areas, except where specifically permitted by 11.10~~9~~. to 11.17~~1~~ or when associated with intrinsically-safe circuits.

11.9~~8~~.2 In addition to other requirements in this chapter, cables in ~~dangerous zones or spaces~~hazardous areas, or which may be exposed to cargo oil, oil vapour or gas, are to be either:

a) mineral insulated with copper sheath, or

b) armoured or braided (for mechanical protection and earth detection) with non-metallic impervious sheath.

11.10~~9~~ Requirements for tankers intended for the carriage in bulk of oil cargoes having a flash point not exceeding 60°C (closed cup test)

11.10~~9~~.1 The following requirements define the electrical equipment permitted within ~~dangerous spaces and zones~~hazardous areas and are in addition to the requirements of 11.1 to 11.9~~8~~.

11.15 Requirements for electrical equipment allowed in stores for welding gas (acetylene) bottles

11.15.1 Electrical equipment to be installed in stores for welding gas (acetylene) bottles is to be suitable for installation in Zone 1 and having minimum explosion group IIC and temperature class T2.

11.16 Requirements for electrical equipment allowed in battery rooms

11.16.1 Switches, fuses and other electrical equipment liable to cause an arc should not normally be installed in battery compartments. Where such equipment is necessary for operational reasons, is to be suitable for installation in Zone 1 and the equipment is to be certified for Group II C gases and temperature Class T1 in accordance with IEC 79, "Electrical Apparatus for Explosive Gas Atmospheres" or an equivalent national standard.

11.17 Requirements for electrical equipment allowed in ammonia plant rooms

11.17.1 Electrical equipment installed in ammonia plant rooms are to meet ISO/IEC 80079-20-1 group IIA class T1. The equipment is to be certified safe type suitable for installation in Zone 1.

End of Chapter

Part 5

Special Ship Types

Chapter 2

Oil Tankers

Section 1

General

1.4 Definitions

1.4.1 *Cargo area* is that part of the vessel that contains cargo holds, cargo tanks, slop tanks and cargo pump-rooms including pump rooms, cofferdams, ballast and void spaces adjacent to cargo tanks and also deck areas throughout the entire length and breadth of the part of the ship over the above mentioned spaces.

IR 1.4.1 Regarding the spaces referred to in 1.4.1, the following interpretation is provided:

- A non-hazardous space in the forecastle area which is protected from the cargo tanks by cofferdam, void space or other compartments, will not be defined as part of cargo area.

- Compartments located above the Cofferdam, void or other compartments protecting the non-hazardous spaces will be defined as part of the cargo area.

Refer Appendix C/ C.1 of this Chapter for an illustration of the above interpretation.

Section 2

Ship Arrangement

2.2 Tank arrangement

2.2.6 Fore peak ballast tanks and space arrangements

2.2.6.1 The fore peak tank can be ballasted with the system serving other ballast tanks within the cargo area, provided:

a) The vent pipe openings are located on open deck at a distance from sources of ignition as required by IEC 60092-502:1999. This requirement does not apply to sounding arrangements.

b) Access to the fore peak tank is direct from open deck. Alternatively, indirect access from the open deck to the forepeak tank may be from a pump-room, deep cofferdam, pipe tunnel, cargo hold, double hull space, bosun's store or similar compartment not intended for the carriage of oil or hazardous cargoes, conforming to the requirements of 2.3.4. Electrical equipment in such indirect access is to be of the certified safe type suitable for use in the hazardous area (as defined in IEC 60092-502) it opens into or is to be isolated before entry.

c) Continuous ventilation is maintained while accessing the forepeak tank.

d) The sounding arrangement to the fore peak tank is direct from open deck.

e) The fore peak tank is gas freed direct from open deck, or through a dedicated trunk to open deck. Before the manhole and the entrance of the dedicated trunk are opened, the trunk and the forepeak tank is to be confirmed as made gas free. Means are to be provided to free the space of gas without opening manholes or the entrance to a dedicated trunk. Manholes on the open deck and away from sources of ignition at the top of the dedicated trunk which are used to gas-free the space are allowed to be opened.

f) The fore peak ballast tank is considered as a hazardous zone 2 if segregated from cargo area with a cofferdam, or as a hazardous zone 1 if located adjacent to a cargo tank. For tankers where a bow thruster space is provided, the piping passing through the non-hazardous bow thruster room shall be fully welded and it is required to have the collision bulkhead valve located within the forepeak tank.

g) Means are to be provided on the open deck by a suitable portable instrument, to allow detection of toxic and flammable vapours within the fore peak tank (based on the cargoes carried in current voyage, and since last de-ballasting of fore peak tank was carried out), in order to ensure the fore peak tank is fully gas freed. In the case that sounding arrangements can be used as the means for the portable instrument additional means for the purpose is not required.

2.2.6.2 Additional requirements for forward spaces not being defined as a ballast tank

2.2.6.2.1 Any spaces, voids and/or indirect accesses from the open deck or intermediate space being located adjacent to cargo tanks, and/or are defined as hazardous area zone 1 or 2, is to follow the same requirements to openings and access as reflected for fore peak ballast tanks in 2.2.6.1.

2.2.6.2.2 In case any spaces or voids are defined as non-hazardous spaces and have access to other non-hazardous spaces (such as bosun store), the following applies:

a) For any non-hazardous space with access to a hazardous space (example: fore peak ballast tank), the non-hazardous space must have access directly to open deck and is to be gas freed directly from open deck, and not through the other non-hazardous space (example: bosun store).

b) Access from bosun store to a non-hazardous space (example: void) having access to hazardous space (example: fore peak ballast tank) may be accepted through a gas tight bolted manhole, with signboard stating that the non-hazardous space cannot be entered until the space is confirmed gas free. Separation of such spaces are described in IEC 60092-502:1999 section 4.1.4 and 4.1.5 as applicable.

2.2.6.3 Refer Appendix C/ C.2 of this Chapter for illustration of the requirements in 2.2.6.1 and 2.2.6.2 (as applicable).

2.2.6.4 The requirements of Section 2.2.6 are not applicable to ships assigned additional notation **FOR CARRIAGE OF LIQUID HAVING F.P EXCEEDING 60°C**

Section 6

Pumping and Piping Systems

6.2 Piping systems for bilge, ballast, oil fuel etc.

6.2.7 Ballast tanks and void spaces within the cargo area are not to be connected to cargo pumps or have any connections to the cargo system. A separate ballast/bilge pump is to be provided for dealing with the contents of these spaces. This pump is to be located in the cargo pump room or other suitable space within the cargo area.

Consideration will be given to connecting double bottom and/or wing tanks, which are in the cargo area, to pumps in the machinery spaces where the tanks are completely

separated from the cargo tanks by cofferdams, heating ducts, or containment spaces, etc.

~~The forepeak tank can be ballasted with the system serving ballast tanks within the cargo area, provided:~~

- ~~the forepeak tank is considered as hazardous area;~~
- ~~the vent pipe openings are located on open deck at an appropriate distance from sources of ignition. In this respect, the hazardous zones distances are to be defined in accordance to IEC 60092-502: Electrical installations in ships – Tankers – Special features;~~
- ~~means are provided, on the open deck, to allow measurement of flammable gas concentrations within the forepeak tank by a suitable portable instrument;~~
- ~~the sounding arrangement to the forepeak tank is direct from open deck;~~
- ~~the access to the forepeak tank is direct from open deck. Alternatively, indirect access from the open deck to the forepeak tank through an enclosed space may be accepted provided that:~~
- ~~In case the enclosed space is separated from the cargo tanks by cofferdams, the access is through a gas tight bolted manhole located in the enclosed space and a warning sign is to be provided at the manhole stating that the forepeak tank may only be opened after:~~

~~a) it has been proven to be gas free; or~~
~~b) any electrical equipment which is not certified safe in the enclosed space is isolated.~~

- ~~In case the enclosed space has a common boundary with the cargo tanks and is therefore a hazardous area, the enclosed space can be well ventilated.~~
- ~~The hazardous area classification for above is in accordance to IEC 60092-502: Electrical installations in ships – Tankers – Special features.~~

Appendix C

C.1 Fore peak ballast tanks and space arrangements

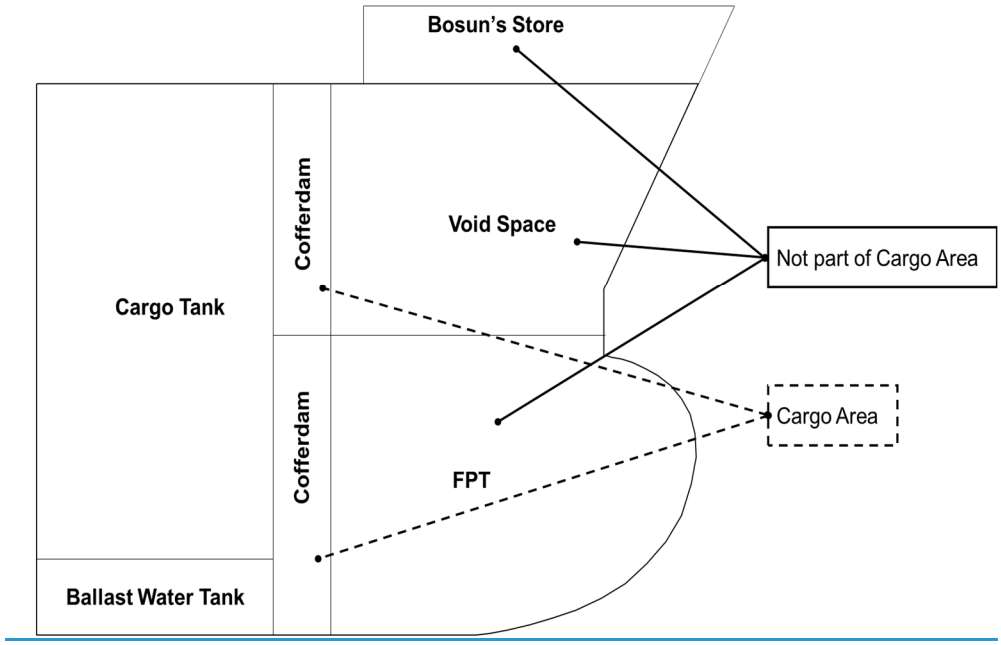


Figure C.1.1 Fore peak ballast tanks and space arrangements, Example 1

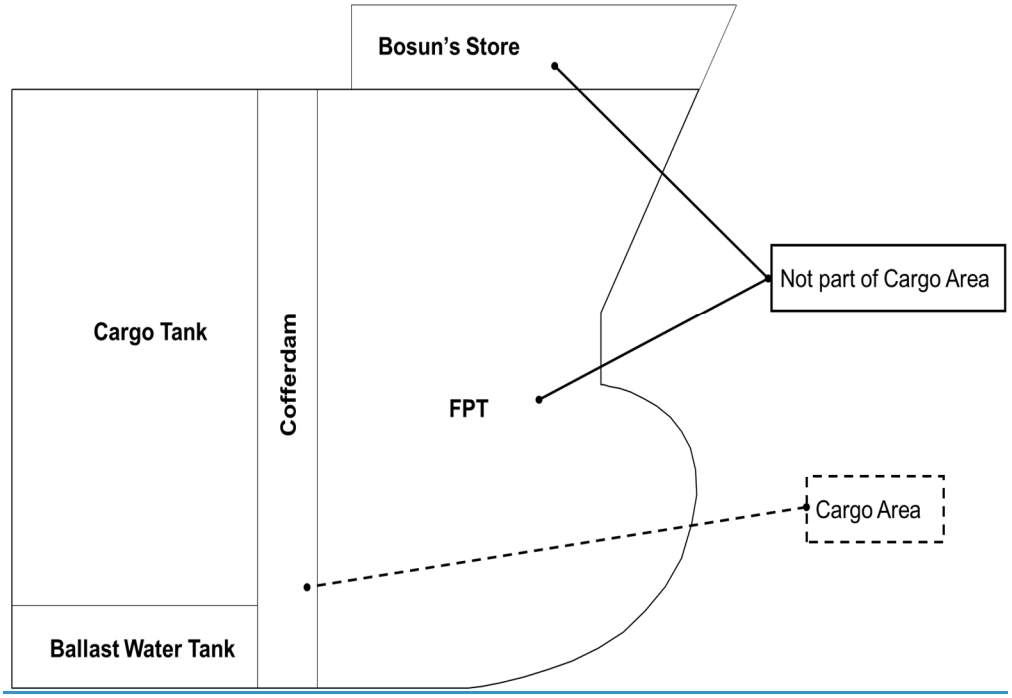


Figure C.1.2 Fore peak ballast tanks and space arrangements, Example 2

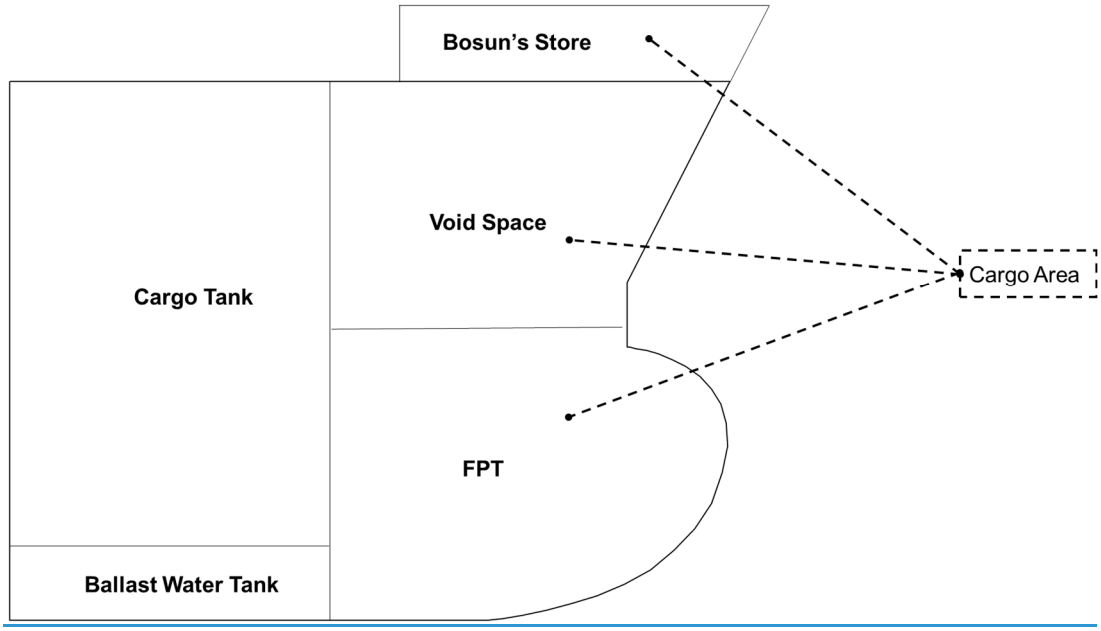


Figure C.1.3 Fore peak ballast tanks and space arrangements, Example 3

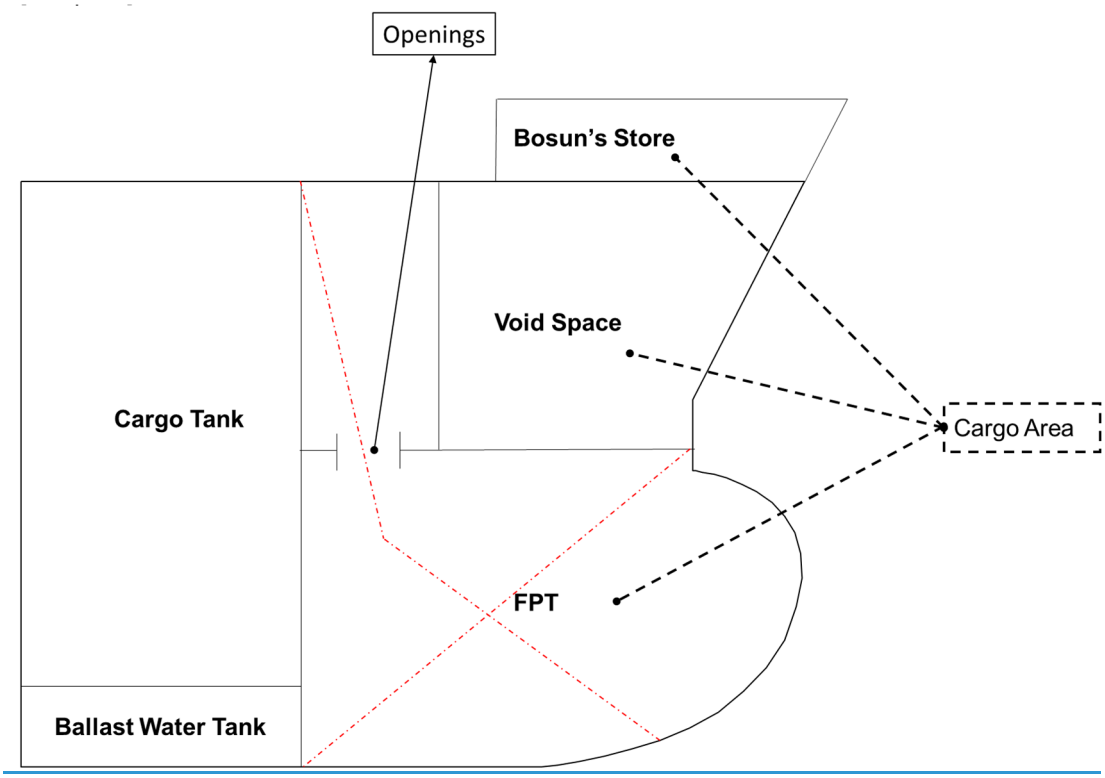


Figure C.1.4 Fore peak ballast tanks and space arrangements, Example 4

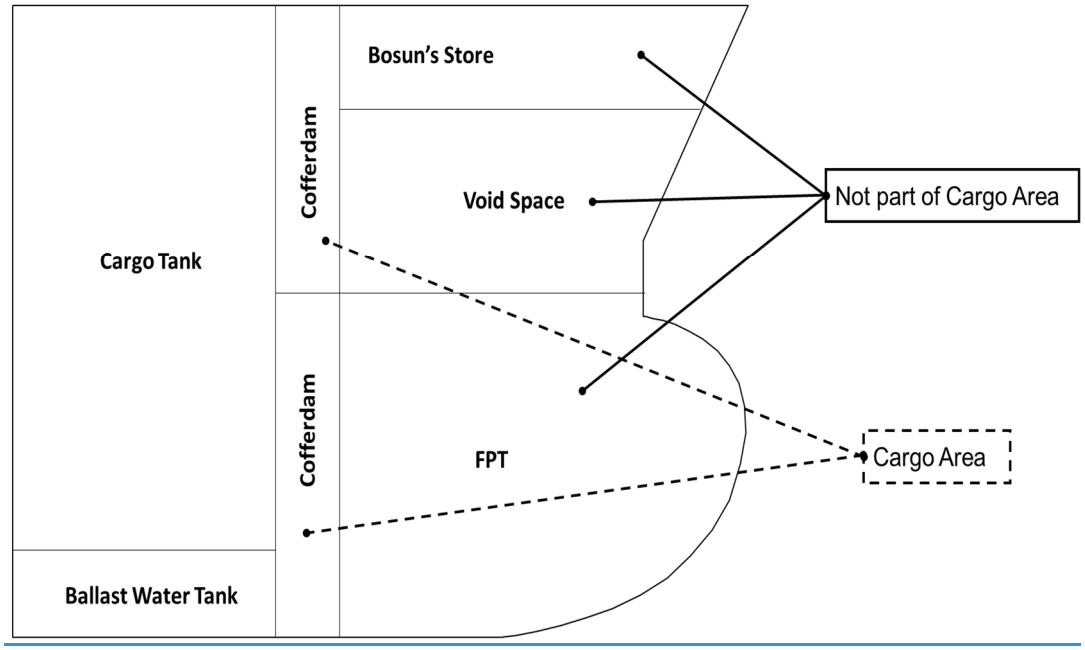


Figure C.1.5 Fore peak ballast tanks and space arrangements, Example 5

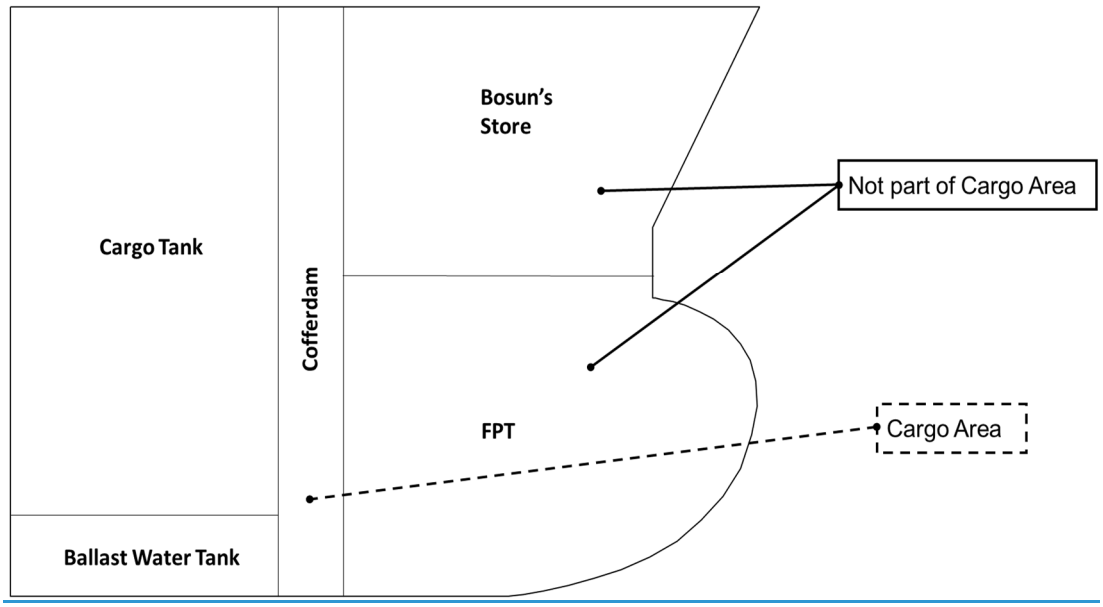
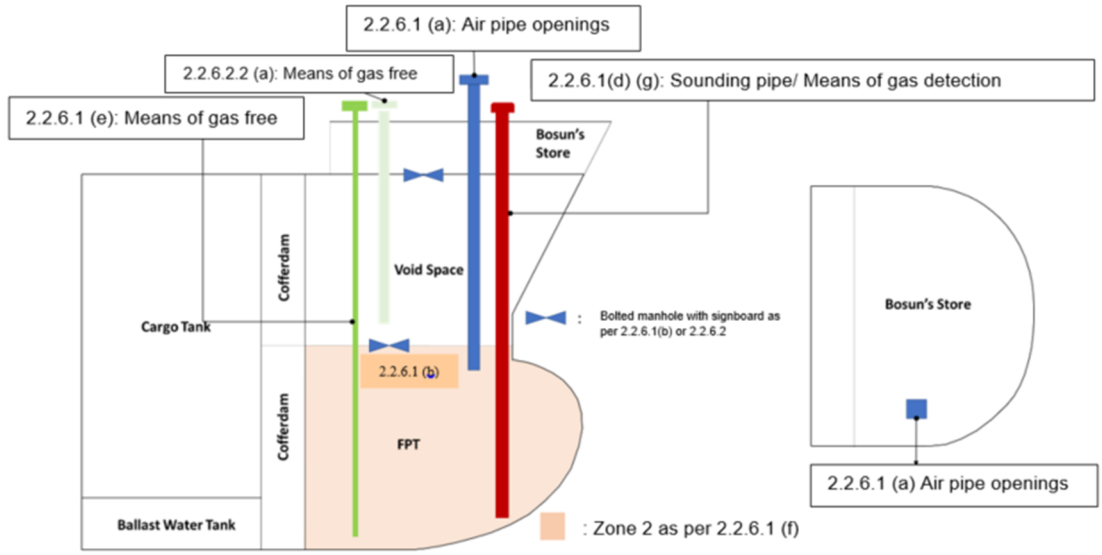


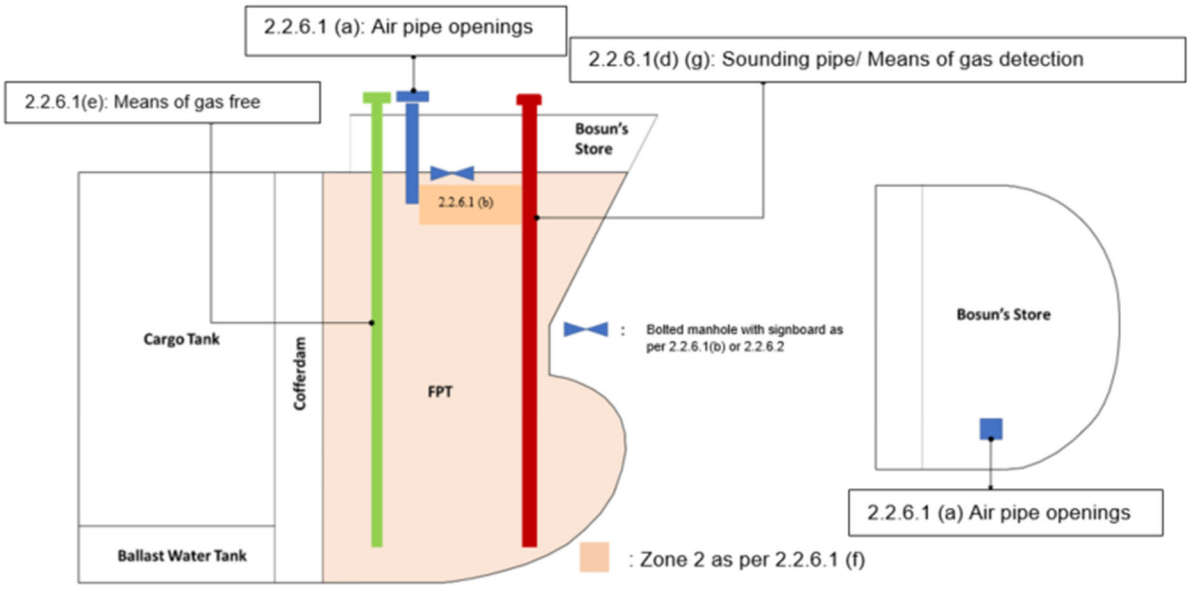
Figure C.1.6 Fore peak ballast tanks and space arrangements, Example 6

C.2 Arrangements for Access, Ventilation, and Gas-Freeing of Fore Peak Ballast Tanks and Adjacent Spaces



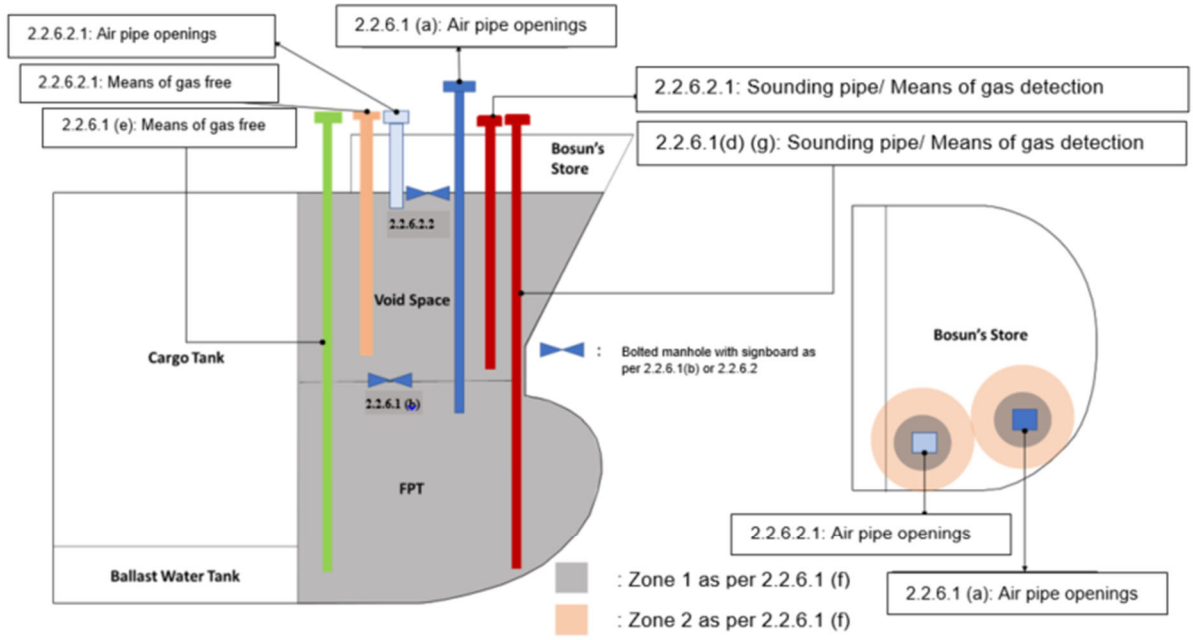
Operational requirement
1. Continuous ventilation is maintained while accessing the FPT as per 2.2.6.1 (c).
2. To detect toxic and flammable vapours within the FPT (based on the cargoes carried in current voyage, and since last de-ballasting of the FPT was carried out), in order to ensure the FPT is fully gas freed as per 2.2.6.1 (g).
3. Where toxic- vapour-detection equipment is not available for some cargoes which require such detection, the FPT may be ventilated by dilution method at a minimum rate of 6 air changes per hour for a minimum of 24 hrs. Tank entry procedures to be done in accordance with IMO resolution A.1050 (27) and Chapter 3, 14.2.4.

Fig C.2.1 Arrangements for Access, Ventilation, and Gas-Freeing of Fore Peak Ballast Tanks and Adjacent Spaces, Example 1



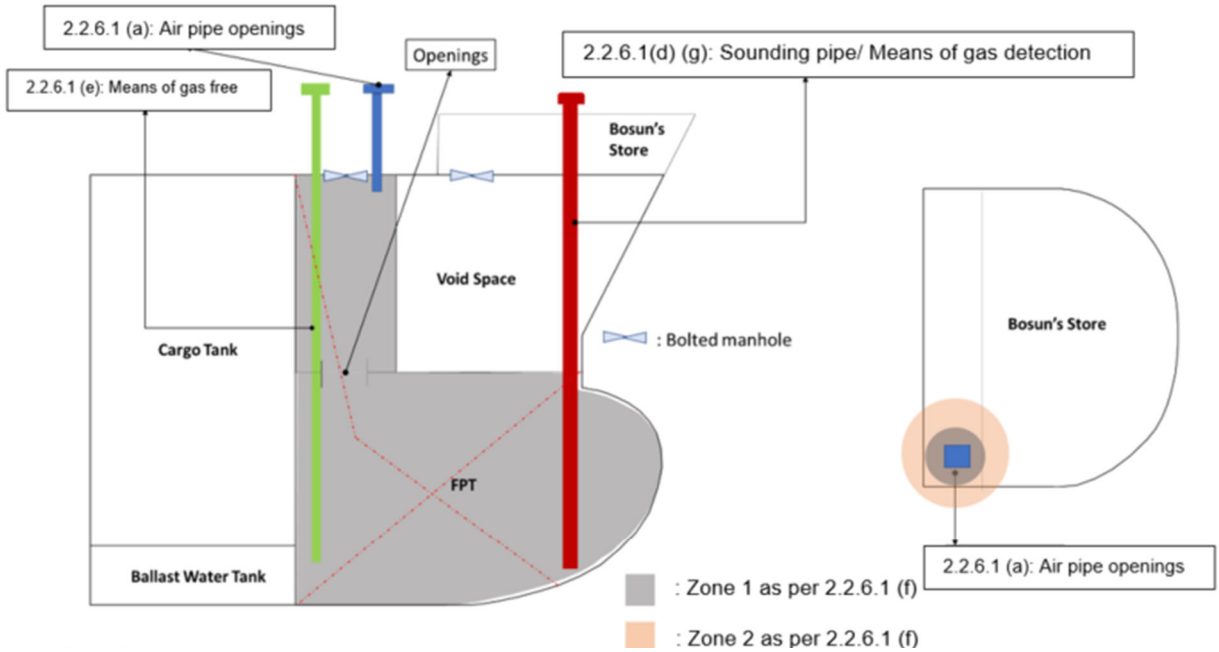
Operational requirement
1. Continuous ventilation is maintained while accessing the FPT as per 2.2.6.1 (c).
2. To detect toxic and flammable vapours within the FPT (based on the cargoes carried in current voyage, and since last de-ballasting of the FPT was carried out), in order to ensure the FPT is fully gas freed as per 2.2.6.1 (g).
3. Where toxic- vapour-detection equipment is not available for some cargoes which require such detection, the FPT may be ventilated by dilution method at a minimum rate of 6 air changes per hour for a minimum of 24 hrs. Tank entry procedures to be done in accordance with IMO resolution A.1050 (27) and Chapter 3, 14.2.4.

Fig C.2.2 Arrangements for Access, Ventilation, and Gas-Freeing of Fore Peak Ballast Tanks and Adjacent Spaces, Example 2



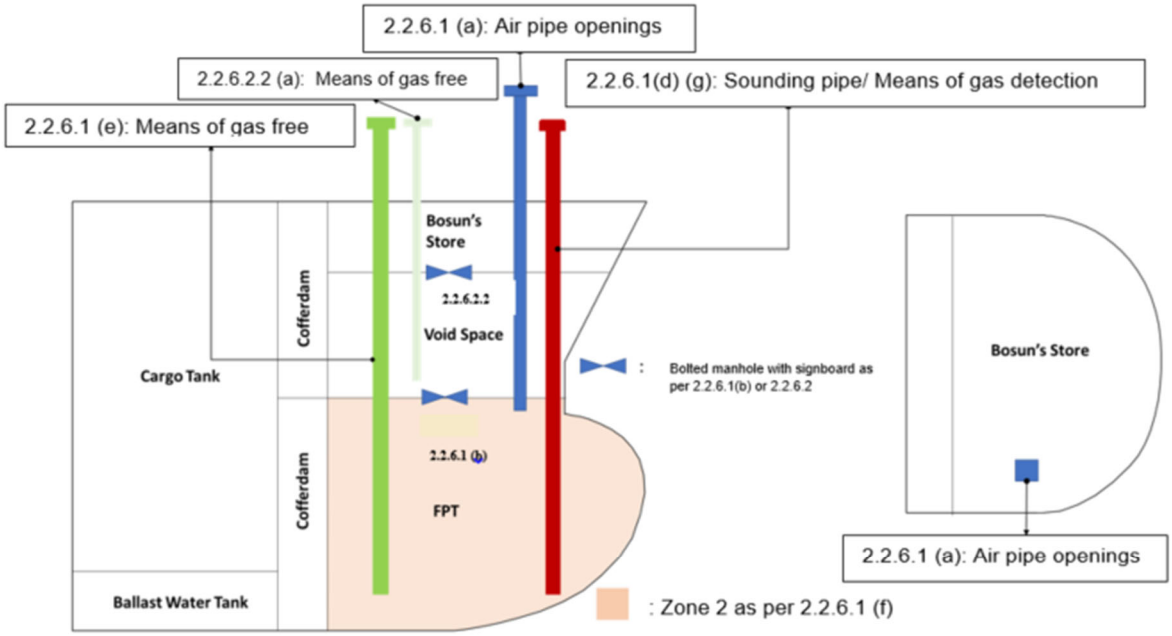
Operational requirement
1. Continuous ventilation is maintained while accessing the FPT as per 2.2.6.1 (c).
2. To detect toxic and flammable vapours within the FPT (based on the cargoes carried in current voyage, and since last de-ballasting of the FPT was carried out), in order to ensure the FPT is fully gas freed as per 2.2.6.1 (g).
3. Where toxic- vapour-detection equipment is not available for some cargoes which require such detection, the FPT may be ventilated by dilution method at a minimum rate of 6 air changes per hour for a minimum of 24 hrs. Tank entry procedures to be done in accordance with IMO resolution A.1050 (27) and Chapter 3, 14.2.4.

Fig C.2.3 Arrangements for Access, Ventilation, and Gas-Freeing of Fore Peak Ballast Tanks and Adjacent Spaces, Example 3



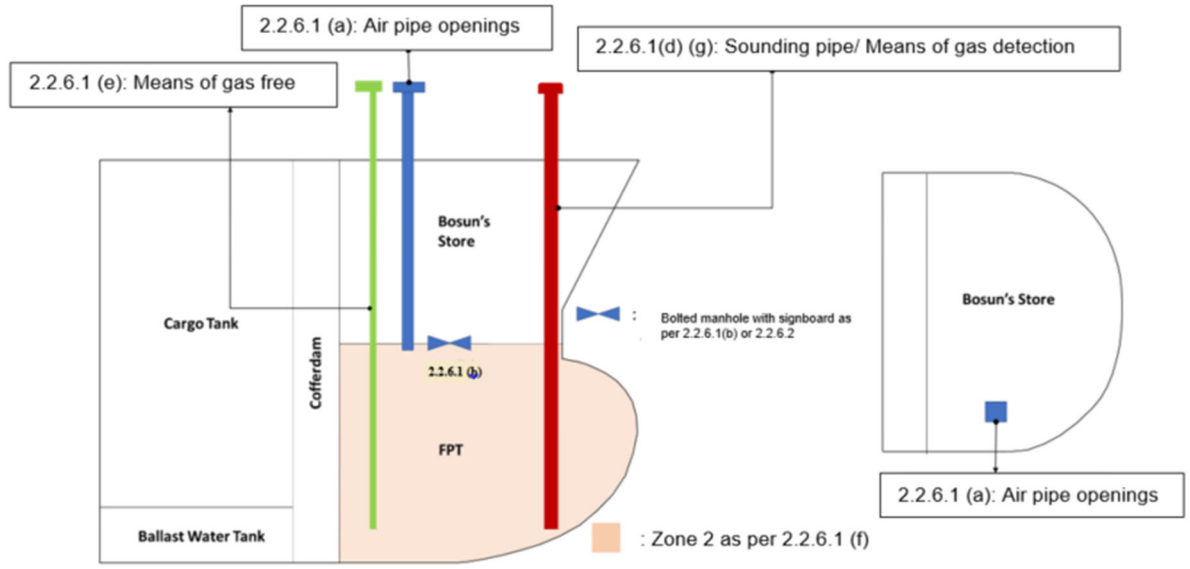
Operational requirement
1. Continuous ventilation is maintained while accessing the FPT as per 2.2.6.1 (c).
2. To detect toxic and flammable vapours within the FPT (based on the cargoes carried in current voyage, and since last de-ballasting of the FPT was carried out), in order to ensure the FPT is fully gas freed as per 2.2.6.1 (g).
3. Where toxic- vapour-detection equipment is not available for some cargoes which require such detection, the FPT may be ventilated by dilution method at a minimum rate of 6 air changes per hour for a minimum of 24 hrs. Tank entry procedures to be done in accordance with IMO resolution A.1050 (27) and Chapter 3, 14.2.4.

Fig C.2.4 Arrangements for Access, Ventilation, and Gas-Freeing of Fore Peak Ballast Tanks and Adjacent Spaces, Example 4



Operational requirement
1. Continuous ventilation is maintained while accessing the FPT as per 2.2.6.1 (c).
2. To detect toxic and flammable vapours within the FPT (based on the cargoes carried in current voyage, and since last de-ballasting of the FPT was carried out), in order to ensure the FPT is fully gas freed as per 2.2.6.1 (g).
3. Where toxic- vapour-detection equipment is not available for some cargoes which require such detection, the FPT may be ventilated by dilution method at a minimum rate of 6 air changes per hour for a minimum of 24 hrs. Tank entry procedures to be done in accordance with IMO resolution A.1050 (27) and Chapter 3, 14.2.4.

Fig C.2.5 Arrangements for Access, Ventilation, and Gas-Freeing of Fore Peak Ballast Tanks and Adjacent Spaces, Example 5



Operational requirement
1. Continuous ventilation is maintained while accessing the FPT as per 2.2.6.1 (c).
2. To detect toxic and flammable vapours within the FPT (based on the cargoes carried in current voyage, and since last de-ballasting of the FPT was carried out), in order to ensure the FPT is fully gas freed as per 2.2.6.1 (g).
3. Where toxic- vapour-detection equipment is not available for some cargoes which require such detection, the FPT may be ventilated by dilution method at a minimum rate of 6 air changes per hour for a minimum of 24 hrs. Tank entry procedures to be done in accordance with IMO resolution A.1050 (27) and Chapter 3, 14.2.4.

Fig C.2.6 Arrangements for Access, Ventilation, and Gas-Freeing of Fore Peak Ballast Tanks and Adjacent Spaces, Example 6

End of Chapter

Part 5

Special Ship Types

Chapter 3

Chemical Carriers

Section 1

General

1.3 Definitions

1.3.6 **Cargo area** is that part of the ship that contains cargo tanks, slop tanks, cargo pump-rooms including pump-rooms, cofferdams, ballast or void spaces adjacent to cargo tanks or slop tanks and also deck areas throughout the entire length and breadth of the part of the ship over the above-mentioned spaces. Where independent tanks are installed in hold spaces, cofferdams, ballast or void spaces at the after end of the aftermost hold space or at the forward end of the forwardmost hold space are excluded from the cargo area. (Regarding the spaces referred above the interpretation provided in Part 5, Chapter 2, IR 1.4.1 applies. Fig. C.1.3 and Fig C.1.4 in Part 5, Chapter 2, Appendix C are not applicable to chemical tankers).

Section 3

Ship Arrangements

3.9 Fore peak ballast tanks and space arrangements

3.9.1 The applicable requirements in Part 5, Chapter 2, Sec 2.2.6 are to be complied with. Fig C.2.3 and Fig C.2.4 in Part 5, Chapter 2, Appendix C are not applicable to Chemical tankers.

End of Chapter

Part 5

Special Ship Types

Chapter 4

Liquefied Gas Carriers

Section 4

Cargo Containment

4.23 Type C independent tanks

4.23.1 Design basis

4.23.1.1 The design basis for type C independent tanks is based on pressure vessel criteria modified to include fracture mechanics and crack propagation criteria. The minimum design pressure defined in 4.23.1.2 is intended to ensure that the dynamic stress range is sufficiently small~~low~~, so that an initial surface flaw will not ~~propagate more than half the thickness of the shell during the lifetime of the tank~~have significant propagation.

4.23.4 *Fatigue design condition*

~~For large type C independent tanks, where the cargo at atmospheric pressure is below -55°C, IRS may require additional verification to check their compliance with 4.23.1.1 regarding static and dynamic stress.~~

IR4.23.4.1 For large type C independent tanks, the Administration/ IRS may require additional fatigue verification as follows:

.1 C_w (maximum allowable cumulative fatigue damage ratio) is to be less than or equal to 0.1; or

.2 predicted failure development time, from the assumed initial defect until reaching a critical state, is not to be less than three times the lifetime of the tank.

Part G
Guidance

4.28 Guidance notes for Sec 4

IR4.28.4 Guidance to finite element analysis of type C tanks for ships

IR4.28.4.1 General

IR4.28.4.1.1 The allowable stresses described in 4.23.3.1 are applicable for the finite element analysis of the type C tanks.

IR4.28.4.1.2 As a supplement to the prescriptive requirements, the finite element analysis of the type C cargo tanks may be carried out for the following cases:

a. Locations where a structural strength cannot be assessed by the prescriptive requirements, e.g. structural discontinuities in way of tank support, Y connection of bi-lobe and multi-lobe tank, etc.

b. Tanks of novel design or configuration

IR4.28.4.1.3 The procedure for finite element analysis should be in accordance with the recognized standards such as ASME Boiler and Pressure Vessel Code, section VIII, Division 2 or other equivalent standard which is acceptable to the Administration/IRS provided the maximum strength utilizations in 4.23.3.1 are complied with.

IR 4.28.4.1.3.1 IRS may accept finite element modelling and analysis which have been performed in accordance with IACS Recommendation 174.

IR4.28.4.1.4 The scantlings arrived at by the prescriptive requirements for the type C tank of the Chapter are not to be reduced by any form of alternative calculations using finite element analysis

IR4.28.4.1.5 For calculation of reaction forces at the tank supports, the requirements specified in 4.23.3.1.4 apply. The following factors are to be taken into account:

.1 elasticity of support material (intermediate layer of wood or similar material); and

.2 change in contact surface between tank and support, and of the relevant reactions, due to thermal shrinkage of tank and elastic deformations of tank and support material

The final distribution of the reaction forces at the supports is not to show any tensile forces.

IR4.28.4.2 Allowable stresses for finite element analysis

IR4.28.4.2.1 In general, finite element models composed of 2D shell element or solid 3D element are considered acceptable for stress calculation. The mesh size of the finite element model is to be selected to the satisfaction of the Administration/IRS.

IR4.28.4.2.2 The application of allowable stresses for linear finite element analysis of the type C tank body using 2D shell element or solid 3D element is given in Table 4.28.4.2.2.

IR4.28.4.2.3 The strength of stiffening rings of type C tanks are to be checked, the calculated stresses of the stiffening ring of type C tanks using finite element method are to be performed according to IR4.28.4, and the permissible stresses of the stiffening rings are not to exceed that of the tank body defined in IR4.28.4.

Table 4.28.4.2.2: Application of allowable stresses for finite element analysis of the Type C tank body using 2D shell element or 3D solid element

Criterion given in 4.23.3.1	**Application for FE 2D shell element or 3D element**	
	Finite Element Results Check	**Locations where check should be applied**
$\sigma_m \leq f$	$\sigma_{e-membrane} \leq f$ (1)	(A) Areas remote from structural discontinuities
$\sigma_L \leq 1.5f$	$\sigma_{e-membrane} \leq 1.5f$ (1)	(B) Area in way of structural discontinuities
$\sigma_b \leq 1.5f$	$\sigma_{e-surface} \leq 1.5f$ (1)	(C) Any area (A) or (B)) where bending stresses exist
$\sigma_L + \sigma_b \leq 1.5f$	$\sigma_{e-surface} \leq 1.5f$ (1)	See (B) and (C)
$\sigma_m + \sigma_b \leq 1.5f$	$\sigma_{e-surface} \leq 1.5f$ (1)	See (A) and (C)
$\sigma_m + \sigma_b + \sigma_g \leq 3f$	$\sigma_{e-surface} \leq 3.0f$ (1)	See (A) and (C)
$\sigma_L + \sigma_b + \sigma_g \leq 3f$	$\sigma_{e-surface} \leq 3.0f$	See (B) and (C)

Where:

$\sigma_{e-membrane}$ is element equivalent stress derived from the stress components at the mid layer/thickness of the element.

$\sigma_{e-surface}$ is element equivalent stress derived from the stress components at the top and bottom layer/surface of the element, whichever is greater.

Note:

1) For accident and testing load conditions, the allowable stresses can be modified according to the 4.23.5.2 and 4.23.6.1

2) The factor f is defined in 4.23.3.

3) For the criterion ≤3.0f, it should be carefully evaluated especially for materials with under matched weld properties. In such cases, the transverse weld tensile strength is not to be less than the actual yield strength of the parent metal, the respective R_e and R_m of the weld, after any applied heat treatment, is to be used

IR4.28.5 Buckling assessment of type C cargo tanks

IR4.28.5.1 General

IR4.28.5.1.1 The buckling assessment of type C cargo tanks is to be carried out in accordance with a recognized pressure vessel standard acceptable to the Administration/IRS. The selected standard is to be used for design and fabrication. The scantlings of a type C tank subject to external pressure is not to be less than the value required by the formulae in 4.28.5.2.

IR4.28.5.1.2 Regarding the lateral buckling of stiffening ring, it is to be considered additionally in accordance with international standards (e.g. PD5500) or equivalent regulations.

IR4.28.5.1.3 For novel configurations where the requirements given in this subsection or recognized standards are not applicable, more advanced buckling assessment methods may be used as deemed appropriate by the Administration/IRS.

IR 4.28.5.1.3.1 Advanced buckling assessment methods to be used include non-linear finite element analysis as described in 4.28.5.1.4. Experimental determination of buckling capacity may also be specially considered by IRS in lieu.

IR4.28.5.1.4 Non-linear finite element analysis considering geometrical and material non-linearity may be accepted as an advanced method, provided that the buckling capacity reflects the plate edge misalignment, ovality and deviation from true circular form over a specified arc or chord length.

IR4.28.5.2 Scantling of shells and stiffening rings under external pressure

IR4.28.5.2.1 For cylindrical shell, the critical buckling pressure Pc, in MPa, can be taken as:

$$P_c = \frac{1}{3}\left[(n^2-1)+\frac{2n^2-1-\nu}{n^2\left(\frac{2L}{\pi D}\right)^2-1}\right]\frac{2E}{1-\nu^2}\left(\frac{t}{D}\right)^2 + \frac{2E\frac{t}{D}}{(n^2-1)\left[n^2\left(\frac{2L}{\pi D}\right)^2+1\right]^2}$$

Where:

D = outside diameter of the cylindrical shell, in mm, based on gross scantling

t = net thickness of the cylindrical shell, in mm, exclusive of corrosion allowance

E = Young's modulus, in N/mm^2

v = Poisson's ratio

n = number of circumferential buckling waves. It is to be taken as the integral value to minimize the critical pressure Pc with $n \geq Max\,(2, (\pi D/2L))$.

L = effective distance between stiffening rings, in mm

IR4.28.5.2.2 For spherical shells such as hemispherical, tori-spherical and ellipsoidal ends, the critical buckling pressure Pc, in MPa, can be taken as:

$$P_c = 1.21E\left(\frac{t}{R}\right)^2$$

Where:

R =outside radius of the sphere shell, in mm, based on gross scantling

E =Young's modulus, in N/mm^2

t = net thickness of the spherical shell, in mm, exclusive of corrosion allowance

The critical buckling pressure formula for the spherical shell above is to be used for hemispherical, tori-spherical and ellipsoidal tank ends, where *R* is taken as the outside radius of the corresponding spherical shell for hemispherical and tori spherical tank ends, and the maximum outside radius of the crown for an ellipsoidal tank end, i.e. $D^2/(4h)$

where h is the external height of the tank end measured based on gross scantling from the connection plane between the cylindrical shell and tank end.

IR4.28.5.2.3 For stiffening ring, the moment of inertia *I*, in mm^4, is not to be less than

$$I = \frac{0.18D^3LP_e}{E}$$

where:

D = outside diameter of the cylindrical shell, in mm, based on gross scantling

E = Young's modulus, in N/mm^2

L = effective distance between stiffening rings, in mm

P_e = external design pressure, in MPa

The width of shell, in mm, contributing to the moment of inertia shall not be greater than $0.75\sqrt{Dt}$,

where
t = net thickness of the cylindrical shell, in mm, exclusive of corrosion allowance.

IR4.28.5.2.4 Cylindrical and spherical shells are to satisfy the following criteria:

$\frac{P_c}{P_e} \geq 4$ (for cylindrical shells)

$\frac{P_c}{P_e} \geq 15$ (for spherical shells)

Where:

P_e = Critical Buckling Pressure (MPa)
P_c = External Design Pressure (MPa)

End of Chapter

Part 5

Special Ship Types

Chapter 8

Offshore Support Vessels

Section 1

General

Table 1.2.2 List of Additional Class Notations for Offshore Support Vessels		
Additional Class Notation	**Description**	**Reference to the applicable requirements to be complied with**
WTV	Vessels equipped for performing well testing operations	Pt.5, Ch.41

Section 2

Offshore Support Vessels (Supply)

2.4 Ship Arrangement and Strength

2.4.5 Deck structure

2.4.5.6 Weather decks aft

.1 The scantlings of the weather deck intended to carry deck cargo, are to be based on a pressure 'p' [kN/m^2] given below :

$$p = p_c + c.\ p_e \qquad \text{~~[N/mm}^2\text{]~~}$$

where,

p_c = Static pressure due to deck cargo as given in Pt.3, Ch.5, Sec.4.2.3.1, ~~in [N/mm^2] to be not less than 1.5 g [kN/m^2].~~ not to be taken less than 14.7 [kN/m^2]

p_e = External sea pressure, [kN/m^2] as given in Pt.3, Ch.5, Sec.4.1.

c = 1.28 - 0.32.q for q < 4 [t/m^2]
= 0 for q $\geq$ 4 [t/m^2]

q = deck cargo loading, in [t/m^2], but not to be taken less than 1.5[t/m^2].

End of Chapter

Part 5

Special Ship Types

Chapter 11

Barges and Pontoons

Section 2

Hull Arrangement and Strength

2.1 General

2.1.2 For barges and pontoons, simplified requirements that are applied for ships of L<90[m], as per Part 3 with respect to design loads, principal load scenarios, scantling requirements etc. are to be applied together with the exceptions given in this Chapter.

2.1.3 For barges and pontoons, the value of common acceleration parameter, "a_0" is to be used as follows (in lieu of the value given in Part 3, Chapter 5, Section 2):

$$a_0 = 0.36, \text{for } L < 90[m]$$

$$a_0 = \frac{3.C_w}{L} + \frac{1}{\sqrt{L}}, \text{for } L \geq 90[m]$$

2.1.4 Where tanks are intended to be emptied by compressed air, the maximum air overpressure is to replace P_{PV}, in the formulae for determining the pressures P_{ls}, in Part 3 Chapter 5, Section 5.1.2, for the static (S) load scenario.

End of Chapter

Part 5

Special Ship Types

Chapter 22

Vessels with Unattended Machinery Spaces

Section 3

Requirements for Monitoring

3.1 Extent of monitoring

3.1.10 The extent of monitoring required for electric propulsion systems is to be in accordance with Part 4, Chapter 7, Section 1, Table 1.10.18.

End of Chapter

Part 5

Special Ship Types

Chapter 35

Gaseous Fuel or other Low Flash Point Fueled Ships

Section 6

Fuel Containment System

6.4 Liquefied gas fuel containment

6.4.15 Tank types

6.4.15.3 Type C independent tanks

6.4.15.3.1 Design basis

6.4.15.3.1.1 The design basis for type C independent tanks is based on pressure vessel criteria modified to include fracture mechanics and crack propagation criteria. The minimum design pressure defined in 6.4.15.3.1.2 is intended to ensure that the dynamic stress range is sufficiently ~~low~~ small so that an initial surface flaw will not ~~propagate more than half the thickness of the shell during the lifetime of the tank~~ have significant propagation.

6.4.15.3.4 Fatigue design condition

~~6.4.15.3.4.1 For type C independent tanks where the liquefied gas fuel at atmospheric pressure is below minus 55[°C], IRS/Administration may require additional verification to check their compliance with 6.4.15.3.1.1, regarding static and dynamic stress depending on the tank size, the configuration of the tank and arrangement of its supports and attachments.~~

IR 6.4.15.3.4.1 For large type C independent tanks, the Administration/IRS may require additional fatigue verification as follows:

.1 C_w is to be less than or equal to 0.1; or

.2 predicted failure development time, from the assumed initial defect until reaching a critical state, is not to be less than three times the lifetime of the tank.

IR 6.4.17 Additional Guidance

IR 6.4.17.1 Guidance to finite element analysis of type C tanks for ships

IR 6.4.17.1.1 General

IR 6.4.17.1.1.1 The allowable stresses described in 4.23.3.1 are applicable for the finite element analysis of the type C tanks.

IR 6.4.17.1.1.2 As a supplement to the prescriptive requirements, the finite element analysis of the type C fuel tanks may be carried out for the following cases:

a. Locations where a structural strength cannot be assessed by the prescriptive requirements, e.g. structural discontinuities in way of tank support, Y connection of bi-lobe and multi-lobe tank, etc.

b. Tanks of novel design or configuration

IR6.4.17.1.1.3 The procedure for finite element analysis should be in accordance with the recognized standards such as ASME Boiler and Pressure Vessel Code, section VIII, Division 2 or other equivalent standard which is acceptable to the Administration/IRS provided the maximum strength utilizations in 6.4.15.3.3.1 are complied with.

IR6.4.17.1.1.3.1 IRS may accept finite element modelling and analysis which have been performed in accordance with IACS Recommendation 174.

IR6.4.17.1.1.4 The scantling arrived at by the prescriptive requirements for the type C tank of the chapter are not to be reduced by any form of alternative calculations using finite element analysis

IR6.4.17.1.1.5 For calculation of reaction forces at the tank supports, the following factors are to be taken into account:

.1 elasticity of support material (intermediate layer of wood or similar material); and

.2 change in contact surface between tank and support, and of the relevant reactions, due to thermal shrinkage of tank and elastic deformations of tank and support material

The final distribution of the reaction forces at the supports is not to show any tensile forces.

IR6.4.17.1.2 Allowable stresses for finite element analysis

IR6.4.17.1.2.1 In general, finite element models composed of 2D shell element or solid 3D element are considered acceptable for stress calculation. The mesh size of the finite element model is to be selected to the satisfaction of the Administration/IRS.

IR6.4.17.1.2.2 The application of allowable stresses for linear finite element analysis of the type C tank body using 2D shell element or solid 3D element is given in Table 6.4.17.1.2.2.

IR6.4.17.1.2.3 The strength of stiffening rings of type C tanks are to be checked, the calculated stresses of the stiffening ring of type C tanks using finite element method are to be performed according to IR6.4.17.1 and the permissible stresses of the stiffening rings are not to exceed that of the tank body defined in Table 6.4.17.1.2.2.

Table 6.4.17.1.2.2: Application of allowable stresses for finite element analysis of the Type C tank body using 2D shell element or 3D solid element

Criterion given in 4.23.3.1	Application for FE 2D shell element or 3D element	
	Finite Element Results Check	Locations where check should be applied
$\sigma_m \leq f$	$\sigma_{e-membrane} \leq f$ (1)	(A) Areas remote from structural discontinuities
$\sigma_L \leq 1.5f$	$\sigma_{e-membrane} \leq 1.5f$ (1)	(B) Area in way of structural discontinuities
$\sigma_b \leq 1.5f$	$\sigma_{e-surface} \leq 1.5f$ (1)	(C) Any area (A) or (B)) where bending stresses exist
$\sigma_L + \sigma_b \leq 1.5f$	$\sigma_{e-surface} \leq 1.5f$ (1)	See (B) and (C)
$\sigma_m + \sigma_b \leq 1.5f$	$\sigma_{e-surface} \leq 1.5f$ (1)	See (A) and (C)
$\sigma_m + \sigma_b + \sigma_g \leq 3f$	$\sigma_{e-surface} \leq 3.0f$ (1)	See (A) and (C)
$\sigma_L + \sigma_b + \sigma_g \leq 3f$	$\sigma_{e-surface} \leq 3.0f$	See (B) and (C)

Where:

$\sigma_{e-membrane}$ is element equivalent stress derived from the stress components at the mid layer/thickness of the element.

$\sigma_{e-surface}$ is element equivalent stress derived from the stress components at the top and bottom layer/surface of the element, whichever is greater.

Note:

1) For accident and testing load conditions, the allowable stresses can be modified according to Section 6.4.15.3.5 and 16.5.4

2) The factor f is defined in 6.4.15.3.3.1.

[3] For the criterion ≤3.0f, it should be carefully evaluated especially for materials with under matched weld properties. In such cases, the transverse weld tensile strength is not to be less than the actual yield strength of the parent metal, the respective R_e and R_m of the weld, after any applied heat treatment, is to be used

IR 6.4.17.3 Buckling assessment of type C cargo tanks

IR6.4.17.3.1 General

IR6.4.17.3.1.1 The buckling assessment of type C cargo tanks is to be carried out in accordance with a recognized pressure vessel standard acceptable to the Administration/IRS. The selected standard is to be used for design and fabrication. The scantlings of a type C tank subject to external pressure is not to be less than the value required by the formulae in IR6.4.17.3.1.2.

IR6.4.17.3.1.2 Regarding the lateral buckling of stiffening ring, it is to be considered additionally in accordance with international standards (e.g. PD5500) or equivalent regulations.

IR6.4.17.3.1.3 For novel configurations where the requirements given in this subsection or recognized standards are not applicable, more advanced buckling assessment methods may be used as deemed appropriate by the Administration/IRS.

IR6.4.17.3.1.3.1 Advanced buckling assessment methods to be used include non-linear finite element analysis as described in 6.4.17.3.1.4. Experimental determination of buckling capacity may also be specially considered by IRS in lieu.

IR6.4.17.3.1.4 Non-linear finite element analysis considering geometrical and material non-linearity may be accepted as an advanced method, provided that the buckling capacity reflects the plate edge misalignment, ovality and deviation from true circular form over a specified arc or chord length.

IR6.4.17.3.2 Scantling of shells and stiffening rings under external pressure

IR6.4.17.3.2.1 For cylindrical shell, the critical buckling pressure Pc, in MPa, can be taken as:

$$P_c = \frac{1}{3}\left[(n^2-1) + \frac{2n^2-1-\nu}{n^2\left(\frac{2L}{\pi D}\right)^2 - 1}\right]\frac{2E}{1-\nu^2}\left(\frac{t}{D}\right)^2 + \frac{2E\frac{t}{D}}{(n^2-1)\left[n^2\left(\frac{2L}{\pi D}\right)^2 + 1\right]^2}$$

Where:

D = outside diameter of the cylindrical shell, in mm, based on gross scantling

t = net thickness of the cylindrical shell, in mm, exclusive of corrosion allowance

E = Young's modulus, in N/mm^2

v = Poisson's ratio

n = number of circumferential buckling waves. It is to be taken as the integral value to minimize the critical pressure Pc with $n \geq Max\,(2, (\pi D/2L))$.

L = effective distance between stiffening rings, in mm

IR6.4.17.3.2.2 For spherical shells such as hemispherical, tori-spherical and ellipsoidal ends, the critical buckling pressure Pc, in MPa, can be taken as:

$$P_c = 1.21E\left(\frac{t}{R}\right)^2$$

Where:

R =outside radius of the sphere shell, in mm, based on gross scantling

E =Young's modulus, in N/mm^2

t = net thickness of the spherical shell, in mm, exclusive of corrosion allowance

The critical buckling pressure formula for the spherical shell above is to be used for hemispherical, tori-spherical and ellipsoidal tank ends, where R is taken as the outside radius of the corresponding spherical shell for hemispherical and tori spherical tank ends, and the maximum outside radius of the crown for an ellipsoidal tank end, i.e. $D^2/(4h)$

where h is the external height of the tank end measured based on gross scantling from the connection plane between the cylindrical shell and tank end.

6.4.17.3.2.3 For stiffening ring, the moment of inertia *I*, in mm^4, is not to be less than

$$I = \frac{0.18D^3LP_e}{E}$$

where:

D = outside diameter of the cylindrical shell, in mm, based on gross scantling

E = Young's modulus, in N/mm^2

L = effective distance between stiffening rings, in mm

P_e = external design pressure, in MPa

The width of shell, in mm, contributing to the moment of inertia shall not be greater than $0.75\sqrt{Dt}$,

where

t = net thickness of the cylindrical shell, in mm, exclusive of corrosion allowance.

6.4.17.3.2.4 Cylindrical and spherical shells are to satisfy the following criteria:

$\frac{P_c}{P_e} \geq 4$ (for cylindrical shells)

$\frac{P_c}{P_e} \geq 15$ (for spherical shells)

Where:

P_e = Critical Buckling Pressure (MPa)

P_c = External Design Pressure (MPa)

End of Chapter

Part 6

Fire Safety Requirements

Chapter 1

General

Section 1

General

1.3 Requirements applicable to existing ships

1.3.5 Ships constructed before 1 July 2012 are also to comply with requirements of ~~chapter~~ Chapter 3, 4.10.1.2 and Chapter 2, 1.2.1.6 and 1.2.1.7.

1.3.10 Ships constructed before 1 January 2026 are to comply with the requirements of Chapter 3, 4.11.2, not later than the date of the first survey on or after 1 January 2026.

Section 3

Definitions

3.59 **Confirmed case (flashpoint)** is when a representative sample analysed in accordance with acceptable standards (Such as ISO 2719:2016) by an accredited laboratory reports the flashpoint as measured to be below 60ºC. The laboratory is to be accredited to ISO/IEC 17025:2017 or an equivalent standard for the performance of the given flash point test ISO 2719:2016.

3.60 **Representative sample** is a product specimen having its physical and chemical characteristics identical to the average characteristics of the total volume being sampled.

3.61 **Oil fuel** is defined in regulation 1 of Annex 1 of the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the protocol of 1978 relating thereto.

End of Chapter

Part 6

Fire Safety Requirements

Chapter 2

Prevention of Fire and Explosion

Section 1

Probability of Ignition

1.2 Arrangements for oil fuel, lubrication oil and other flammable oils

1.2.1 Limitations in the use of oils as fuel

The following limitations are to apply to the use of oil as fuel:

.4 in cargo ships, to which SOLAS, Chapter II-1, Part G is not applicable, the use of oil fuel having a lower flashpoint than otherwise specified in 1.2.1.1, for example crude oil, may be permitted provided that such fuel is not stored in any machinery space and subject to the approval by the Administration/IRS of the complete installation; ~~and~~

.6 ships carrying oil fuel prior to bunkering are to be provided with a declaration signed and certified by the oil fuel supplier's representative, that the oil fuel to be supplied is in conformity with 1.2.1, and the test method used for determining the flashpoint. A bunker delivery note for the oil fuel delivered to the ship is to contain either the flashpoint specified in accordance with standards acceptable to IRS (Such as ISO 2719:2016), or a statement that the flashpoint has been measured at or above 70ºC (This information may be included in the bunker delivery note according to MARPOL Annex VI/18);

.7 Oil fuel delivered to and used on board ships are not to jeopardize the safety of ships or adversely affect the performance of the machinery or be harmful to personnel.

End of Chapter

Part 6

Fire Safety Requirements

Chapter 3

Suppression of Fire

Section 1

Detection and Alarm

1.5 Protection of accommodation and service spaces and control stations

1.5.2 Requirements for passenger ships carrying more than 36 passengers

.1 A fixed fire detection and fire alarm system is to be installed and arranged as to provide smoke detection in service spaces, control stations and accommodation spaces, including corridors, stairways and escape routes within accommodation spaces. Smoke detectors need not be fitted in private bathrooms and galleys. Spaces having little or no fire risk such as voids, public toilets, carbon dioxide rooms and similar spaces need not be fitted with a fixed fire detection and fire alarm system. Detectors fitted in cabins, when activated are also to be capable of emitting, or cause to be emitted, ~~generating or activating~~ an audible alarm within the space where they are located.

1.5.5 Cargo ships (constructed on or after 1 January 2026)

Accommodation and service spaces and control stations of cargo ships are to be protected by a fixed fire detection and fire alarm system and/or an automatic sprinkler, fire detection and fire alarm system as follows depending on a protection method adopted in accordance with Ch.3, 3.2.3.1.

1.5.5.1 Method IC

A fixed fire detection and fire alarm system is to be so installed and arranged as to provide smoke detection in all corridors, stairways and escape routes within accommodation spaces and in all control stations and cargo control rooms.

1.5.5.2 Method IIC

An automatic sprinkler, fire detection and fire alarm system of an approved type complying with the relevant requirements of the Fire Safety Systems Code (Chapter 8) are to be so installed and arranged as to protect accommodation spaces, galleys and other service spaces, except spaces which afford no substantial fire risk such as void spaces, sanitary spaces, etc. In addition, a fixed fire detection and fire alarm system ~~of an approved type complying with the requirements of Ch.8, Sec.9~~ is to be so installed and arranged as to provide smoke detection in all corridors, stairways and escape routes within accommodation spaces and in all control stations and cargo control rooms.

1.5.5.3 Method IIIC

A fixed fire detection and fire alarm system is to be so installed and arranged as to detect the presence of fire in all accommodation spaces and service spaces providing smoke detection in corridors, stairways and escape routes within accommodation spaces, except spaces which afford no substantial fire risk such as void spaces, sanitary spaces, etc. In addition, a fixed fire detection and fire alarm system is to be so installed and arranged as to provide smoke detection in all corridors, stairways and escape routes within accommodation spaces and in all control stations and cargo control rooms.

IR1.5.5.3 The above requirement applies to accommodation block. Service spaces built away from accommodation block need not be fitted with a fixed fire detection and fire-alarm system complying with FSS Code (Chapter 8).

1.5.6 Cargo ships (constructed before 1 January 2026)

Accommodation and service spaces and control stations of cargo ships are to be protected by a fixed fire detection and fire alarm system and/or an automatic sprinkler, fire detection and fire alarm system as follows depending on a protection method adopted in accordance with Ch.3, 3.2.3.1.

1.5.6.1 Method IC

A fixed fire detection and fire alarm system is to be so installed and arranged as to provide smoke detection in all corridors, stairways and escape routes within accommodation spaces.

1.5.6.2 Method IIC

An automatic sprinkler, fire detection and fire alarm system of an approved type complying with the relevant requirements of the Fire Safety Systems Code (Chapter 8) are to be so installed and arranged as to protect accommodation spaces, galleys and other service spaces, except spaces which afford no substantial fire risk such as void spaces, sanitary spaces, etc. In addition, a fixed fire detection and fire alarm system of an approved type complying with the requirements of Ch.8, Sec.9 is to be so installed and arranged to provide smoke detection in all corridors, stairways and escape routes within accommodation spaces.

1.5.6.3 Method IIIC

A fixed fire detection and fire alarm system is to be so installed and arranged as to detect the presence of fire in all accommodation spaces and service spaces providing smoke detection in corridors, stairways and escape routes within accommodation spaces, except spaces which afford no substantial fire risk such as void spaces, sanitary spaces, etc.

IR1.5.6.3 The above requirement applies to accommodation block. Service spaces built away from accommodation block need not be fitted with a fixed fire detection and fire-alarm system complying with FSS Code (Chapter 8).

Section 3

Containment of Fire

3.6 Protection of cargo space boundaries

3.6.1 In passenger ships carrying more than 36 passengers, the boundary bulkheads and decks of special category and ro-ro spaces are to be insulated to "A-60" class standard. However, where a category (5), (9) and (10) space, as defined in 3.2.2.3, is on one side of the division the standard may be reduced to "A-0". Where fuel oil tanks are below a special category space, the integrity of the deck between such spaces may be reduced to "A-0" standard.

Note: Para 3.6.1 above, is applicable to ships constructed before 1 January 2026.

Section 4

Fire Fighting

4.11 Fire-extinguishing media restrictions

The purpose is to protect persons on board against exposure to dangerous substances used in firefighting, as well as to minimize the impact of fire-extinguishing media that are deemed detrimental to the environment.

4.11.1 Application

4.11.1.1 This subsection is applicable to ships constructed on or after 1 January 2026.

4.11.1.2 Ships constructed before 1 January 2026 are to comply with 4.11.2 below, not later than the date of the first survey on or after 1 January 2026.

4.11.2 General

4.11.2.1 The prohibited substances in this section are to be delivered to appropriate shore-based reception facilities when removed from the ship.

4.11.2.2 Use or storage of extinguishing media containing perfluorooctane sulfonic acid (PFOS) is to be prohibited.

End of Chapter

Part 6

Fire Safety Requirements

Chapter 7

Special Requirements

Contents

Section 3

Protection of Vehicle, Special Category, Open and Closed Ro-Ro Spaces, and Weather Decks Intended for the Carriage of Vehicles

3.1 Purpose

The purpose of this section is to provide additional safety measures in order to address the fire safety objectives of this part for ships fitted with vehicle, special category and ro-ro spaces. For this purpose, the following functional requirements are to be met:

.1 fire protection systems are to be provided to adequately protect the ship from the fire hazards associated with vehicle, special category and ro-ro spaces~~,~~; and weather deck intended for the carriage of vehicles;

3.2 General requirements

3.2.1 Application

3.2.1.3 Passenger ships constructed before 1 January 2026, including those constructed before 1 July 2012, are also to comply with the requirements of 3.4.1.6, 3.4.4 and 3.6.2.3.

3.3 Precaution against ignition of flammable vapours in closed vehicle spaces, closed ro-ro spaces and special category spaces

3.3.1 Ventilation systems

3.3.1.5 *Permanent openings*

In cargo ships, ~~Permanent~~ permanent openings in the side plating, the ends or deckhead of the space are to be so situated that a fire in the cargo space does not endanger stowage areas and embarkation stations for survival craft and accommodation spaces, service spaces and control stations in superstructures and deckhouses above the cargo spaces.

3.4 Detection and alarm

3.4.1 Fixed fire detection and fire alarm systems

The requirements of paragraphs 3.4.1.1 through 3.4.1.4 only apply to passenger ships constructed on or after 1 January 2026. Passenger ships constructed before 1 January 2026, including those constructed before 1 July 2012, are to comply with the requirements of paragraph 3.4.1.6 not later than the first survey on or after 1 January 2028. (These ships can continue to comply with requirements of 3.4.1.7 until the first survey on or after 01 January 2028).

The requirements of paragraph 3.4.1.5 are to apply to cargo ships constructed on or after 1 January 2026. Cargo ships constructed before 1 January 2026 are to comply with the requirements of paragraph 3.4.1.7.

3.4.1.1 In vehicle, special category and ro-ro spaces, there is to be provided an individually identifiable fixed fire detection and fire alarm system. The system is to comply with the requirements of the Fire Safety Systems Code (Chapter 8).

3.4.1.1.1 The fixed fire detection and fire alarm system is to provide smoke and heat detection throughout vehicle, special category and ro-ro spaces. IRS/the Administration may accept linear heat detectors as the required system for heat detection. The system is to be capable of rapidly detecting the onset of fire. The location of detectors is to be to the satisfaction of IRS, taking into account the effects of ventilation and other relevant factors. After being installed, the system is to be tested under normal ventilation conditions and is to give an overall response time to the satisfaction of IRS.

3.4.1.2 If a fixed water-based deluge system is used for vehicle, special category and ro-ro spaces, then a fire detection and fire alarm system identifiable to the same sections of the deluge system are to be arranged.

3.4.1.3 The fire detection and fire alarm system is to be designed with a system interface which provides logical and unambiguous presentation of the information, to allow a quick and correct understanding and decision-making. In particular, section numbering of the alarm system is to coincide with that of other systems, such as a fixed water-based fire-extinguishing system or video monitoring system, if available.

3.4.1.4 A fixed fire detection and fire alarm system is to be provided for the area on the weather deck intended for the carriage of vehicles. The fixed fire detection system is to be capable of rapidly detecting the onset of the fire anywhere on the area. The type of detectors and their spacing and location are to be to the satisfaction of IRS, taking into account the effects of weather conditions, cargo obstruction and other relevant factors. Different settings may be used for specific operation sequences, such as during loading or unloading and during voyage, in order to reduce the false alarms.

3.4.1.5 In cargo ships, vehicle spaces, special category spaces and ro-ro spaces are to be provided with a fixed fire detection and fire alarm system complying with the requirements of the Fire Safety Systems Code (Chapter 8). The fixed fire detection system is to be capable of rapidly detecting the onset of fire. The type of detectors and their spacing and location are to be to the satisfaction of IRS, taking into account the effects of ventilation and other relevant factors. After being installed, the system is to be tested under normal ventilation conditions and is to give an overall response time to the satisfaction of IRS.

3.4.1.6 For passenger ships constructed before 1 January 2026, including those constructed before 1 July 2012, a fixed fire detection and fire alarm system complying with the requirements of the Fire Safety Systems Code (Chapter 8) is to be provided in special category spaces, open and closed ro-ro and vehicle spaces. The fixed fire detection system is to be capable of rapidly detecting the onset of fire. The fixed fire detection and fire alarm system is to provide smoke and heat detection throughout vehicle, special category and ro-ro spaces. In this context, heat detectors are to comply with the spacing and coverage area requirements as applicable for smoke detectors. Heat detectors are only required where there is already a smoke detector.

3.4.1.7 Except as provided in 3.4.3.1, there is to be provided a fixed fire detection and fire alarm system complying with the requirements of the Fire Safety Systems Code (Chapter 8). The fixed fire detection system is to be capable of rapidly detecting the onset of fire. The type of detectors and their spacing and location is to be to the satisfaction of IRS taking into account the effects of ventilation and other relevant factors. After being installed the system is to be tested under normal ventilation conditions and is to give an overall response time to the satisfaction of IRS.

IR3.4.1.7 The requirement of 3.4.1.7 need not apply to weather decks used for the carriage of vehicle for fuel in their tanks.

3.4.3 Special category spaces

3.4.3.1 An efficient fire patrol system is to be maintained in special category spaces. ~~However,~~ For passenger ships constructed before 1 January 2026, if an efficient fire patrol system is maintained by a continuous fire watch at all times during the voyage, a fixed fire detection and fire alarm systems is not required, until the first survey on or after 01 January 2028.

3.4.4 Video monitoring

The requirements of paragraphs 3.4.4.1 and 3.4.4.2 apply to ships constructed on or after 1 January 2026. Passenger ships with vehicle, special category or ro-ro spaces constructed before 1 January 2026, including those constructed before 1 July 2012, are to comply with the requirements of paragraphs 3.4.4.1 and 3.4.4.2 not later than the first survey on or after 1 January 2028.

3.4.4.1 For passenger ships, an effective video monitoring system is to be arranged in vehicle, special category and ro-ro spaces for continuous monitoring of these spaces. The system is to be provided with immediate playback capability to allow for quick identification of fire location, as far as practicable. Cameras are to be installed to cover the whole space, high enough to see over cargo and vehicles after loading.

3.4.4.2 The videos recorded by this monitoring system are to be available for replay at a continuously manned control station or at the safety centre for at least seven days, on ro-ro passenger ships constructed on or after 1 January 2026 and 24 hours for existing ro-ro passenger ships constructed before 1 January 2026, including those constructed before 1 July 2012. The correspondence between any one video camera and the section of the fixed water-based fire-extinguishing system protecting the space covered by this camera are to be clearly displayed close to the video monitor. Continuous monitoring of the video image by the crew is not required.

3.5 Structural fire protection and arrangement of openings

This sub section applies to passenger ships constructed on or after 1 January 2026. Passenger ships constructed before 1 January 2026 are required only to comply with the requirements of 3.5.1.1

3.5.1 Structural fire protection

3.5.1.1 In passenger ships carrying more than 36 passengers, the boundary bulkheads and decks of special category and ro-ro spaces are to be insulated to "A-60" class standard. However, where a category (5), (9) and (10) space, as defined in Ch.3, 3.2.2.3, is on one side of the division, the standard may be reduced to "A-0". Where fuel oil tanks are below a special category space, the integrity of the deck between such spaces may be reduced to "A-0" standard.

3.5.1.2 Where a special category space or ro-ro space is subdivided with internal decks, the fire rating of these decks are to be determined based on the capacity and arrangement of the fixed water-based fire-extinguishing system. If the fixed water-based fire-extinguishing system cannot simultaneously cover the applicable area above and below a given deck, this deck is to be of "A-30" standard while any ramps and doors between decks are to be made of steel and of a design being as tight as practical.

~~Notwithstanding the provisions of Ch.3, 3.2.2, in passenger ships carrying more than 36 passengers, the boundary bulkheads and decks of special category spaces and ro-ro spaces are to be insulated to "A-60" class standard. However, where a category (5), (9) and (10) space, as defined in Ch.3, 3.2.2.3, is on one side of the division the standard may be reduced to "A-0". Where fuel oil tanks are below a special category space or a ro-ro space, the integrity of the deck between such spaces, may be reduced to "A-0" standard.~~

3.5.2 Arrangement of openings in ro-ro spaces and special category spaces

3.5.2.1 Openings in the side plating, the ends or deckhead of the ro-ro space are to be situated and arranged so that a fire in the ro-ro space does not endanger:

.1 stowage areas for survival craft;

.2 embarkation stations and assembly stations, including access to such stations; and

.3 accommodation spaces, control stations and normally occupied service spaces in superstructures and deckhouses above the ro-ro space.

Openings are not permitted for all decks directly below these spaces and within a safety distance of minimum 6.0 m measured horizontally.

3.5.2.2 This requirement does not apply to openings fitted with closing arrangements, such as ramps and doors. Ramps and doors shall be of steel for all decks directly below accommodation spaces, control stations and normally occupied service spaces, and

minimum "A-0" for all decks directly below survival craft, embarkation stations and assembly stations.

3.5.2.3 Openings are, however, accepted in ro-ro spaces below accommodation spaces, control stations and normally occupied service spaces, when the fire integrity of the ship's side, including windows and doors, is "A-60" on boundaries in a rectangular area measured 6.0 m horizontally forward and aft of the openings and vertically minimum two deck levels above the deck level with the opening. "A-0" windows protected by a water-based system with an application rate of at least 5.0 [L/min/m^2] may be accepted as equivalent to "A-60" windows. Ventilation inlets are to be designed to minimize the risk of contamination. (Refer Chapter 2 section 2, Chapter 3, 2.2 and 3.7.1.5 and Chapter 7, 3.3.1.4)

3.5.2.4 Openings for mechanical ventilation of ro-ro and special category spaces are permitted below accommodation spaces, service spaces and control stations in superstructures, if the opening is protected by a closing device, with a closing arrangement not likely to be cut off in case of a fire in the ro-ro spaces, capable of being closed from a readily accessible position. The closing device is to be made of steel or other fire-resistant material. Such openings are not permitted below survival craft, the emergency generator and air intakes for the engine-room(s).

3.5.2.5 Notwithstanding the above, air intakes serving machinery used for the ship's main propulsion, power generation and emergency power generation are to be in a position minimizing the risk of being contaminated by a fire in the ro-ro space or special category space.

3.5.3 Arrangement of weather deck intended for the carriage of vehicles

3.5.3.1 Appropriate arrangements are to be made so that a fully developed fire on weather decks intended for the carriage of vehicles does not endanger:

.1 stowage areas for survival craft;

.2 embarkation stations and assembly stations including access to these; and

.3 accommodation spaces, control stations and normally occupied service spaces in superstructures and deckhouses adjacent to the weather deck.

3.5.3.2 Appropriate arrangements are to be made providing a safety distance, measured horizontally, from the designated vehicle lanes of more than 6.0 m to accommodation spaces, control stations and normally occupied service spaces in superstructures and deckhouses adjacent to the weather deck.

3.5.3.3 The safety distance can be reduced to 3.0 m when boundaries, including windows and doors, within 6.0 m are of "A-60" integrity. Alternatively, "A-0" boundaries protected by a water-based system with an application rate of at least 5.0 [L/min/m^2] may be accepted as equivalent.

3.5.3.4 Survival craft and embarkation stations, including access to these, are to be protected with a safety distance of more than 12.0 m. Safety distances is to be measured horizontally.

3.5.3.5 Notwithstanding the above, air intakes serving machinery used for the ship's main propulsion, power generation and emergency power generation is to be in a position minimizing the risk of being contaminated by a fire on the weather deck intended for carriage of vehicles.

3.6 Fire-extinction

3.6.1 Fixed fire-extinguishing systems

(*The requirements of 3.6.1.1 and 3.6.1.2 apply to ships constructed on or after 1 July 2014. Ships constructed before 1 July 2014 are to comply with the previously applicable requirements of paragraphs 3.6.1.1 and 3.6.1.2.)*

3.6.2 Fixed water-based fire extinguishing system on weather decks intended for carriage of vehicles

(*The requirements of paragraphs 3.6.2.1 and 3.6.2.2 apply to ro-ro passenger ships constructed on or after 1 January 2026. Passenger ships with vehicle, special category or ro-ro spaces constructed before 1 January 2026, including those constructed before 1 July 2012, are to comply with the requirements of paragraph 3.6.2.3 no later than the first survey on or after 1 January 2028.)*

3.6.2.1 In passenger ships, a fixed water-based fire-extinguishing system based on monitor(s) is to be installed in order to cover weather decks intended for the carriage of vehicles. The monitor(s) is to comply with the provisions of the Fire Safety Systems Code (Chapter 8).

3.6.2.2 In passenger ships, drainage is to be provided where a fixed water-based fire-extinguishing system is installed to cover weather decks intended for carriage of vehicles. The system is to be sized to remove no less than 125% of the combined capacity of both the monitor(s) and the required number of fire hose nozzles.

3.6.2.3 For passenger ships constructed before 1 January 2026, including those constructed before 1 July 2012, a fixed water-based fire-extinguishing system based on monitor(s) is to be installed in order to protect areas on weather decks intended for the carriage of vehicles. Monitors are to be located in positions which ensure unobstructed protection of vehicles in the area on the weather deck intended for carriage for vehicles, as far as practicable. Operation of monitors is to be ensured by safe access ways or remote control not to be impaired by a fire in the area protected by that monitor. Capacity of each monitor is to be at least 1250 L/min. The Administration may permit lower flow rates when the required rate is not practical given the size and arrangement of the ship. The Administration may also permit alternative arrangements for ships that have already installed a fixed water-based fire-extinguishing system based on monitor(s) prior to 1 January 2026.

3.7 Decision-making

(The requirements of this sub section are to apply to passenger ships constructed on or after 1 January 2026.)

In passenger ships, vehicle, special category and ro-ro spaces, where fixed pressure water-spraying systems are fitted, are to be provided with suitable signage and marking on deckhead and bulkhead and on the vertical boundaries allowing easy identification of the sections of the fixed fire-extinguishing system. Suitable signage and markings are to be adapted to typical patterns of crew movement taking into consideration obstruction by cargo or fixed installations. Section number signs is to be of photoluminescent material (Refer Chapter 8 Section 11 for the evaluation and testing of photoluminescent material). The section numbering indicated inside the space is to be same as section valve identification and section identification at the safety centre or continuously manned control station.

Section 7

Safety Centre on Passenger Ships

7.6 Control and monitoring of safety systems

7.6.1 Notwithstanding the requirements set out elsewhere in the part of the rules, the full functionality (operation, control, monitoring or any combination thereof, as required) of the safety systems listed below shall be available from the safety centre:

- fire detection and fire alarm system;

End of Chapter

Part 6

Fire Safety Requirements

Chapter 8

Fire Safety Systems Code

Section 7

Fixed Pressure Water-Spraying and Water-Mist Fire-Extinguishing Systems

7.2 Engineering specifications

7.2.5 Fixed water-based fire-extinguishing system on ro-ro passenger ships weather decks intended for the carriage of vehicles

This sub section details the specification of fixed water-based fire-extinguishing system on ro-ro passenger ships having weather decks intended for the carriage of vehicles as required by Chapter 7. The requirements of this sub section apply to ro-ro passenger ships constructed on or after 1 January 2026.

7.2.5.1 The protected area is to be the entire length and width of the weather deck intended for the carriage of vehicles. The fixed monitor(s) is to be capable of delivering water to:

.1 the area of weather decks intended for carriage of vehicles; and

.2 the area, including superstructure boundaries located up to 8.0 m, measured horizontally, from the area intended for vehicle storage, or the next vertical boundaries, whichever is less

7.2.5.2 The combined capacity of all fixed monitors are to be minimum 2.0 L/min per square metre of the protected area, but in no case the output of any monitor is to be less than 1250 L/min. Even distribution of water is to be ensured.

7.2.5.3 The distance from the monitor to the farthest extremity of the protected area forward of that monitor is not to be more than 75% of the monitor throw in still air conditions.

7.2.5.4 Each monitor is to be located outside the area which it protects, in a safe position, with access not likely to be cut off in case of fire. Monitors are to be installed in positions which allow for unobstructed water coverage with vehicles stowed to maximum capacity of the weather deck. However, areas that cannot be covered by water monitors are to be protected by water nozzles. Nozzles are to be designed and installed taking into account weather conditions and provide 5.0 L/min per square metre for the area they cover and have release controls in a position being accessible in case of a fire.

7.2.5.5 The system is to be available for immediate use and capable of continuously supplying water. The water supply is to be capable of simultaneously supplying water at the required rate for the entire width of the weather deck intended for carriage of vehicles and a length of 40 m, or the entire length of the weather deck if this is less than 40 m. In no case the supply capacity is to be less than that required for the largest monitor.

7.2.5.6 The system may be supplied by the fire main, the pump(s) serving other fixed water-based fire-fighting systems or a dedicated pump providing a continuous supply of seawater.

Where the ship's fire pumps are used to feed the monitor(s):

.1 it is to be possible to segregate the ship's fire main from the monitor(s) by means of a valve in order to operate both systems separately or simultaneously; and

.2 the capacity of the pumps is to be sufficient to serve both systems simultaneously, including two jets of water at the required pressure from the fire main system. In case the weather deck is also to carry dangerous goods, capacity for four jets of water at the required pressure is to be provided.

Where another fixed water-based fire-fighting system is used to feed the monitor(s):

.3 it is to be possible to segregate the other fixed water-based fire-fighting system from the monitor(s) by means of a valve in order to operate both systems separately or simultaneously; and

.4 the capacity of the pump(s) is to , in case of open ro-ro spaces, be sufficient to serve both systems simultaneously, minimum two sections of the fixed water-based fire-fighting system being close to the openings facing weather deck and one monitor serving the weather deck. For closed ro-ro spaces and special category spaces, simultaneous operation is not required.

Section 9

Fixed Fire Detection and Fire Alarm Systems

9.1 Application

9.1.1 This chapter details the specifications of ~~for~~ fixed fire detection and fire alarm systems as required by Ch.3, Sec.1. Unless expressly provided otherwise, the requirements of this section are applicable to ships constructed on or after 1 July 2012. The requirements of 9.2.3.1.5 and 9.2.4.2.2 of this section apply to ships constructed on or after 1 January 2026.

9.2 Engineering specifications

9.2.3 Component requirements

9.2.3.1 Detectors

9.2.3.1.3 Heat detectors and linear heat detectors are to be certified to operate before the temperature exceeds 78°C but not until the temperature exceeds 54°C, when the temperature is raised to those limits at a rate less than 1°C per minute, when tested according to standards EN 54:2001 and IEC 60092-504. Alternative testing standards may be accepted by IRS. At higher rates of temperature rise, the heat detector and linear heat detector is to operate within temperature limits to the satisfaction of the Surveyors having regard to the avoidance of detector insensitivity or oversensitivity.

9.2.3.1.4 The operation temperature of heat detectors and linear heat detectors in drying rooms and similar spaces of a normal high ambient temperature may be up to 130°C, and up to 140°C in saunas.

9.2.3.1.5 Linear heat detectors are to be tested according to standards EN 54-22:2015 and IEC 60092-504. Alternative testing standards may be used as determined by IRS

9.2.4 Installation requirements

9.2.4.2 Positioning of detectors

9.2.4.2.2.1 IRS may require or permit other ~~different~~ spacing ~~to that specified in the above table if~~ based upon test data which demonstrate the characteristics of the detectors. Detectors located below moveable ro-ro decks are to be in accordance with the above.

9.2.4.2.2.2 The distance between two sensor cables of the linear heat detection system is not to be more than 9.0 m, while the distance between such cables and bulkheads is not to be more than 4.5 m.

Table 9.1 : Spacing of detectors			
Type of detector	**Max. floor area per detector**	**Max. distance apart between centres**	**Max. distance away from bulkheads**
Heat	37 $[m]^2$	9 [m]	4.5 [m]
Smoke	74 $[m]^2$	11 [m]	5.5 [m]
Combined smoke and heat	74 $[m]^2$	9 [m]	4.5 [m]

9.2.5 System control requirements

9.2.5.1 Visual and audible fire signals

9.2.5.1.2 On ro-ro passenger ships constructed on or after 1 January 2026, alarm notifications is to follow a consistent alarm presentation scheme (wording, vocabulary, colour and position). Alarms are to be immediately recognizable on the navigation bridge and is not to be compromised by noise or poor placing.

9.2.5.1.3 On ro-ro passenger ships constructed on or after 1 January 2026, the interface is to provide alarm addressability, allow the crew to identify the alarm history, the most recent alarm and the means to suppress alarms while ensuring the alarms with ongoing trigger conditions are still clearly visible.

9.2.5.1.4 On ro-ro passenger ships constructed on or after 1 January 2026, the smoke detector function in special category and ro-ro spaces may be disconnected during loading and unloading of vehicles. The time of disconnection is to be adapted to the time of loading/unloading and be automatically reset after this predetermined time. The central unit is to indicate whether the detector sections are disconnected or not. Disconnection of the heat detection function or manual call points is not to be permitted.

End of Chapter