GUIDELINES FOR STATUTORY SURVEYS OF SEA-GOING SHIPS ENGAGED ON NON-INTERNATIONAL VOYAGES

PART FOUR SAFETY OF SHIPS

Contents

Chapter 1 GENERAL PROVISIONS ····· 4-1
1 Application ····· 4-1
2 Definitions ····· 4-1
3 Class of passenger ships ····· 4-2

Chapter 2-1 CONSTRUCTION − SUBDIVISION AND STABILITY, MACHINERY AND ELECTRICAL INSTALLATIONS ····· 4-3
1 Subdivision and stability ····· 4-3
2 Machinery installations ····· 4-29
3 Electrical installations ····· 4-40
4 Automation requirements for periodically unattended machinery spaces ····· 4-51
5 Structure of ships ····· 4-54

Chapter 2-2 CONSTRUCTION − FIRE PROTECTION, FIRE DETECTION AND FIRE EXTINCTION ····· 4-56
1 General provisions ····· 4-56
2 Fire safety measures for passenger ships ····· 4-95
3 Fire safety measures for cargo ships ····· 4-108
4 Fire safety measures for tankers ····· 4-126
5 Fire safety measures for special purpose ships ····· 4-142
6 Fire safety measures for non-power-driven ships ····· 4-143
7 Special fire safety measures for dock pontoons ····· 4-144
8 Special fire safety measures for oil recovery ships ····· 4-146
9 Special fire safety measures for floating docks ····· 4-150
Appendix Lists of Solid Bulk Cargoes for Which a Fixed Gas Fire-extinguishing System May Be Exempted or for Which a Fixed Gas Fire-Extinguishing System Is Ineffective (MSC/Circ.1146) ····· 4-153

Chapter 3 LIFE-SAVING APPLIANCES ····· 4-156
1 General provisions ····· 4-156
2 Provision of life-saving appliances ····· 4-156
3 Stowage, embarkation, launching and recovery of survival craft ····· 4-164
4 Musters and drills ····· 4-166
5 Maintenance and inspections of life-saving appliances ····· 4-169
6 Requirements for life-saving appliances ····· 4-170
7 Decision support system for masters ····· 4-172
Appendix List of First-aid Outfit for Survival Craft ····· 4-173

Chapter 4 RADIOCOMMUNICATIONS ····· 4-174
1 General provisions ····· 4-174
2 Provision of radiocommunication equipment ····· 4-175
3 Basic technical requirements and performance standards ····· 4-176
4 Installation and power supply ····· 4-178

Chapter 5 NAVIGATIONAL EQUIPMENT ····· 4-180
1 General provisions ····· 4-180
2 Requirements of provision ····· 4-181
3 Performance standards ····· 4-184

Chapter 6 CARRIAGE OF CARGOES ····· 4-185
1 General provisions ····· 4-185
2 Special provisions for bulk cargoes other than grain ····· 4-186
3 Carriage of grain ····· 4-186
4 Carriage of dangerous goods ····· 4-190

Chapter 7 INTACT STABILITY ····· 4-192
1 General provisions ····· 4-192
2 Basic requirements for stability ····· 4-193
3 Additional requirements for stability ····· 4-199

Chapter 8 SINGAL EQUIPMENT ····· 4-218
1 General provisions ····· 4-218
2 Lights ····· 4-219
3 Flashing lights ····· 4-224
4 Shapes ····· 4-225
5 Sound signal appliances ····· 4-226
Appendix 1 Comparison of Range of Visibility and Luminous Intensity for Lights ····· 4-228
Appendix 2 Chromaticity of Lights (Diagram) ····· 4-228

Chapter 1 GENERAL PROVISIONS

1 Application

1.1 Unless expressly provided otherwise, this PART is not to apply to high-speed craft.

1.2 For articulated connected pusher tug-barge combination, unless provided otherwise, the pusher tug and the barge are to be considered as separate ships complying with the relevant requirements of this PART. For rigidly connected pusher tug-barge combination, unless provided otherwise, the combination is to be considered as a single ship complying with the relevant requirements of this PART.

2 Definitions

2.1 For the purpose of this PART, unless expressly provided otherwise:

(1) A *passenger* is every person other than:

① the master and the members of the crew or other persons employed or engaged in any capacity on board a ship for the business of that ship; and

② a child under one year of age.

(2) A *passenger ship* is a ship which carries more than 12 passengers.

(3) A *cargo ship* is any ship which is not a passenger ship.

(4) *Special personnel* means all persons who are not passengers or members of the crew or children of under one year of age and who are specially needed for the particular operational duties of the ship and are carried in addition to those persons required for the normal navigation, engineering and maintenance of the ship or engaged to provide services for the persons carried on board. Special personnel are expected to be able bodied with a fair knowledge of the layout of the ship and to have received some training in safety procedures and the handling of the ship's safety equipment. Wherever the number of special personnel appears as a parameter in the Guidelines, it is to include the number of passengers carried on board which may not exceed 12.

(5) *Persons (carried) onboard* are all personnel carried onboard the ship, including passengers, crew and special personnel, if any.

(6) A *bulk carrier* is a ship which is constructed generally with single deck, topside tanks and hopper side tanks in cargo spaces, and is intended primarily to carry dry cargo in bulk. Ship types such as ore carriers and combination carriers are included.

(7) A *tanker* is a cargo ship which is constructed or converted to carry inflammable liquid cargoes in bulk.

(8) A *chemical tanker* is a ship engaged in the carriage of bulk cargoes of dangerous liquid chemical substances, other than petroleum or similar inflammable products.

(9) A *liquefied gas carrier* is a ship engaged in the carriage of liquefied gases having a vapour pressure exceeding 0.28 MPa absolute at a temperature of 37.8℃, and other similar products.

(10) A *special purpose ship* means a mechanically self-propelled ship which, by reason of its function, carries on board more than 12 special personnel, including:

① ships engaged in research, expeditions and survey;

② ships for training of marine personnel;

③ whale and fish factory ships not engaged in catching;

④ ships processing other living resources of the sea not engaged in catching;

⑤ other ships similar to ships mentioned in ① to ④ above.

(11) An *offshore supply ship* is:

① mainly intended for the carriage of stores, materials and equipment to mobile offshore units; and

② designed to have the accommodation and bridge erections in the forward part of the vessel and an exposed deck in the after part for the handling of cargo at sea.

(12) A *pusher tug-barge combination* is a combination of a pusher tug and a barge connected by mechanical means in rigid or articulated manner.

(13) An *oil recovery ship* means a steel ship specially or also engaged in the recovery of oil floating on the sea.

(14) A *dock pontoon* is a non-power-driven ship or offshore unit which is not used for navigation and which is secured to the shore by anchors and mooring chains.

(15) *Construction* means the construction of a ship the keel of which is laid or which is at a similar stage of

construction as follows:

① construction identifiable with a specific ship begins; and

② assembly of that ship has commenced comprising at least 50 tons or one percent of the estimated mass of all structural material, whichever is less.

(16) *Deadweight* is the difference in tonnes between the displacement of a ship in water of a specific gravity of 1.025 at the draught corresponding to the assigned summer freeboard and the lightweight of the ship.

(17) *Lightweight* is the displacement of a ship in tonnes without cargo, fuel, lubricating oil, ballast water, fresh water and feedwater in tanks, consumable stores, and passengers and crew and their effects.

(18) *Place of refuge* is any naturally or artificially sheltered area which may be used as a shelter by a craft under conditions likely to endanger its safety, such as port of departure, port of arrival and other ports, havens, anchorages, waters sheltered by jetties that can provide refuge.

3 Class of passenger ships

3.1 Passenger ships, including ro-ro passenger ships, are classified into I, II and III according to the service area and the distance from the course of the voyage to the place of refuge, as indicated in Table 3.1.

Categorization of Passenger Ships **Table 3.1**

Class of passenger ship	Limitation for navigation		
	Service area	Distance from the course of the voyage to the place of refuge	
		Summer/Tropical*	Winter*
I	Unrestricted service, service category 1	—	—
II	service category 2	≥ 10 n mile	≥ 5 n mile
III	service category 2	< 10 n mile	< 5 n mile
	service category 3	—	—

* Seasonal areas as specified in Annex II to the International Convention on Load Lines, 1966.

Chapter 2-1 CONSTRUCTION - SUBDIVISION AND STABILITY, MACHINERY AND ELECTRICAL INSTALLATION

1 Subdivision and stability

1.1 Application

1.1.1 This Section applies to the subdivision and stability of passenger ships defined by 2.1, Chapter 1 of this PART and cargo ships of various types (except for those not propelled by mechanical means).

1.1.2 Subdivision and damage stability of mono-hull passenger ships

(1) The subdivision and stability of the following mono-hull passenger ships are to comply with the relevant requirements of 1.24 of this Chapter as well as Parts A, B, B-1, B-2 and B-4, Chapter II-1 of the International Convention for the Safety of Life at Sea (SOLAS) (except Reg.8-1 of Part B-1, and factor $S_{intermediate,I}$ in 1.1 of Reg.7-2 of Part B-1 is taken as 1.0):

① passenger ships of class I;

② passenger ships of class II carrying 500 or more persons;

③ passenger ships of class III carrying 1000 or more persons.

(2) For mono-hull passenger ships other than (1)①~③, damage stability is to comply with the requirements of 1.4 of this Chapter, and subdivision is to comply with the relevant requirements for passenger ships in this Chapter.

1.1.3 For twin hull passenger ships, damage stability is to comply with the requirements of 1.5 of this Chapter, and subdivision is to comply with the relevant requirements for passenger ships in this Chapter.

1.1.4 If it is unreasonable or impracticable for new type or special type passenger ships to carry out some provisions, the certain requirements may be exempted subject to agreement, provided that the corresponding safety measures are taken.

1.1.5 A cargo ship, whenever built, which is converted to a passenger ship is to be treated as a passenger ship constructed on the date on which such a conversion commences.

1.1.6 For cargo ships and other ships other than passenger ships, damage stability is to comply with the requirements of 1.6 to 1.12 of this Chapter.

1.2 Definitions

1.2.1 The relevant definitions are as follows:

(1) *Subdivision load line* is a waterline used in determining the subdivision of the ship.

(2) *Deepest subdivision load line* is the waterline which corresponds to the assigned summer load line.

(3) *Length of the ship* L_{WL} is the length measured between perpendiculars taken at the extremities of the deepest subdivision load line.

(4) *Breadth of the ship* is the extreme width of the ship at or below the deepest subdivision load line, measured amidships to the moulded line of the frame in a ship with a metal shell and to the outer surface of the hull in a ship with a shell of any other material.

(5) *Draught* is the vertical distance from the moulded base line at mid-length of L_{WL} to the subdivision load line in question.

(6) *Bulkhead deck:* bulkhead deck in a passenger ship is the uppermost deck to which the main bulkheads are carried watertight. In a cargo ship the freeboard deck may be taken as the bulkhead deck.

(7) *Margin line* is a line drawn at least 76 mm below the upper surface of the bulkhead deck at side.

(8) *Permeability* of a space is the proportion of the immersed volume of that space which can be occupied by water.

(9) *Machinery space* is to be taken as extending from the moulded base line to the margin line and between the extreme main transverse watertight bulkheads, bounding the spaces containing the

main and auxiliary propulsion machinery, boilers serving the needs of propulsion, and all permanent coal bunkers. In the case of unusual arrangements, the limits of the machinery spaces are to be agreed upon.
(10) *Passenger spaces* are those spaces which are provided for the accommodation and use of passengers, excluding baggage, store, provision and mail rooms. Spaces provided for the accommodation and use of the crew are to also be regarded as passenger spaces.
(11) *Ro-ro spaces* are spaces not normally subdivided in any way and normally extending to either a substantial length or the entire length of the ship in which motor vehicles with fuel in their tanks for their own propulsion or goods (packaged or in bulk, in or on rail or road cars, vehicles (including road or rail tankers), trailers, containers, pallets, demountable tanks or in or on similar stowage units or other receptacles) can be loaded and unloaded normally in a horizontal direction.
(12) *Weathertight* means that in any sea conditions water will not penetrate into the ship.
(13) *Freeboard deck* is the deck as defined in 2.1(9), Chapter 1, PART THREE of the Guidelines.
(14) *Cargo ships* are carriers propelled by mechanical means designed to carry mainly dry cargoes. For the purpose of this Chapter, pusher tug-barge combination as a whole does not belong to cargo ships.
(15) *Length* L_L is defined as in 2.1(1), Chapter 1, PART THREE of the Guidelines.

1.2.2 In all cases volumes and areas are to be calculated to moulded lines.

1.3 Special requirements concerning passenger ship subdivision

1.3.1 If the distance between two adjacent main transverse bulkheads, or their equivalent plane bulkheads, or the distance between the transverse planes passing through the nearest stepped portions of the bulkheads, is less than 3 m plus 3% of the length of the ship L_{WL}, or 11 m, whichever is the less, only one of these bulkheads is to be regarded as forming part of the subdivision of the ship.

1.3.2 A main transverse bulkhead may be recessed provided that all parts of the recess lie inboard of vertical surfaces on both sides of the ship, situated at a distance from the shell plating equal to one fifth the breadth of the ship, and measured at right angles to the centerline at the level of the deepest subdivision load line. Any part of a recess which lies outside these limits is to be dealt with as a step in accordance with 1.3.3.

1.3.3 A main transverse bulkhead may be stepped provided that additional subdivision is provided in way of the step to maintain the same measure of safety as that secured by a plane bulkhead.

1.4 Stability of mono-hull passenger ships in damaged condition

1.4.1 Sufficient intact stability is to be provided in all service conditions so as to enable the ship to withstand the final stage of flooding of the following compartments in compliance with the requirements of 1.4.5, 1.4.6, 1.4.7 and 1.4.8 of this Chapter:
(1) the flooding of any one main compartment which exceeds the floodable length as defined by 1.4.4(1) of this Chapter;
(2) the flooding of forepeak tank or aft peak tank;
(3) the flooding of those two adjacent main compartments which are separated by a bulkhead stepped not subject to the conditions of 1.3.3 of this Chapter.

1.4.2 Where in calculation, the following requirements are to be complied with:
(1) the requirements of 1.4.1 of this Chapter are to be determined by calculations which are in accordance with 1.4.3 and 1.4.4 of this Chapter and which take into consideration the proportions and design characteristics of the ship and the arrangement and configuration of the damaged compartments. In making these calculations the ship is to be assumed in the worst anticipated service condition as regards stability;
(2) Where it is proposed to fit decks, inner skins or longitudinal bulkheads of sufficient tightness to seriously restrict the flow of water, it is to be satisfied that proper consideration is given to such restrictions in the calculations.

1.4.3 For the purpose of making damage stability calculations the volume and surface permeability are to be in general according to the provisions of Table 1.4.3.

Permeability of compartment spaces **Table 1.4.3**

Spaces	Permeability
Appropriated to cargo, coal or stores	0.60
Occupied by accommodation	0.95
Occupied by machinery	0.85
Intended for liquids	0～0.95①
Void spaces	0.95

Note: ① The permeability of partially loaded tanks is to be same as the phase of the liquids carried by the tanks. Once tanks loaded with liquids are damaged, it is to be assumed that the liquids carried have flown out of the tanks completely and are replaced by sea water till the waterplane of the last equilibrium.

Higher surface permeability is to be assumed in respect of spaces which, in the vicinity of the damage waterplane, contain no substantial quantity of accommodation or machinery and spaces which are not generally occupied by any substantial quantity of cargo or stores.

1.4.4 Assumed extent of damage is to be as follows:
(1) longitudinal extent: 3 m plus 3% of the length of the ship, or 11 m, whichever is the less;
(2) transverse extent measured inboard from the ship's side, at right angles to the centerline at the level of the deepest subdivision load line): a distance of one fifth of the breadth of the ship;
(3) vertical extent: from the base line upwards without limit;
(4) if any damage of lesser extent than that indicated in(1), (2) and (3) above would result in a more severe condition regarding heel or loss of stability, such damage is to be assumed in the calculations.

1.4.5 Unsymmetrical flooding is to be kept to a minimum consistent with efficient arrangements. Where it is necessary to correct large angles of heel, the means adopted are to, where practicable, be self-acting, but in any case where controls to cross-flooding fittings are provided they are to be operable from above the bulkhead deck. These fittings together with their controls are to be acceptable. The maximum angle of heel after flooding but before equalization is not to exceed 15 °. Where cross-flooding fittings are required the time for equalization is not to exceed 15 min. Suitable information concerning the use of cross-flooding fittings is to be supplied to the master of the ship.①

1.4.6 The final conditions of the ship after damage and, in the case of unsymmetrical flooding, after equalization measures have been taken are to be as follows:
(1) in the case of symmetrical flooding there is to be a positive residual metacentric height of at least 0.05 m as calculated by the constant displacement method;
(2) in the case of unsymmetrical flooding, the angle of heel for one-compartment flooding is not to exceed 7 °. For the simultaneous flooding of two main compartments specified in 1.4.1(3), a heel of 12 °may be permitted;
(3) in no case is the margin line to be submerged in the final stage of flooding. If it is considered that the margin line may become submerged during an intermediate stage of flooding, investigations and arrangements necessary for the safety of the ship may be required.

1.4.7 The stability required in the final condition after damage, and after equalization where provided, is to be determined as follows:
(1) The positive residual righting lever curve is to have a minimum range of 10 °beyond the angle of equilibrium to the flooding angle or vanishing angle, whichever is the lesser.
(2) The maximum positive residual righting lever curve beyond the angle of equilibrium to the flooding angle or vanishing angle is not to be less than the value obtained from the following formula. However, in no case is this righting lever to be less than 0.1 m.

$$GZ = \frac{\text{Heeling moment as passengers crowding at one side}}{\text{Displacement}} \quad \text{m}$$

① Refer to IMO Resolution MSC.362(92) Revised Recommendation on a Standard Method for Evaluating Cross-Flooding Arrangements.

(3) For the purpose of calculating the heeling moments of the side where passengers are crowded, the following assumptions are to be made:

① four persons per square meter, a mass of 75 kg for each passenger;

② passengers are to be distributed on available deck areas towards one side of the ship on the decks where muster stations are located and in such a way that they produce the most adverse heeling moment.

1.4.8 In intermediate stages of flooding, the maximum righting lever is to be at least 0.05 m and the range of positive righting levers is to be at least 7 °. In all cases, only one breach in the hull and only one flee surface need be assumed.

1.4.9 The master of the ship is to be supplied with the data necessary to maintain sufficient intact stability under service conditions to enable the ship to withstand the critical damage. In the case of ships requiring cross-flooding the master of the ship is to be informed of the conditions of stability on which the calculations of heel are based and be warned that excessive heeling might result should the ship sustain damage when in a less favorable condition.

1.4.10 The data referred to in 1.4.9 of this Chapter to enable the master to maintain sufficient intact stability is to include information which indicates the maximum permissible height of the ship's centre of gravity above keel (KG), or alternatively the minimum permissible metacentric height (GM), for a range of draughts or displacements sufficient to include all service conditions. The information is to show the influence of various trims taking into account the operational limits.

1.4.11 Each ship is to have scales of draughts marked clearly at the bow and stern. In the case where the draught marks are not located where they are easily readable, or operational constraints for a particular trade make it difficult to read the draught marks, then the ship is also to be fitted with a reliable draught indicating system by which the bow and stem draughts can be determined.

1.4.12 On completion of loading of the ship and prior to its departure, the master is to determine the ship's trim and stability and also ascertain and record that the ship is in compliance with stability criteria in the relevant provisions. The determination of the ship's stability is always to be made by calculation. The use of an electronic loading and stability computer or equivalent means for this purpose may be accepted.

1.4.13 No relaxation from the requirements for damage stability may be considered unless it is shown that the intact metacentric height in any service condition necessary to meet these requirements is excessive for the service intended.
Relaxations from the requirements for damage stability are to be permitted only in exceptional cases and subject to the condition that the proportions, arrangements and other characteristics of the ship are the most favorable to stability after damage which can practically and reasonably be adopted in the particular circumstances.

1.5 Stability of twin hull passenger ships in damaged condition

1.5.1 The damage stability of twin hull passenger ships is to be calculated under a float condition and loading condition with worse stability.

1.5.2 The float stability and residual stability are to be checked for the following flooding conditions:
(1) if damage occurs at any position along the ship length in one demi-hull, excluding main transverse watertight bulkheads the spacing of which exceeds the longitudinal damage extent specified in 1.5.2(2);
(2) longitudinal extent: 0.1L or 3 m+0.03L or 11 m, whichever is the least;
(3) transverse extent: 0.2B or 0.05L or 5m, whichever is the least;
(4) vertical extent is to be taken for the full depth of the craft;
(5) if the spacing between main transverse watertight bulkheads is less than the longitudinal damage extent specified in 1.5.2(2), one or more transverse watertight bulkheads are to be

assumed non-existent;
(6) if the forepeak or aft peak of one demi-hull is flooded;
(7) if the forepeaks or aft peaks of the two demi-hulls are flooded simultaneously, and it causes severe results, the calculations are to be made for this damaged condition;
(8) if any damage of lesser extent than that above would result in a more severe condition, calculations are to be made for this damaged condition.

1.5.3 Permeability is the same as that in 1.4.3 of this Chapter.

1.5.4 The ships in damaged condition are to comply with the following requirements:
(1) in the final flooding stage, any part of the margins for bulkhead deck is not to be submerged; the lower edge of openings which are flooded continuously in the intermediate flooding stage is not to be submerged;
(2) in the final flooding stage, the heeling angle is not to exceed 7°, the maximum heeling angle after flooding but before the equalization is not to exceed 12°;
(3) in the final flooding stage, the positive stability range of righting level curve is not to be less than 5°, the area under the curve within this range is not to be less than 0.015 m·rad; the maximum righting level within the positive stability range is not to be less than the heeling moments due to crowding of passengers at one side; in the intermediate flooding stage, the positive stability range is not to be less than 3°, the area is not to be less than 0.005 m·rad. The openings which are flooded continuously are not to be submersed within the above-mentioned range.

1.5.5 Where it is necessary to correct large angles of heel, the measure of equalization is to be made. The fittings of control are to be operable from above the bulkhead and subject to approval. The time required for equalization is not to exceed 15 min. Suitable information concerning the measure of equalization is to be supplied to the master of the ship.

1.6 Subdivision and stability of cargo ships①

1.6.1 Application
(1) The requirements for damage stability in this part apply to cargo ships over 80 m in length (L_L) but are to exclude those ships which are shown to comply with damage stability requirements in other parts of the Guidelines except cargo ships intended for the carriage of deck cargoes assigned with B-60 and B-100 freeboard specified in Chapter 3, PART THREE of the Guidelines.
(2) Any reference hereinafter to guidelines refers to the set of guidelines contained in 1.6.1 to 1.6.8 of this part.
(3) For a particular ship or group of ships, alternative arrangements may be accepted, if the same degree of safety as represented by the Guidelines is achieved.

1.6.2 Definitions
For the purpose of the Guidelines, unless expressly provided otherwise:
(1) *Partial load line* is the light ship draught plus 60% of the difference between the light ship draught and deepest subdivision load line.
(2) *Subdivision length of the ship* (L_s) is the greatest projected molded length of that part of the ship at or below deck or decks limiting the vertical extent of flooding with the ship at the deepest subdivision load line.
(3) *Mid-length* is the mid-point of the subdivision length of the ship.
(4) *Aft terminal* is the aft limit of the subdivision length.
(5) *Forward terminal* is the forward limit of the subdivision length.
(6) *Breadth (B)* is the greatest molded breadth of the ship at or below the deepest subdivision load line.
(7) *Draught (d)* is the vertical distance from the molded baseline at mid-length to the waterline in question.
(8) *Permeability (μ)* of a space is the proportion of the immersed volume of that space which can be occupied by water.

① It should be read in conjunction with resolution A.684(17) Explanatory Notes to the SOLAS Regulations on Subdivision and Damage Stability of Cargo Ships of 100 Metres in Length and over adopted by IMO. This resolution applies also to ships of 80 meters in L_L and upwards.

1.6.3 Required subdivision index *R*

(1) The Guidelines are intended to provide ships with a minimum standard of subdivision.

(2) The degree of subdivision to be provided is to be determined by the required subdivision index R, as follows:

$$R = (0.002 + 0.0009L_s)^{1/3}$$

where: L_s— subdivision length of the ship, in m.

1.6.4 Attained subdivision index *A*

(1) The attained subdivision index *A*, calculated in accordance with this paragraph, is not to be less than the required subdivision index *R*.

(2) The attained subdivision index *A* is to be calculated for the ship by the following formula:

$$A = \sum p_i s_i$$

where: *i* —represents each compartment or group of compartments under consideration;

p_i—accounts for the probability that only the compartment or group of compartments under consideration may be flooded, disregarding any horizontal subdivision;

s_i—accounts for the probability of survival after flooding the compartment or group of compartments under consideration, including the effects of any horizontal subdivision.

(3) In calculating *A*, level trim is to be used.

(4) This summation covers only those cases of flooding which contribute to the value of the attained subdivision index *A*.

(5) The summation indicated by the above formula is to be taken over the ship's length for all cases of flooding in which a single compartment or two or more adjacent compartments are involved.

(6) Wherever wing compartments are fitted, contribution to the summation indicated by the formula is to be taken for all cases of flooding in which wing compartments are involved; and additionally, for all cases of simultaneous flooding of a wing compartment or compartments and the adjacent inboard compartment or compartments, assuming a rectangular penetration which extends to the ship's centerline, but excludes damage to any centerline bulkhead.

(7) The assumed vertical extent of damage is to extend from the baseline upwards to any watertight horizontal subdivision above the waterline or higher. However, if a lesser extent will give a more severe result, such extent is to be assumed.

(8) If pipes, ducts or tunnels are situated within assumed flooded compartments, arrangements are to be made to ensure that progressive flooding cannot thereby extend to compartments other than those assumed flooded. However, minor progressive flooding may be permitted if it is demonstrated that its effects can be easily controlled and the safety of the ship is not impaired.

(9) In the flooding calculations carried out according to the Guidelines, only one breach of the hull need be assumed.

1.6.5 Calculation of the factor p_i

(1) The factor p_i is to be calculated according to paragraph 1.1 as appropriate, using the following notations:

x_1 = the distance from the aft terminal of L_s to the foremost portion of the aft end of the compartment being considered;

x_2 = the distance from the aft terminal of L_s to the aftermost portion of the forward end of the compartment being considered;

$$E_1 = \frac{x_1}{L_s}$$

$$E_2 = \frac{x_2}{L_s}$$

$$E = E_1 + E_2 - 1$$

$$J = E_2 - E_1$$

$J' = J - E$, if $E \geq 0$

$J' = J + E$, if $E < 0$

The maximum non-dimensional damage length

$J_{\max} = \frac{48}{L_s}$, but not more than 0.24.

The assumed distribution density of damage location along the ship's length

$a = 1.2 + 0.8E$, but not more than 1.2.

The assumed distribution function of damage location along the ship's length

$F = 0.4 + 0.25E(1.2 + a)$.

$$y = \frac{J}{J_{\max}}$$

$$p = F_1 J_{\max}$$

$$q = 0.4F_2 (J_{\max})^2$$

$F_1 = y^2 - \frac{y^3}{3}$, if $y < 1$

$F_1 = y - \frac{1}{3}$ otherwise;

$F_2 = \frac{y^3}{3} - \frac{y^4}{12}$, if $y < 1$

$F_2 = \frac{y^2}{2} - \frac{y}{3} + \frac{1}{12}$ otherwise.

① The factor p_i is determined for each single compartment:

(a) Where the compartment considered extends over the entire ship length L_s:

$$p_i = 1$$

(b) Where the aft limit of the compartment considered coincides with the aft terminal:

$$p_i = F + 0.5ap + q$$

(c) Where the forward limit of the compartment considered coincides with the forward terminal:

$$p_i = 1 - F + 0.5ap$$

(d) When both ends of the compartment considered are inside the aft and forward terminals of the ship length L_s:

$$p_i = ap$$

(e) In applying the formulae of (b), (c) and (d), where the compartment considered extends over the "mid-length", these formulae values are to be reduced by an amount determined according to the formula for q, in which $F2$ is calculated taking $y = \frac{J'}{J_{\max}}$.

(2) Wherever wing compartments are fitted, the p_i-value for a wing compartment is to be obtained by multiplying the value, as determined in (3), by the reduction factor r according to (b), which represents the probability that the inboard spaces will not be flooded.

① The p_i-value for the case of simultaneous flooding of a wing and adjacent inboard compartment is to be obtained by using the formulae of (3), multiplied by the factor (1 - r).

② The reduction factor r is to be determined by the following formulae:

for $j \geq 0.2\frac{b}{B}$:

$$r = \frac{b}{B}(2.3 + \frac{0.08}{J + 0.02}) + 0.1, \text{ if } \frac{b}{B} \leq 0.2$$

$$r = (\frac{0.016}{J + 0.02} + \frac{b}{B} + 0.36), \text{ if } \frac{b}{B} > 0.2$$

for $j < 0.2\frac{b}{B}$, the reduction factor r is to be determined by linear interpolation between:

$r = 1$, for $J = 0$

and

r = as for the case where $J \geq 0.2b/B$, for $J = 0.2b/B$

where:

b = the mean transverse distance in meters measured at right angles to the centerline at the deepest subdivision load line between the shell and a plane through the outermost portion of and parallel to that part of the longitudinal bulkhead which extends between the longitudinal limits used in calculating the factor p_i.

(3) To evaluate p_i for compartments taken singly the formulae in paragraphs (1) and (2) are to be applied directly.

① To evaluate the p_i-values attributable to groups of compartments the following applies:

for compartments taken by pairs:

$$p_i = p_{12} - p_1 - p_2;$$

$$p_i = p_{23} - p_2 - p_3, \text{ etc.}$$

for compartments taken by groups of three:

$$p_i = p_{123} - p_{12} - p_{23} + p_2;$$

$$p_i = p_{234} - p_{23} - p_{34} + p_3, \text{ etc.}$$

for compartments taken by groups of four:

$$p_i = p_{1234} - p_{123} - p_{234} + p_{23};$$

$$p_i = p_{2345} - p_{234} - p_{345} + p_{34}, \text{ etc.}$$

where:

p_{12}, p_{23}, p_{34}, etc.,

p_{123}, p_{234}, p_{345}, etc., and

p_{1234}, p_{2345}, p_{3456}, etc.

are to be calculated according to the formulae in 1.6.5(1) and 1.6.5(2) for a single compartment whose non-dimensional length J corresponds to that of a group consisting of the compartments indicated by the indices assigned to p.

② The factor p_i for a group of three or more adjacent compartments equals zero if the no dimensional length of such a group minus the non-dimensional length of the aftermost and foremost compartments in the group is greater than J_{max}.

1.6.6 Calculation of the factor s_i

(1) The factor is to be determined for each compartment or group of compartments according to the following:

① In general for any condition of flooding from any initial loading conditions are to be:

$$s = C\sqrt{0.5(GZ_{\max})(range)}$$

with:

$$C = 1, \text{ if } \theta_e \leq 25°,$$

$$C = 0, \text{ if } \theta_e > 30°,$$

$$C = \sqrt{\frac{30 - \theta_e}{5}}, \text{ otherwise;}$$

GZ_{max} = maximum positive fighting lever (metres) within the range as given below but not more than 0.1 m;

$range$ = range of positive righting levers beyond the angle of equilibrium (degrees) but not more than 20°; however, the range is to be terminated at the angle where openings not capable of being closed weather tight are immersed;

θ_e = final equilibrium angle of heel (degrees).

② s = 0 where the final waterline taking into account sinkage, heel and trim, immerses the lower edge of openings through which progressive flooding may take place. Such opening is to include air-pipes, ventilators and openings which are closed by means of weather tight doors or hatch covers, and may exclude those openings closed by means of watertight manhole covers and flush scuttles, small watertight hatch covers which maintain the high integrity of the deck, remotely operated sliding watertight doors, access doors and access hatch covers, of watertight integrity, normally closed at sea and side scuttles of the

non-opening type. However, if the compartments so flooded are taken into account in the calculations the requirements of this paragraph are to be applied.

③ For each compartment or group of compartments s_i is to be weighted according to draught considerations as follows:

$$s_i = 0.5s_l + 0.5s_p$$

where:

s_1 is the s-factor at the deepest subdivision load line;

s_p is the s-factor at the partial load line.

(2) For all compartments forward of the collision bulkhead, the *s*-value, calculated assuming the ship to be at its deepest subdivision load line and with assumed unlimited vertical extent of damage, is to be equal to 1.

(3) Wherever a horizontal subdivision is fitted above the waterline in question the following applies.

① The *s*-value for the lower compartment or group of compartments is to be obtained by multiplying the value as determined in paragraph (1)① by the reduction factor *v* according to (3)③, which represents the probability that the spaces above the horizontal subdivision will not be flooded.

② In cases of positive contribution to index A due to simultaneous flooding of the spaces above the horizontal subdivision, the resulting *s*-value for such a compartment or group of compartments is to be obtained by an increase of the value as determined by paragraph (3)① by the s-value for simultaneous flooding according to paragraph (1)①, multiplied by the factor (1 - *v*).

③ The probability factor v_i is to be calculated according to:

$v_i = \dfrac{H - d}{H_{\max} - d}$ for the assumed flooding up to the horizontal subdivision above the subdivision load line, where *H* is to be restricted to a height of $H_{\max}$,

$v_i = 1$ if the uppermost horizontal subdivision in way of the assumed damaged region is below $H_{\max}$,

where: *H*— is the height of the horizontal subdivision above the baseline (in m) which is assumed to limit the vertical extent of damage;

H_{max}— is the maximum possible vertical extent of damage above the baseline (in m), or

$H_{\max} = d + 0.056L_s\left(1 - \dfrac{L_s}{500}\right)$, if $L_s \leq 250$ m

$H_{\max} = d + 7$, if $L_s > 250$ m

whichever is less.

1.6.7 For the purpose of the subdivision and damage stability calculations of the Guidelines, the permeability of each space or part of a space① is to be as follows:

Appropriated to stores	0.60
Occupied by accommodation	0.95
Occupied by machinery	0.85
Void spaces	0.95
Dry cargo spaces	0.70

1.6.8 Stability information

(1) The master of the ship is to be supplied with such reliable information as is necessary to enable him by rapid and simple means to obtain accurate guidance as to the stability of the ship under varying conditions of service. The information is to include:

① a curve of minimum operational metacentric height (GM) versus draught which assures compliance with the relevant intact stability requirements and the requirements of 1.6.1 to

① Refer to MSC/Circ.651− Interpretations of regulations of part B-1 of SOLAS chapter II-1.

1.6.6, alternatively a corresponding curve of the maximum allowable vertical centre of gravity (KG) versus draught, or with the equivalents of either of these curves;

② instructions concerning the operation of cross-flooding arrangements;

③ all other data and aids which might be necessary to maintain stability after damage.

(2) In order to provide the information referred to in (1)①, the limiting GM (or KG) values to be used, if they have been determined from considerations related to the subdivision index, the limiting GM is to be varied linearly between the deepest subdivision load line and the partial load line.[①] In such cases, for draughts below the partial load line if the minimum GM requirement at this draught results from the calculation of the subdivision index, then this GM value is to be assumed for lesser draughts, unless the intact stability requirements apply.

1.7 Subdivision and stability of oil tankers

1.7.1 The subdivision and stability of oil tankers are to comply with the relevant provisions of Chapter 2, PART FIVE of the Guidelines.

1.8 Subdivision and stability of chemical tankers

1.8.1 The subdivision and stability of chemical tankers are to comply with the relevant provisions of Chapter 2 of the International Code for the Construction and Equipment of Ships carrying Dangerous Chemicals in Bulk (IBC Code).

1.9 Subdivision and stability of liquefied gas carriers

1.9.1 The subdivision and stability of liquefied gas carriers are to comply with the relevant provisions of Chapter 2 of the International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (IGC Code).

1.10 Subdivision and stability of nuclear ships

1.10.1 The subdivision and stability of nuclear ships are to comply with the relevant provisions of Reg. 2, Chapter VIII of the International Convention for the Safety of Life at Sea (SOLAS).

1.11 Subdivision and stability of special purpose ships

1.11.1 The subdivision and damage stability of special purpose ships carrying not more than 240 persons should be adequate to meet the survival standard specified in 1.11.4, after sustaining assumed side damage to the extent given in 1.11.2, in locations along the ship's length as specified in 1.11.1.1 and 1.11.1.2 for any condition of loading.

1.11.1.1 In a special purpose ship carrying not more than 60 persons the damage should be assumed to occur anywhere in its length between transverse watertight bulkheads, spaced at a distance of not less than the longitudinal extent of side damage specified in 1.11.2.1, except involving damage to the machinery space.

1.11.1.2 In a special purpose ship carrying more than 60 but not more than 240 persons the damage should be assumed to occur anywhere in its length between transverse watertight bulkheads spaced at a distance of not less than the longitudinal extent of side damage specified in 1.11.2.1. In any such special purpose ship having a length of 100 m and over the assumed damage at the forward end should include damage to the collision bulkhead.

1.11.1.3 A special purpose ship carrying more than 240 persons should meet the subdivision and damage stability requirements for a passenger ship carrying that number of passengers.

1.11.2 Subject to the provisions of this section the extent of damage should be assumed as follows:

1.11.2.1 Longitudinal extent: (1/3) $L_L^{2/3}$ or 14.5 m, whichever is less.

1.11.2.2 Transverse extent: B/5 or 11.5 m, whichever is less (measured inboard from the ship's side at right angles to the centreline at the level of the summer load line).

1.11.2.3 Vertical extent: from the moulded line of the bottom shell plating at centerline upwards without limit.

1.11.2.4 If any damage of a lesser extent than that specified in 1.11.2.1, 1.11.2.2 and/or 1.11.2.3 results in a more severe condition, such damage should be taken into account.

① Refer to MSC/Circ.651− Interpretations of regulations of part B-1 of SOLAS chapter II-1.

1.11.2.5 If pipes, ducts, trunks or tunnels are situated within the assumed extent of damage, arrangements should be such that progressive flooding cannot thereby extend to compartments other than those assumed to be flooded for each case of damage.

1.11.3 The requirements of 1.11.1 should be confirmed by calculations which take into consideration the design characteristics of the ship, the arrangements, configuration and contents of the damaged compartments, the distribution of dry cargo, the distribution, specific gravities and the free surface effect of liquids and should be based on the following provisions:

1.11.3.1 The permeability of spaces assumed to be damaged should be as follows:

Spaces	Permeability
Appropriated to cargo	by calculation, but not less than 0.60
Appropriated to stores	0.60
Occupied by accommodation	0.95
Occupied by machinery	0.85
Intended for voids	0.95

1.11.3.2 Wherever as a result of assumed damage a tank is penetrated, it should be assumed that any liquid therein is completely lost from that compartment and replaced by salt water up to the level of the final plane of equilibrium.

1.11.4 The ship may be regarded as achieving the required survival standard if the following conditions are met:

1.11.4.1 The damage waterline before the equalization and/or in the process thereof should be below the lower edge of any opening through which progressive flooding may take place. Such openings include air-pipes, ventilators and openings which are closed by means of weathertight doors or hatch covers but may exclude those openings closed by means of watertight manhole covers and flush scuttles, small watertight cargo tank hatch covers which maintain the high integrity of the deck, remotely operated watertight sliding doors and sidescuttles of the non-opening type.

1.11.4.2 The angle of heel due to unsymmetrical flooding should not exceed 20 ° prior to equalization and after equalization should not exceed:

7 ° - in the case of flooding between adjacent transverse watertight bulkheads as required in 1.11.1.1 and 1.11.1.2

12 ° - in the case of flooding involving the collision bulkhead as required in 1.11.1.2. In special cases additional heel due to the unsymmetrical moment may be allowed but in no case should the final heel exceed 15 degrees.

1.11.4.3 The initial metacentric height of a ship in the final stage of flooding for the static equilibrium position in case of symmetrical flooding and for the upright position in case of unsymmetrical flooding as calculated by the constant displacement method should be not less than 0.05 m before appropriate measures to increase the metacentric height have been taken.

1.11.4.4 The righting lever curve at the final stage of flooding should have a minimum range of 20 ° beyond the position of equilibrium in association with a maximum righting lever of at least 100 mm within this range. However, for special purpose ships with length L_L not more than 50 m and carrying not more than 60 persons, the range can be reduced but not less than 10 °. Unprotected openings should not be immersed within this range of residual stability except where the space concerned is included in damage stability calculations as a floodable space. Within this range the immersion of all openings listed in 1.11.4.1 and other openings capable of being closed watertight may be permitted.

1.11.4.5 CCS should be satisfied that the damage stability and trim are sufficient during intermediate stages of flooding.

1.11.5 The ship should be designed so as to keep unsymmetrical flooding to a minimum consistent with efficient arrangements. The means adopted for equalization of the ship should, where practicable, be self-acting, but in any case where controls to cross-flooding fittings are provided they should be operable from above the bulkhead deck.

1.11.6 Special purpose ships should be also meet the following subdivision requirements of the Chapter:

(1) 1.15, 1.21, 1.22, 1.23, 1.25.1, 1.26, 1.27, 1.29 of this Chapter by all special purpose ships, as applicable;
(2) 1.13 by special purpose ships carrying more than 60 persons;
(3) 1.14 by special purpose ships carrying not more than 60 persons;
(4) 1.19 and 1.20 by special purpose ships carrying more than 240 persons;
(5) 1.17 for all special purpose ships except that for special purpose ships of not more than 50 m in length exemptions may be granted;
(6) 1.18 and 1.24 are not applicable.

1.12 Subdivision and stability of offshore supply vessels

1.12.1 The subdivision and stability of offshore supply vessels are to comply with the relevant provisions of PART NINE of the Guidelines.

1.13 Peak and machinery space bulkheads, shaft tunnels, etc., in passenger ships

1.13.1 A forepeak or collision bulkhead is to be fitted which is to be watertight up to the bulkhead deck. This bulkhead is to be located at a distance from the forward perpendicular of not less than 5% of the length of the ship L_{WL} and not more than 3 m plus 5% of the length of the ship L_{WL}.

1.13.2 Where any part of the ship below the waterline extends forward of the forward perpendicular, e.g. a bulbous bow, the distances stipulated in 1.13.1 of this Chapter are to be measured from a point either:
(1) at the mid-length of such extension; or
(2) at a distance 1.5% of the length of the ship L_{WL} forward of the forward perpendicular; or
(3) at a distance 3 m forward of the forward perpendicular;
whichever gives the smallest measurement.

1.13.3 Where a long forward superstructure is fitted, the forepeak or collision bulkhead on all passenger ships is to be extended watertight to the next full deck above the bulkhead deck. The extension need not be fitted directly above the bulkhead below, provided that all parts of the extension are not located forward of the forward limit specified in 1.13.1 or 1.13.2 of this Chapter, with the exemption permitted by 1.13.4 of this Chapter, and the part of the deck which forms the step is made effectively weathertight.

1.13.4 Where bow doors are fitted and a sloping loading ramp forms part of the extension of the collision bulkhead above the bulkhead deck the part of the ramp which is more than 2.3 m above the bulkhead deck may extend forward of the limit specified in 1.13.1 or 1.13.2 of this Chapter. The ramp is to be weathertight over its complete length.

1.13.5 An after peak bulkhead, and bulkheads dividing the machinery space, from the cargo and passenger spaces forward and aft, are also to be fitted and made watertight up to the bulkhead deck. The after peak bulkhead may, however, be stepped below the bulkhead deck, provided the degree of safety of the ship as regards subdivision is not thereby diminished.

1.13.6 In all cases stern tubes are to be enclosed in watertight spaces of moderate volume. The stern gland is to be situated in a watertight shaft tunnel or other watertight space separate from the stern tube compartment and of such volume that, if flooded by leakage through the stern gland, the margin line will not be submerged.

1.14 Peak and machinery space bulkheads and stern tubes in cargo ships

1.14.1 A collision bulkhead is to be fitted which is to be watertight up to the freeboard deck. This bulkhead is to be located at a distance from the forward perpendicular of not less than 5% of the length of the ship L_{WL} or 10 m, whichever is the less, and, except as may be permitted, not more than 8% of the length of the ship L_{WL}.

1.14.2 Where any part of the ship below the waterline extends forward of the forward perpendicular, e.g. a bulbous bow, the distances stipulated in 1.14.1 of this Chapter are to be

measured from a point either:
(1) at the mid-length of such extension; or
(2) at a distance 1.5% of the length of the ship forward of the forward perpendicular; or
(3) at a distance 3 m forward of the forward perpendicular;
whichever gives the smallest measurement.

1.14.3
(1) The bulkhead may have steps or recesses provided they are within the limits prescribed in above-mentioned 1.14.1 or 1.14.2.
(2) No door, manhole, access opening, ventilation duct or any other opening is to be fitted in the collision bulkhead below the freeboard deck.
(3) Except as provided in (4) below, the collision bulkhead may be pierced below the freeboard deck by not more than one pipe for dealing with fluid in the forepeak tank Pipes piercing the collision bulkhead are to be fitted with suitable valves operable from above the freeboard deck and the valve chest is to be secured at the bulkhead inside the forepeak. The valves may be fitted on the after side of the collision bulkhead provided that the valves are readily accessible under all service conditions and the space in which they are located is not a cargo space. All valves are to be of steel, bronze or other approved ductile material. Valves of ordinary cast iron or similar material are not acceptable.
(4) If the forepeak is divided to hold two different kinds of liquids, the collision bulkhead to be pierced below the freeboard deck by two pipes may be permitted, each of which is fitted as required by (3), provided that, having regard to the additional subdivision provided in the forepeak, the safety of the ship is maintained.

1.14.4 Where a long forward superstructure is fitted the collision bulkhead is to be extended weathertight to the deck next above the freeboard deck. The extension need not be fitted directly above the bulkhead below, provided it is located within the limits prescribed in 1.14.1 or 1.14.2 of this Chapter, with the exemption permitted by 1.14.5 of this Chapter, and the part of the deck which forms the step is made effectively weathertight.

1.14.5 Where bow doors are fitted and a sloping loading ramp forms part of the extension of the collision bulkhead above the freeboard deck the part of the ramp which is more than 2.3 m above the freeboard deck may extend forward of the limit specified in above-mentioned 1.14.1 or 1.14.2. The ramp is to be weathertight over its complete length.

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

1.14.7 Bulkheads are to be fitted separating the machinery space from cargo and passenger spaces forward and aft and made watertight up to the freeboard deck.

1.14.8 Stern tubes are to be enclosed in a watertight space (or spaces) of moderate volume. Other measures to minimize the danger of water penetrating into the ship in case of damage to stern tube arrangements may be permitted.

1.15 Double bottoms in passenger ships
1.15.1 A double bottom is to be fitted extending from the forepeak bulkhead to the after peak bulkhead as far as this is practicable and compatible with the design and proper working of the ship.
(1) In ships of 50 m and upwards but less than 61 m in length a double bottom is to be fitted at least from the machinery space to the fore peak bulkhead, or as near thereto as practicable.
(2) In ships of 61 m and upwards but less than 76 m in length a double bottom is to be fitted at least outside the machinery space, and is to extend to the fore and after peak bulkheads, or as near thereto as practicable.
(3) In ships of 76 m in length and upwards, a double bottom is to be fitted amidships, and is to extend to the fore and after peak bulkheads, or as near thereto as practicable.

1.15.2 Where a double bottom is required to be fitted, its depth is to comply with the requirements of CCS Rules for Classification of Sea-going Steel Ships and other standards recognized by CCS, and the inner bottom is to be continued out to the ship's sides in such a manner as to protect the bottom to the turn of the bilge. Such protection will be deemed satisfactory if the line of intersection of the outer edge of the margin plate with the bilge plating is not lower at any part than a horizontal plane passing through the point of intersection with the frame line amidships of a transverse diagonal line inclined at 25 °to the base line and cutting it at a point one ha lf the ship's moulded breadth from the middle line.

1.15.3 Small wells constructed in the double bottom in connection with drainage arrangements of holds, etc., are not to extend downwards more than necessary. The depth of the well is in no case to be more than the depth less 460 mm of the double bottom at the centreline, nor is the well to extend below the horizontal plane referred to in 1.15.2 of this Chapter. A well extending to the outer bottom is, however, permitted at the after end of the shaft tunnel. Other wells (e.g. for lubricating oil under main engines) may be permitted if satisfied that the arrangements give protection equivalent to that afforded by a double bottom complying with 1.15 of this Chapter.

1.15.4 A double bottom need not be fitted in way of watertight compartments of moderate size used exclusively for the carriage of liquids, provided the safety of the ship, in the event of bottom or side damage, is not thereby impaired.

1.15.5 For the liners in specified route service, a double bottom to be dispensed with in any part of the ship may be permitted, if the fitting of a double bottom in that part would not be compatible with the design and proper working of the ship.

1.15.6 Any part not fitted with double bottom according to 1.15.1, 1.15.4 and 1.15.5, and unusual double bottom arrangement is to prove that ship can withstand damage specified by 1.15.7.

1.15.7 For passenger ships other than those specified in 1.1.2(1)① to ③ of this Section, compliance with the requirements is to be achieved by demonstrating that when subject to a bottom damage assumed at any position along the ship’s bottom (excluding transverse watertight bulkheads forming boundaries of the engine room) and with an extent specified in (2) of this paragraph, the relevant residue stability criteria of this Chapter can be complied with:
(1) Flooding of such spaces is not to render emergency power and lighting, internal communication, signals or other emergency devices inoperable in other parts of the ship.
(2) Assumed extent of damage is to be as follows:

	For 0.3 *L* from the forward perpendicular of the ship	**Any other part of the ship**
Longitudinal extent	1/3 $L^{2/3}$ or 14.5 m, whichever is less	1/3 $L^{2/3}$ or14.5 m, whichever is less
Transverse extent	*B*/6 or 10 m, whichever is less	*B*/6 or 5 m, whichever is less
Vertical extent, measured from the keel line	*B*/20 or 2 m, whichever is less	*B*/20 or 2 m, whichever is less

(3) If any damage of a lesser extent than the maximum damage specified in (2) above would result in a more severe condition, such damage is to be considered.

1.16 Double bottoms in cargo ships other than tankers

1.16.1 A double bottom is to be fitted extending from the collision bulkhead to the after peak bulkhead, as far as this is practicable and compatible with the design and proper working of the ship.

1.16.2 Where a double bottom is required to be fitted, its depth is to comply with the requirements of CCS Rules for Classification of Sea-going Steel Ships and the other standards recognized by CCS, and the inner bottom is to be continued out to the ship's side in such a manner as to protect the bottom to the turn of the bilge.

1.16.3 Small wells constructed in the double bottom, in connection with the drainage arrangements of holds, are not to extend in depth more than necessary. A well extending to the outer bottom, may, however, be permitted at the after end of the shaft tunnel of the ship. Other wells may be permitted if the arrangements give protection equivalent to that afforded by a double bottom complying with 1.12 of this Chapter.

1.16.4 A double bottom need not be fitted in way of watertight compartments used exclusively for the carriage of liquids, provided the safety of the ship, in the event of bottom damage, is not thereby impaired.

1.16.5 Any part not fitted with double bottom according to 1.16.1 and 1.16.4, and unusual double bottom arrangement are to prove that ship can withstand damage specified by 1.16.6.

1.16.6 Compliance with the requirements is to be achieved by demonstrating that when subject to a bottom damage assumed at any position along the ship's bottom (excluding transverse watertight bulkheads forming boundaries of the engine room) and with an extent specified in (2) of this paragraph, the relevant residue stability criteria of this Chapter can be complied with:
(1) Flooding of such spaces is not to render emergency power and lighting, internal communication, signals or other emergency devices inoperable in other parts of the ship.
(2) Assumed extent of damage is to be as follows:

	For 0.3 *L* from the forward perpendicular of the ship	**Any other part of the ship**
Longitudinal extent	1/3 $L^{2/3}$ or 14.5 m, whichever is less	1/3 $L^{2/3}$ or14.5 m, whichever is less
Transverse extent	*B*/6 or 10 m, whichever is less	*B*/6 or 5 m, whichever is less
Vertical extent, measured from the keel line	*B*/20 or 2 m, whichever is less	*B*/20 or 2 m, whichever is less

(3) If any damage of a lesser extent than the maximum damage specified in (2) above would result in a more severe condition, such damage is to be considered.

1.17 Openings in watertight bulkheads in passenger ships

1.17.1 The number of openings in watertight bulkheads is to be reduced to the minimum compatible with the design and proper working of the ship; satisfactory means are to be provided for closing these openings.

1.17.2 Where pipes, scuppers, electric cables, etc., are carried through watertight subdivision bulkheads, arrangements are to be made to ensure the watertight integrity of the bulkheads.
Valves not forming part of a piping system are not to be permitted in watertight subdivision bulkheads.
Lead or other heat sensitive materials are not to be used in systems which penetrate watertight subdivision bulkheads, where deterioration of such systems in the event of fire would impair the watertight integrity of the bulkheads.

1.17.3 The watertight bulkhead and collision bulkhead are to comply with the following requirements.
(1) No doors, manholes, or access openings are permitted:
① in the collision bulkhead below the margin line;
② in watertight transverse bulkheads dividing a cargo space from an adjoining cargo space or from a permanent or reserve bunker, except as provided in 1.17.10 and 1.18 of this Chapter.
(2) Except as provided in (3) below, the collision bulkhead may be pierced below the margin line by not more than one pipe for dealing with fluid in the forepeak tank, provided that the pipe is fitted with a screw down valve capable of being operated from above the bulkhead deck, the valve chest being secured inside the forepeak to the collision bulkhead. The fitting of this valve on after side of the collision bulkhead may be permitted provided that the valve is readily accessible under all service conditions and the space in which it is located is not a cargo space.
(3) If the forepeak is divided to hold two different kinds of liquids, the collision bulkhead to be pierced below the margin line by two pipes may be permitted, each of which is fitted as required by (2), provided that there is no practical alternative to the fitting of such a second pipe and that, having regard to the additional subdivision provided in the forepeak, the safety of the ship is

maintained.

1.17.4 Watertight doors fitted in bulkheads between permanent and reserve bunkers are to always be accessible, except as provided in 1.17.9(4) of this Chapter for between-deck bunker doors.
Satisfactory arrangements are to be made by means of screens or otherwise to prevent the coal from interfering with the closing of watertight bunker doors.

1.17.5 Subject to 1.17.11 of this Chapter, not more than one door, apart from the doors to bunkers and shaft tunnels, may be fitted in each main transverse bulkhead within spaces containing the main and auxiliary propulsion machinery including boilers serving the needs of propulsion and all permanent bunkers. Where two or more shafts are fitted, the tunnels are to be connected by an intercommunicating passage. There is to be only one door between the machinery space and the tunnel spaces where two shafts are fitted and only two doors where there are more than two shafts. All these doors are to be of the sliding type and are to be so located as to have their sills as high as practicable. The hand gear for operating these doors from above the bulkhead deck is to be situated outside the spaces containing the machinery.

1.17.6 The watertight door is to comply with the following requirements.
(1) Watertight doors, except as provided in 1.17.10(1) or 1.18 of this Chapter, are to be power-operated sliding doors complying with the requirements of 1.17.7 of this Chapter capable of being closed simultaneously from the central operating console at the navigation bridge in not more than 60 s with the ship in the upright position.
(2) The means of operation whether by power or by hand of any power-operated sliding watertight door are to be capable of closing the door with the ship listed to 15 ° either way. Consideration is to also be given to the forces which may act on either side of the door as may be experienced when water is flowing through the opening applying a static head equivalent to a water height of at least 1 m above the sill on the centreline of the door.
(3) Watertight door controls, including hydraulic piping and electric cable, are to be kept as close as practicable to the bulkhead in which the doors are fitted, in order to minimize the likelihood of them being involved in any damage which the ship may sustain. The positioning of watertight doors and their controls is to be such that if the ship sustains damage within one fifth of the breadth of the ship, such distance being measured at right angles to the centreline at the level of the deepest subdivision load line, the operation of the watertight doors clear of the damaged portion of the ship is not impaired.
(4) All power-operated sliding watertight doors are to be provided with means of indication which will show at all remote operating positions whether the doors are open or closed. Remote operating positions are to only be at the navigation bridge and at the location where hand operation above the bulkhead deck is required.
(5) For the passenger ships constructed before 1 February 1992, the doors not in compliance with the above-mentioned (1) to (4) are to be closed before the voyage commences, and are to be kept closed during navigation; the time of opening such doors in port and of closing them before the ship leaves port is to be entered into the log-book.

1.17.7 The sliding watertight door is to comply with the following requirements.
(1) Each power-operated sliding watertight door:
① is to have a vertical or horizontal motion;
② is to, subject to 1.17.11 of this Chapter, be normally limited to a maximum clear opening width of 1.2 m. Larger doors only to the extent considered necessary for the effective operation of the ship may be permitted provided that other safety measures, including the following, are taken into consideration:
(a) special consideration is to be given to the strength of the door and its closing appliances in order to prevent leakages;
(b) the door is to be located outside the damage zone $B/5$;
(c) the door is to be kept closed when the ship is at sea, except for limited periods when determined absolutely necessary;
③ is to be fitted with the necessary equipment to open and close the door using electric power,

hydraulic power, or any other accepted form of power;

④ is to be provided with an individual hand-operated mechanism. It is to be possible to open and close the door by hand at the door itself from either side, and in addition, close the door from an accessible position above the bulkhead deck with an all-round crank motion or some other accepted movement providing the same degree of safety. Direction of rotation or other movement is to be clearly indicated at all operating positions. The time necessary for the complete closure of the door, when operating by hand gear, is not to exceed 90 s with the ship in the upright position;

⑤ is to be provided with controls for opening and closing the door by power from both sides of the door and also for closing the door by power from the central operating console at the navigation bridge;

⑥ is to be provided with an audible alarm, distinct from any other alarm in the area, which will sound whenever the door is closed remotely by power and which is to sound for at least 5 s but no more than 10 s before the door begins to move and is to continue sounding until the door is completely closed. In the case of remote hand operation it is sufficient for the audible alarm to sound only when the door is moving. Additionally, in passenger areas and areas of high ambient noise the audible alarm to be supplemented by an intermittent visual signal at the door may be required;

⑦ is to have an approximately uniform rate of closure under power. The closure time, from the time the door begins to move to the time it reaches the completely closed position, is to in no case be less than 20 s and more than 40 s with the ship in the upright position.

(2) The electrical power required for power-operated sliding watertight doors is to be supplied from the emergency switchboard either directly or by a dedicated distribution board situated above the bulkhead deck. The associated control, indication and alarm circuits are to be supplied from the emergency switchboard either directly or by a dedicated distribution board situated above the bulkhead deck and be capable of being automatically supplied by the transitional source of emergency electrical power consisting of accumulator batteries in the event of failure of either the main or emergency source of electrical power.

(3) Power-operated sliding watertight doors are to have either:

① a centralized hydraulic system with two independent power sources each consisting of a motor and pump capable of simultaneously closing all doors. In addition, there is to be for the whole installation hydraulic accumulators of sufficient capacity to operate all the doors at least three times, i.e. closed-open-closed, against an adverse list of 15°. This operating cycle is to be capable of being carried out when the accumulator is at the pump cut-in pressure. The fluid used is to be chosen considering the temperatures liable to be encountered by the installation during its service. The power operating system is to be designed to minimize the possibility of having a single failure in the hydraulic piping adversely affect the operation of more than one door. The hydraulic system is to be provided with a low-level alarm for hydraulic fluid reservoirs serving the power-operated system and a low gas pressure alarm or other effective means of monitoring loss of stored energy in hydraulic accumulators. These alarms are to be audible and visual and are to be situated on the central operating console at the navigation bridge; or

② an independent hydraulic system for each door with each power source consisting of a motor and pump capable of opening and closing the door. In addition, there is to be a hydraulic accumulator of sufficient capacity to operate the door at least three times, i.e. closed-open-closed, against an adverse list of 15°. This operating cycle is to be capable of being carried out when the accumulator is at the pump cut-in pressure. The fluid used is to be chosen considering the temperatures liable to be encountered by the installation during its service. A low gas pressure group alarm or other effective means of monitoring loss of stored energy in hydraulic accumulators are to be provided at the central operating console on the navigation bridge. Loss of stored energy indication at each local operating position is also to be provided; or

③ an independent electrical system and motor for each door with each power source consisting of a motor capable of opening and closing the door. The power source is to be capable of being automatically supplied by the transitional source of emergency electrical power consisting of accumulator batteries in the event of failure of either the main or emergency

source of electrical power and with sufficient capacity to operate the door at least three times, i.e. closed-open-closed, against an adverse list of 15°.

The power systems for power-operated watertight sliding doors as specified in ①, ② and ③ is to be separate from any other power system. A single failure in the electric or hydraulic power-operated systems excluding the hydraulic actuator is not to prevent the hand operation of any door.

(4) Control handles are to be provided at each side of the bulkhead at a minimum height of 1.6 m above the floor and are to be so arranged as to enable persons passing through the doorway to hold both handles in the open position without being able to set the power closing mechanism in operation accidentally. The direction of movement of the handles in opening and closing the door is to be in the direction of door movement and is to be clearly indicated.

(5) As far as practicable, electrical equipment and components for watertight doors are to be situated above the bulkhead deck and outside hazardous areas and spaces.

(6) The enclosures of electrical components necessarily situated below the bulk head deck are to provide suitable protection against the ingress of water.①

(7) Electric power, control, indication and alarm circuits are to be protected against fault in such a way that a failure in one door circuit will not cause a failure in any other door circuit. Short circuits or other faults in the alarm or indicator circuits of a door are not to result in a loss of power operation of that door. Arrangements are to be such that leakage of water into the electrical equipment located below the bulkhead deck will not cause the door to open.

(8) A single electrical failure in the power operating or control system of a power-operated sliding watertight door is not to result in a closed door opening, availability of the power supply is to be continuously monitored at a point in the electrical circuit as near as practicable to each of the motors required by 1.17.7(3) of this Chapter. Loss of any such power supply is to activate an audible and visual alarm at the central operating console at the navigation bridge.

1.17.8 The central operating console at the navigation bridge is to comply with the following requirements.

(1) The central operating console at the navigation bridge is to have a “master mode" switch with two modes of control: a “local control" mode which is to allow any door to be locally opened and locally closed after use without automatic closure, and a “doors closed" mode which is to automatically close any door that is open. The “doors closed" mode is to automatically close any door that is open. The “doors closed" mode is to permit doors to be opened locally and is to automatically reclose the doors upon release of the local control mechanism. The “master mode" switch is to normally be in the “local control" mode. The “doors closed" mode is to only be used in an emergency or for testing purposes. Special consideration is to be given to the reliability of the “master mode" switch.

(2) The central operating console at the navigation bridge is to be provided with a diagram showing the location of each door, with visual indicators to show whether each door is open or closed. A red light is to indicate a door is fully open and a green light is to indicate a door is fully closed. When the door is closed remotely the red light is to indicate the intermediate position by flashing. The indicating circuit is to be independent of the control circuit for each door.

(3) It is not to be possible to remotely open any door from the central operating console.

1.17.9 The control of opening and closing watertight doors is to comply with the following requirements.

(1) All watertight doors are to be kept closed during navigation except that the y may be opened during navigation as specified in (2), (3) and (4) below. Watertight doors of width of more than 1.2 m permitted by 1.17.11 may only be opened in the circumstances detailed in that paragraph. Any door which is opened in accordance with this paragraph is to be ready to be immediately

---

① Refer to the following IEC Publication 529, 1976:
.1 electrical motors, associated circuits and control components; protected to IP×7 standard;
.2 door position indicators and associated circuit components; protected to IP ×8 standard; and
.3 door movements warning signals, protected to IP×6 standard.
Other arrangements for the enclosures of electrical components may be fitted provided that an equivalent protection is achieved. The water pressure testing of the enclosures protected to IP×8 is to be based on the pressure that may occur at the location of the component during flooding for a period of 36h.

closed.
(2) A watertight door may be opened during navigation to permit the passage of passengers or crew, or when work in the immediate vicinity of the door necessitates it being opened. The door must be immediately closed when transit through the door is complete or when the task which necessitated it being open is finished.
(3) Certain watertight doors may be permitted to remain open during navigation only if considered absolutely necessary; that is, being open is determined essential to the safe and effective operation of the ship's machinery or to permit passengers normally unrestricted access throughout the passenger area. Such determination is to be made by the Surveyor only after careful consideration of the impact on ship operations and survivability. A watertight door permitted to remain thus open is to be clearly indicated in the ship's stability information and is to always be ready to be immediately closed.
(4) Sliding watertight doors fitted between bunkers in the between-decks below the bulkhead deck may sometimes be open at sea for the purpose of trimming coal. The opening and closing of these doors are to be recorded in the log-book.

1.17.10 If considered that such doors are essential, watertight doors of satisfactory construction may be fitted in watertight bulkheads dividing cargo between deck spaces complying with the following requirements.
(1) Such doors may be hinged, rolling or sliding doors but are not to be remotely controlled. They are to be fitted at the highest level and as far from the shell plating as practicable, but in no case are the outboard vertical edges to be situated at a distance from the shell plating which is less than one fifth of the breadth of the ship, such distance being measured at right angles to the centreline at the level of the deepest subdivision load line.
(2) Such doors are to be closed before the voyage commences and are to be kept closed during navigation; the time of opening such doors in port and of closing them before the ship leaves port is to be entered in the log-book. Should any of the doors be accessible during the voyage, they are to be fitted with a device which prevents unauthorized opening. When it is proposed to fit such doors, the number and arrangements are to receive the special consideration of the Surveyor.

1.17.11 Portable plates on bulkheads are not to be permitted except in machinery spaces. Such plates are to always be in place before the ship leaves port, and are not to be removed during navigation except in case of urgent necessity at the discretion of the master. The times of removal and replacement of any such portable plates is to be recorded in the log-book, and the necessary precautions are to be taken in replacing them to ensure that the joints are watertight. Not more than one power-operated sliding watertight door may be permitted in each main transverse bulkhead larger than those specified in 1.17.7(1)② to be substituted for these portable plates, provided these doors are closed before the ship leaves port and remain closed during navigation except in case of urgent necessity at the discretion of the master. These doors need not meet the requirements of 1.17.7(1)④ regarding complete closure by hand-operated gear in 90 s. The time of opening and closing these doors, whether the ship is at sea or in port, is to be recorded in the log-book.

1.17.12 The trunkways on watertight bulkheads are to comply with the following requirements.
(1) Where trunkways or tunnels for access from crew accommodation to the stock hold, for piping, or for any other purpose are carried through main transverse watertight bulkheads, they are to be watertight and in accordance with the requirements of 1.22 of this Chapter. The access to at least one end of each such tunnel or trunkway, if used as a passage at sea, is to be through a trunk extending watertight to a height sufficient to permit access above the margin line. The access to the other end of the trunkway or tunnel may be through a watertight door of the type required by its location in the ship. Such trunkways or tunnels are not to extend through the first subdivision bulkhead abaft the collision bulkhead.
(2) Where it is proposed to fit tunnels piercing main transverse watertight bulkheads, these are to receive the special consideration.
(3) Where trunkways in connection with refrigerated cargo and ventilation or forced draught trunks are carried through more than one watertight bulkhead, the means of closure at such openings are to be operated by power and be capable of being closed from a central position

situated above the bulkhead deck.

1.17-1 Openings in watertight bulkheads and internal decks in cargo ships

(1) The number of openings in watertight subdivisions is to be kept to a minimum compatible with the design and proper working of the ship. Where penetrations of watertight bulkheads and internal decks are necessary for access, piping, ventilation, electrical cables, etc., arrangements are to be made to maintain the watertight integrity. Relaxation in the water tightness of openings above the freeboard deck may be permitted, provided that it is demonstrated that any progressive flooding can be easily controlled and that the safety of the ship is not impaired.

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

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

(4) Watertight doors or ramps of satisfactory construction may be fitted to internally subdivide large cargo spaces, provided that CCS is satisfied that such doors or ramps are essential. These doors or ramps may be hinged, rolling or sliding doors or ramps, but are not to be remotely controlled.① Such doors or ramps are to be closed before the voyage commences and are to be kept closed during navigation; the time of opening such doors or ramps in port and of closing them before the ship leaves port is to be entered in the log-book. Should any of the doors or ramps be accessible during the voyage, they are to be fitted with a device which prevents unauthorized opening.

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

(6) For cargo ships with no requirements for damage stability with the length of the ship L_L less than 80 m, the doors in the watertight bulkhead between the engine room and steering gear compartment/after peak tank may be fast-closing hinged watertight doors. The doors are to open outwards from the main protected space, and are to be fitted with plates "kept closed while at sea" on both sides of the door. Alarm signals are to be shown in the navigation bridge if the doors are not closed.

1.18 Passenger ships carrying goods vehicles and accompanying personnel

1.18.1 The passenger ships carrying goods vehicles and accompanying personnel are the passenger ships designed or adapted for the carriage of goods vehicles and accompanying personnel exceeding 12, regardless of the date of construction.

1.18.2 If in such a ship the total number of passengers (including personnel accompanying vehicles) does not exceed $N = 12 + A/25$, where A = total deck area (square meters) of spaces available for the stowage of goods vehicles and where the clear height at the stowage position and at the entrance to such spaces is not less than 4 m, the provisions of 1.17.10 of this Chapter in respect of watertight doors apply except that the doors may be fitted at any level in watertight bulkheads dividing cargo spaces. Additionally, indicators are required on the navigation bridge to show automatically when each door is closed and all door fastenings are secured.

① Refer to MSC/Circ.651, Interpretations of regulations of part B-1 of SOLAS Chapter II-1.

1.18.3 When applying the provisions of this Chapter to such a ship, *N* is to be taken as the maximum number of passengers for which the ship may be certified in accordance with this paragraph.

1.18.4 In applying 1.4 of this Chapter for the worst operating conditions, the permeability for cargo spaces intended for the stowage of goods vehicles and containers is to be derived by calculation in which the goods vehicles and containers are to be assumed to be non-watertight and their permeability taken as 0.65. For ships engaged in dedicated services the actual value of permeability for goo ds vehicles or containers may be applied. In no case is the permeability of the cargo spaces in which the goods vehicles and containers are carried to be taken as less than 0.60.

1.19 Openings in the shell plating of passenger ships and cargo ships below the bulkhead deck

1.19.1 The number of openings in the shell plating is to be reduced to the minimum compatible with the design and proper working of the ship.

1.19.2 The arrangement and efficiency of the means for closing any opening in the shell plating are to be consistent with its intended purpose and the position in which it is fitted and generally to the satisfaction of the Surveyor.

1.19.3 Subject to the requirements of PART THREE of the Guidelines, no sidescuttle is to be fitted in such a position that its sill is below a line drawn parallel to the bulkhead deck at side and having its lowest point 2.5% of the breadth of the ship above the deepest subdivision load line, or 500 mm, whichever is the greater.
All sidescuttles the sills of which are below the bulkhead deck, as permitted by the above-mentioned paragraph are to be of such construction as will effectively prevent any person opening them without the consent of the master of the ship.

1.19.4 Where in a between-decks, the sills of any of the sidescuttles referred to in 1.19.3 of this Chapter are below a line drawn parallel to the bulkhead deck at side and having its lowest point 1.4 m plus 2.5% of the breadth of the ship above the water when the ship departs from any port, all the sidescuttles in that between-decks are to be closed watertight and locked before the ship leaves port, and they are not to be opened before the ship arrives at the next port. In the application of this paragraph, the appropriate allowance for fresh water may be made when applicable.
The time of opening such sidescuttles in port and of closing and locking them before the ship leaves port is to be entered in the log-book.

1.19.5 For any ship that has one or more sidescuttles so placed that the requirements of 1.19.4 would apply when it was floating at its deepest subdivision load line, the limiting mean draught may be indicated subject to agreement at which these sidescuttles will have their sills above the line drawn parallel to the bulkhead deck at side, and having its lowest point 1.4 m plus 2.5% of the breadth of the ship above the waterline corresponding to the limiting mean draught, and at which it will therefore be permissible to depart from port without previously closing and locking them and to open them at sea on the responsibility of the master during the voyage to the next port. In tropical zones as defined in PART THREE of the Guidelines, this limiting draught may be increased by 0.3 m.

1.19.6 Efficient hinged inside deadlights so arranged that they can be easily and effectively closed and secured watertight, are to be fitted to all sidescuttles except that abaft one eighth of the ship's length from the forward perpendicular and above a line drawn parallel to the bulkhead deck at side and having its lowest point at a height of 3.7 m plus 2.5% of the breadth of the ship above the deepest subdivision load line, the deadlights may be portable in passenger accommodation other than that for steerage passengers, unless the deadlights are required by PART THREE of the Guidelines to be permanently attached in their proper positions. Such portable deadlights are to be stowed adjacent to the sidescuttles they serve.

1.19.7 Sidescuttles and their deadlights which will not be accessible during navigation are to be

closed and secured before the ship leaves port.

1.19.8 No sidescuttles are to be fitted in any spaces which are appropriated exclusively to the carriage of cargo or coal.
Sidescuttles may, however, be fitted in spaces appropriated alternatively to the carriage of cargo or passengers, but they are to be of such construction as will effectively prevent any person opening them or their deadlights without the con sent of the master.
If cargo is carried in such spaces, the sidescuttles and their deadlights are to be closed watertight and locked before the cargo is shipped and such closing and locking are to be recorded in the log-book.

1.19.9 Automatic ventilating sidescuttles are not to be fitted in the shell plating below the bulkhead deck without the special sanction of the Surveyor.

1.19.10 The number of scuppers, sanitary discharges and other similar openings in the shell plating is to be reduced to the minimum either by making each discharge serve for as many as possible of the sanitary and other pipes, or in any other satisfactory manner.

1.19.11 All inlets and discharges in the shell plating are to be fitted with efficient and accessible arrangements for preventing the accidental admission of water into the ship.
Subject to the requirements of PART THREE of the Guidelines, and except as provided in 1.19.12 of this Chapter, each separate discharge led through the shell plating from spaces below the bulkhead deck is to be provided with either one automatic non-return valve fitted with a positive means of closing it from above the bulkhead deck or with two automatic non-return valves without positive means of closing, provided that the inboard valve is situated above the deepest subdivision load line and is always accessible for examination under service conditions. Where a valve with positive means of closing is fitted, the operating position above the bulkhead deck is always to be readily accessible and means are to be provided for indicating whether the valve is open or closed.
The requirements of PART THREE of the Guidelines are to apply to discharges led through the shell plating from spaces above the bulkhead deck.

1.19.12 Machinery space main and auxiliary sea inlets and discharges in connection with the operation of machinery are to be fitted with readily accessible valves between the pipes and the shell plating or between the pipes and fabricated boxes attached to the shell plating. The valves may be controlled locally and are to be provided with indicators showing whether they are open or closed.

1.19.13 All shell fittings and valves required by 1.19 of this Chapter are to be of steel, bronze or other approved ductile material. Valves of ordinary cast iron or similar material are not acceptable. All pipes to which 1.19 refers are to be of steel or other approved equivalent material.

1.19.14 Gangway, cargo and coaling ports fitted below the bulkhead deck are to be of sufficient strength. They are to be effectively closed and secured watertight before the ship leaves port, and are to be kept closed during navigation.
Such ports are in no case to be so fitted as to have their lowest point below the deepest subdivision load line.

1.19.15 The inboard opening of each ash-chute, rubbish-chute, etc., is to be fitted with an efficient cover.
If the inboard opening is situated below the bulkhead deck, the cover is to be watertight, and in addition an automatic non-return valve is to be fitted in the chute in an easily accessible position above the deepest subdivision load line. When the chute is not in use both the cover and the valve are to be kept closed and secured.

1.19-1 External openings in cargo ships
(1) All external openings leading to compartments assumed intact in the damage analysis, which

are below the final damage waterline, are required to be watertight.
(2) External openings required to be watertight in accordance with (1) are to be of sufficient strength and, except for cargo hatch covers, are to be fitted with indicators on the bridge.
(3) Openings in the shell plating below the deck limiting the vertical extent of damage are to be kept permanently closed while at sea. Should any of these openings be accessible during the voyage, they are to be fitted with a device which prevents unauthorized opening.
(4) Notwithstanding the requirements of (3), particular doors may be opened at the discretion of the master, if necessary for the operation of the ship and provided that the safety of the ship is not impaired.
(5) Other closing appliances which are kept permanently closed at sea to ensure the watertight integrity of external openings are to be provided with a notice affixed to each appliance to the effect that it is to be kept closed. Manholes fitted with closely bolted covers need not be so marked.

1.20 Watertight integrity of passenger ships above the bulkhead deck

1.20.1 All reasonable and practicable measures are to be required to be taken to limit the entry and spread of water above the bulkhead deck. Such measures may include partial bulkheads or webs. When partial watertight bulkheads and webs are fitted on the bulkhead deck, above or in the immediate vicinity of main subdivision bulkheads, they are to have watertight shell and bulkhead deck connections so as to restrict the flow of water along the deck when the ship is in a heeled damaged condition. Where the partial watertight bulkhead does not line up with the bulkhead below, the bulkhead deck between is to be made effectively watertight.

1.20.2 The bulkhead deck or a deck above it is to be weathertight. All openings in the exposed weather deck are to have coamings of ample height and strength and are to be provided with efficient means for expeditiously closing them weathertight. Freeing ports, open rails and scuppers are to be fitted as necessary for rapidly clearing the weather deck of water under all weather conditions.

1.20.3 Sidescuttles, gangway, cargo and coaling ports and other means for closing openings in the shell plating above the margin line are to be of efficient design and construction and of sufficient strength having regard to the spaces in which they are fitted and their positions relative to the deepest subdivision load line.

1.20.4 Efficient inside deadlights, so arranged that they can be easily and effectively closed and secured watertight, are to be provided for all sidescuttles to spaces below the first deck above the bulkhead deck.

1.20.5 The open end of air pipes terminating within a superstructure is to be at least 1 m above the waterline when the ship heels to an angle of 15°, or the maximum angle of heel during intermediate stages of flooding, as determined by direct calculation, whichever is the greater. Alternatively, air pipes from tanks other than oil tanks may discharge through the side of the superstructure.

1.21 Construction and testing of watertight bulkheads, etc., in passenger ships and cargo ships

1.21.1 Each watertight subdivision bulkhead, whether transverse or longitudinal, is to be constructed in such a manner that it is to be capable of supporting, with a proper margin of resistance, the pressure due to the maximum head of water which it might have to sustain in the event of damage to the ship but at least the pressure due to a head of water up to the margin line. The construction of these bulkheads is to be subject to approval.

1.21.2 Steps and recesses in bulkheads are to be watertight and as strong as the bulkhead at the place where each occurs.
Where frames or beams pass through a watertight deck or bulkhead, such deck or bulkhead is to be made structurally watertight without the use of wood or cement.

1.21.3 Testing main compartments by filling them with water is not compulsory. When testing by filling with water is not carried out, a hose test is compulsory; this test is to be carried out in the most advanced stage of the fitting out of the ship. In any case, a thorough inspection of the watertight bulkheads is to be carried out.

1.21.4 The forepeak, double bottoms (including duct keels) and inner skins are to be tested with water to a head corresponding to the requirements of 1.21.1 of this Chapter.

1.21.5 Tanks which are intended to hold liquids, and which form part of the subdivision of the ship, are to be tested for tightness with water to a head up to the deepest subdivision load line or to a head corresponding to two thirds of the depth from the top of keel to the margin line in way of the tanks, whichever is the greater; provided that in no case is the test head to be less than 0.9 m above the top of the tank.

1.21.6 The tests referred to in 1.21.4 and 1.21.5 of this Chapter are for the purpose of ensuring that the subdivision structural arrangements are watertight and are not to be regarded as a test of the fitness of any compartment for the storage of oil fuel or for other special purposes for which a test of a superior character may be required depending on the height to which the liquid has access in the tank or its connections.

1.22 Construction and testing of watertight decks, trunks, etc., in passenger ships and cargo ships

1.22.1 Watertight decks, trunks, tunnels, duct keels and ventilators are to be of the same strength as watertight bulkheads at corresponding levels. The means used for making them watertight, and the arrangements adopted for closing openings in them, are to be subject to approval. Watertight ventilators and trunks are to be carried at least up to the bulkhead deck in passenger ships and up to the freeboard deck in cargo ships.

1.22.2 After completion, a hose or flooding test is to be applied to watertight decks and a hose test to watertight trunks, tunnels and ventilators.

1.23 Construction and testing of watertight doors, sidescuttles, etc., in passenger ships and cargo ships

1.23.1 In passenger ships:

(1) the design, materials and construction of all watertight doors, sidescuttles, gangway, cargo and coaling ports, valves, pipes, ash-chutes and rubbish-chutes referred to in this paragraph are to be subject to approval;

(2) the frames of vertical watertight doors are to have no groove at the bottom in which dirt might lodge and prevent the door closing properly.

1.23.2 In passenger ships and cargo ships each watertight door is to be tested by water pressure to a head up to the bulkhead deck or freeboard deck respectively. The test is to be made before the ship is put into service, either before or after the door is fitted.

1.24 Assigning, marking and recording of subdivision load lines for passenger ships

1.24.1 In order that the required degree of subdivision is maintained, a load line corresponding to the approved subdivision draught is to be assigned and marked on the ship's sides. A ship having spaces which are specially adapted for the accommodation of passengers and the carriage of cargo alternatively may, if the owners desire, have one or more additional load lines assigned and marked to correspond with the approved subdivision draughts for the alternative service conditions.

1.24.2 The subdivision load lines assigned and marked are to be recorded in the Passenger Ship Safety Certificate, and are to be distinguished by the notation P1 for the principal passenger condition, and P2, P3, etc., for the alternative conditions.

1.24.3 The freeboard corresponding to each of these load lines is to be measured at the same

position and from the same deck line as the freeboards determined in accordance with the requirements of PART THREE of the Guidelines.

1.24.4 The freeboard corresponding to each approved subdivision load line and the conditions of service for which it is approved, is to be clearly indicated on the Passenger Ship Safety Certificate.

1.24.5 In no case is any subdivision load line mark to be placed above the deepest load line in salt water as determined by the strength of the ship or the requirements of PART THREE of the Guidelines.

1.24.6 Whatever may be the position of the subdivision load line marks, a ship is in no case to be located so as to submerge the load line mark appropriate to the season and locality as determined in accordance with the requirements of PART THREE of the Guidelines.

1.24.7 A Ship is in no case to be so loaded that when it is in salt water the subdivision load line mark appropriate to the particular voyage and condition of service is submerged.

1.25 Damage control information

1.25.1 Damage control plans in passenger ships

(1) There are to be permanently exhibited, for the guidance of the officer in charge of the ship, plans showing clearly for each deck and hold the boundaries of the watertight compartments, the openings therein with the means of closure and position of any controls thereof, and the arrangements for the correction of any list due to flooding. In addition, booklets containing the aforementioned information are to be made available to the officers of the ship[①].

1.25.2 Damage control in dry cargo ships (applicable to ships with damage stability requirements)

(1) There is to be permanently exhibited or readily available on the navigation bridge, for the guidance of the officer in charge of the ship, a plan showing clearly for each deck and hold the boundaries of the watertight compartments, the openings therein with the means of closure and position of any controls thereof, and the arrangements for the correction of any list due to flooding. In addition, booklets containing the aforementioned information are to be made available to the officers of the ship[①].

(2) Indicators are to be provided for all sliding doors and for hinged doors in watertight bulkheads. Indication showing whether the doors are open or closed is to be given on the navigation bridge. In addition, shell doors and other openings which could lead to major flooding if left open or not properly secured, are to be provided with such indicators.

(3) Safety instructions

① General precautions are to consist of a listing of equipment, conditions and operational procedures necessary to maintain watertight integrity under normal ship operations.

② Specific precautions are to consist of a listing of elements (i.e. closures, security of cargo, sounding of alarms, etc.) vital to the survival of the ship and its crew.

1.26 Ballasting of passenger ships

1.26.1 Water ballast are not to in general be carried in tanks intended for oil fuel. In ships in which it is not practicable to avoid putting water in oil fuel tanks, oily-water separating equipment subject to agreement is to be fitted, or other alternative means, such as discharge to shore facilities, acceptable to the Surveyor is to be provided for disposing of the oily-water ballast.

1.26.2 The discharge of ballast water is to be in compliance with the requirements in PART FIVE of the Guidelines.

1.26-1 Ballasting of pusher tug-barge combination

1.26-1.1 Push tugs are to be able to control the floatation change caused by oil, water by adjusting ballast water at any service condition so as to prevent harmful loading on connectors.

---

① Refer to MSC.1/Circ.1245 − Guidelines for Damage Control Plans and Information to the Master.

1.27 Marking, periodical operation and inspection of watertight doors, etc., in passenger ships

1.27.1 Drills for the operating of watertight doors, sidescuttles, valves and c losing mechanisms of scuppers, ash-chutes and rubbish-chutes are to take place weekly. In ships in which the voyage exceeds one week in duration a complete drill is to be held before leaving port, and others thereafter at least once a week during the voyage. All watertight doors, both hinged and power operated, in main transverse bulkheads, in use at sea, are to be operated daily.

1.27.2 The watertight doors and all mechanisms and indicators connected therewith, all valves, the closing of which is necessary to make a compartment water tight, and all valves the operation of which is necessary for damage control cross-connections are to be periodically inspected at sea at least once a week.

Such valves, doors and mechanisms are to be suitably marked to ensure that they may be properly used to provide maximum safety.

1.28 Closure of cargo loading doors

1.28.1 The following doors, located above the margin line, are to be closed and locked before the ship proceeds on any voyage and are to remain closed and locked until the ship is at its next berth:

(1) cargo loading doors in the shell or the boundaries of enclosed superstructures;

(2) bow visors fitted in positions, as indicated in the above-mentioned (1);

(3) cargo loading doors in the collision bulkhead;

(4) weathertight ramps forming an alternative closure to those defined in the above-mentioned (1) to (3).

Provided that where a door cannot be opened or closed while the ship is at the berth, such a door may be opened or left open while the ship approaches or draws away from the berth, but only so far as may be necessary to enable the door to be immediately operated. In any case, the inner bow door must be kept closed.

1.28.2 Notwithstanding the requirements of 1.28.1(1) and (4) of this Chapter, the master may be authorized to decide to open particular doors, if necessary for the operation of the ship or the embarking and disembarking of passengers, when the ship is at safe anchorage and provided that the safety of the ship is not impaired.

1.28.3 The master is to ensure that an effective system of supervision and reporting of the closing and opening of the doors referred to in 1.28.1 is implemented.

1.28.4 The master is to ensure, before the ship proceeds on any voyage, that an entry in the log-book, is made of the time of the last closing of the doors specified in 1.28.1 and the time of any opening of particular doors in accordance with 1.28.2.

1.29 Entries in log of passenger ships

1.29.1 Hinged doors, portable plates, sidescuttles, gangway, cargo and coaling ports and other openings, which are required by this Chapter to be kept closed during navigation, are to be closed before the ship leaves port. The time of closing and the time of opening (if permissible under this Chapter) are to be recorded in the log-book.

1.29.2 A record of all drills and inspections required by 1.27 of this Chapter is to be entered in the log-book with an explicit record of any defects which may be disclosed.

1.30 Water level detectors on single hold cargo ships other than bulk carriers

1.30.1 Ships having a length (L_L) of less than 80 m, and a single cargo hold below the freeboard deck or cargo holds below the freeboard deck which are not separated by at least one bulkhead made watertight up to that deck, are to be fitted in such space or spaces with water level

detectors.[①]

1.30.2 The water level detectors required by 1.30.1 of this Chapter are to:
(1) give an audible and visual alarm at the navigation bridge when the water level above the inner bottom in the cargo hold reaches a height of not less than 0.3 m, and another when such level reaches not more than 15% of the mean depth of the cargo hold; and
(2) be fitted at the aft end of the hold, or above its lowest part where the inner bottom is not parallel to the designed waterline. Where webs or partial watertight bulkheads are fitted above the inner bottom, Administrations may require the fitting of additional detectors.

1.30.3 The water level detectors required by 1.30.1 need not be fitted in ships having watertight side compartments each side of the cargo hold length extending vertically at least from inner bottom to freeboard deck.

2 Machinery installations

2.1 General requirements

2.1.1 The machinery, boilers and other pressure vessels, associated piping systems and fittings are to be of a design and construction adequate for the service for which they are intended and are to be so installed and protected as to reduce to a minimum any danger to persons on board, due regard being paid to moving parts, hot surfaces and other hazards. The design is to have regard to materials used in construction, the purpose for which the equipment is intended, the working conditions to which it will be subjected and the environmental conditions on board.

2.1.2 Main propulsion machinery and all auxiliary machinery essential to the propulsion and the safety of the ship are, as fitted in the ship, to be designed to operate when the ship is upright and when inclined at any angle of list up to and including 15° either way under static conditions and 22.5° under dynamic conditions (rolling) either way and simultaneously inclined dynamically (pitching) 7.5° by bow or stern. The deviation from these angles may be permitted, taking into consideration the type, size and service conditions of the ship.

2.1.3 Sufficient power for going astern is to be provided to secure proper control of the ship in all normal circumstances.

2.1.4 At least two independent means are to be provided for communicating orders from the navigation bridge to the position in the machinery space or in the control room from which the engines are normally controlled; one of these is to be an engine-room telegraph which provides visual indication of the orders and responses both in the machinery spaces and on the navigation bridge. Appropriate means of communication are to be provided from the navigation bridge and the engine- room to any other position from which the engines may be controlled.

2.1.5 The levels of machinery noise in machinery spaces is to be reduced in accordance with the approved standards.

2.1.6 Special consideration is to be given to the design, construction and installation of propulsion machinery systems so that any mode of their vibrations is not to cause undue stresses in this machinery in the normal operating ranges.

2.1.7 In any cases, all spaces, where flammable or toxic gases or vapours may accumulate, are to be provided with adequate ventilation.

2.1.8 Accessibility for the purpose of control, maintenance and overhaul of machinery and equipment is to be provided in machinery and boiler spaces.

2.1.9 For passenger ships navigating beyond service category 3 and cargo ships of 500 gross

① Refer to the Performance standards for water level detectors on bulk carriers and single hold cargo ships other than bulk carriers, adopted by the Maritime Safety Committee by resolution MSC.188 (79).

tonnage and above navigating in and beyond service category 1, the arrangement of machinery installations is to be such that the machinery can be brought into operation from the dead ship condition without external aid.

2.1.10 Main and auxiliary machinery essential for the propulsion, control and safety of the ship is to be provided with effective means for its operation and control. All control systems essential for the propulsion, control and safety of the ship are to be independent or designed such that failure of one system does not degrade the performance of another system.

2.1.11 For all passenger ships and cargo ships of 500 gross tonnage and above, an engineers' alarm is to be provided to be operated from the engine control room or at the maneuvering platform as appropriate, and is to be clearly audible in the engineers' accommodation.

2.1.12 Means are to be provided whereby normal operation of propulsion machinery can be sustained or restored even though one of the essential auxiliaries becomes inoperative.

2.1.13 All boilers, all parts of machinery, all steam, hydraulic, pneumatic and other systems and their associated fittings which are under internal pressure are to be subjected to appropriate tests including a pressure test before being put into service for the first time.

2.2 Machinery

2.2.1 Where risk from overspeeding of machinery exists, means are to be provided to ensure that the safe speed is not exceeded.

2.2.2 Where main or auxiliary machinery including pressure vessels or any parts of such machinery are subject to internal pressure and may be subject to dangerous overpressure, means are to be provided where practicable to protect against such excessive pressure.

2.2.3 All gearing and every shaft and coupling used for transmission of power to machinery essential for the propulsion and safety of the ship or for the safety of persons on board are to be so designed and constructed that they will withstand the maximum working stresses to which they may be subjected in all service conditions, and due consideration is to be given to the type of engines by which they are driven or of which they form part.

2.2.4 Internal combustion engines of a cylinder diameter of 200 mm or a crankcase volume of 0.6 m^3 and above is to be provided with crankcase explosion relief valves of a suitable type with sufficient relief area. The relief valves are to be arranged or provided with means to ensure that discharge from them is so directed as to minimize the possibility of injury to personnel.

2.2.5 Main turbine propulsion machinery and, where applicable, main internal combustion propulsion machinery and auxiliary machinery are to be provided with automatic shutoff arrangements in the case of failures such as lubricating oil supply failure which could lead rapidly to complete breakdown, serious damage or explosion. The provisions for overriding automatic shutoff devices may be permitted.

2.3 Machinery piping systems

2.3.1 Steam boilers and feed systems

(1) Every steam boiler is to be provided with not less than two safety valves of adequate capacity. Small auxiliary boiler with evaporating capacity not exceeding 1000 kg/h and design pressure not exceeding 0.78 MPa may be fitted with only one safety valve.

(2) Each oil-fired boiler which is intended to operate without manual supervision is to have safety arrangements which shut off the fuel supply and give an alarm in the case of low water level, air supply failure or flame failure.

(3) Every boiler essential for the safety of the ship and designed to contain water at a specified level is to be provided with at least two means for indicating its water level, at least one of which is to be a direct reading gauge glass.

(4) Main boilers, auxiliary boilers essential for the safety of the ship or auxiliary boilers supplying

steam for heating heavy fuel oil is to be provided with not less than two separate feed water systems including the feed pumps.
For cargo ships navigating in service category 1 and within or passenger ships navigating in service category 3, auxiliary boilers may be provided with one separate feed water system including the feed pump and one spare pump capable of being easily installed and connected.
For cargo ships of less than 500 gross tonnage, the feed system of auxiliary boilers mentioned above may be dispensed with the spare pump.
(5) Suitable arrangements are to be provided to preclude, as far as practicable, the entry of oil or other contaminants which may adversely affect the boiler.

2.3.2 Steam pipe systems
(1) Every steam pipe and every fitting connected thereto through which steam may pass is to be so designed, constructed and installed as to withstand the maximum working stresses to which it may be subjected.
(2) Means are to be taken in all steam piping systems to avoid excessive stress caused by expansion and contraction.
(3) Means are to be provided for draining every steam pipe in which dangerous water hammer action might otherwise occur.
(4) If a steam pipe or fitting may receive steam from any source at a higher pressure than that for which it is designed a suitable reducing valve, relief valve and pressure gauge are to be fitted.

2.3.3 Air pressure systems
(1) In every ship means are to be provided to prevent overpressure in any part of compressed air systems and wherever water jackets or casings of air compressors and coolers might be subjected to dangerous overpressure due to leakage into them from air pressure parts. Suitable pressure relief arrangements are to be provided for all systems.
(2) The main starting air arrangements for main propulsion internal combustion engines are to be adequately protected against the effects of backfiring and internal explosion in the starting air pipes.
(3) Discharge pipes from starting air compressors are to lead directly to the starting air receivers, and all starting pipes from the air receivers to main or auxiliary engines are to be entirely separate from the compressor discharge pipe system.
(4) Provision is to be made to reduce to a minimum the entry of oil into the air pressure systems and to drain these systems.

2.4 Bilge pumping system
2.4.1 The bilge pumping arrangements in passenger ships and cargo ships are to comply with the following requirements.
(1) An efficient bilge pumping system is to be provided, capable of pumping from and draining any watertight compartment other than a space permanently appropriated for the carriage of fresh water, water ballast, oil fuel or liquid cargo and for which other efficient means of pumping are provided, under all practical conditions. Efficient means are to be provided for draining water from insulated holds.
(2) Sanitary, ballast and general service pumps may be accepted as independent power bilge pumps if fitted with the necessary connections to the bilge pumping system.
(3) All bilge pipes used in or under fuel storage tanks or in boiler or machinery spaces, including spaces in which oil-settling tanks or oil fuel pumping units are situated, are to be of steel or other suitable material.
(4) The arrangement of the bilge and ballast pumping system is to be such as to prevent the possibility of water passing from the sea and from water ballast spaces into the cargo and machinery spaces, or from one compartment to another. Provision is to be made to prevent any deep tank having bilge and ballast connections being inadvertently flooded from the sea when containing cargo, or being discharged through a bilge pump when containing water ballast.
(5) All distribution boxes and manually operated valves in connection with the bilge pumping arrangements are to be in positions which are accessible under ordinary circumstances.
(6) Provision is to be made for the drainage of enclosed cargo spaces situated on the bulkhead deck of a passenger ship and on the freeboard deck of a cargo ship, provided that the means of

drainage may be permitted to be dispensed with in any particular compartment of any ship or class of ship if it is satisfactory that by reason of size or internal subdivision of those spaces the safety of the ship is not thereby impaired.

① Where the freeboard to the bulkhead deck or the freeboard deck, respectively, is such that the deck edge is immersed when the ship heels more than 5°, the drainage is to be by means of a sufficient number of scuppers of suitable size discharging directly overboard, fitted in accordance with the requirements of 1.19 of this Chapter in the case of a passenger ship and the requirements for scuppers, inlets and discharges of the requirements of PART THREE of the Guidelines in the case of a cargo ship.

② Where the freeboard is such that the edge of the bulkhead deck or the edge of the freeboard deck, respectively, is immersed when the ship heels 5° or less, the drainage of the enclosed cargo spaces on the bulkhead deck or on the freeboard deck, respectively, is to be led to a suitable space, or spaces, of adequate capacity, having a high water level alarm and provided with suitable arrangements for discharge overboard. In addition it is to be ensured that:

(a) the number, size and disposition of the scuppers are such as to prevent unreasonable accumulation of free water;

(b) the pumping arrangements required by this paragraph for passenger ships or cargo ships, as applicable, take account of the requirements for any fixed pressure water-spraying fire-extinguishing system;

(c) water contaminated with petrol or other dangerous substances is not drained to machinery spaces or other spaces where sources of ignition may be present; and

(d) where the enclosed cargo space is protected by a carbon dioxide fire-extinguishing system the deck scuppers are fitted with means to prevent the escape of the smothering gas.

2.4.2 The additional requirements for bilge pumping arrangements in passenger ships are as follows:

(1) The bilge pumping system required by 2.4.1(1) of this Chapter is to be capable of operation under all practicable conditions after a casualty whether the ship is upright or listed. For this purpose wing suctions are generally to be fitted except in narrow compartments at the end of the ship where one suction may be sufficient. In compartments of unusual form, additional suctions may be required. Arrangements are to be made whereby water in the compartment may find its way to the suction pipes. Where, for particular compartments, the provision may be dispensed with subject to agreement if calculations made in accordance with the conditions laid down in 1.4.2 to 1.4.7 of this Chapter show that the survival capability of the ship will not be impaired.

(2) At least three power pumps are to be fitted connected to the bilge main, one of which may be driven by the propulsion machinery.

For the following ships, where the bilge pump criteria≥30, an independent power-driven pump is to be added:

① passenger ships navigating in and beyond service category 1;

② passenger ships carrying 500 passengers and more navigating in service category 2.

For passenger ships of less than 100 gross tonnage and carrying not more than 100 passengers, if the duration of navigation does not exceed 4 h, two independent power-driven bilge pumps are to be fitted.

(3) Where practicable, the power bilge pumps are to be placed in separate watertight compartments and so arranged or situated that these compartments will not be flooded by the same damage. If the main propulsion machinery, auxiliary machinery and boilers are in two or more watertight compartments, the pumps available for bilge service are to be distributed as far as is possible throughout these compartments.

(4) On a passenger ship of 91.5 m in length and upwards or with bilge pump criteria≥30, the arrangements are to be such that at least one power bilge pump is to be available for use in all flooding conditions which the ship is required to withstand, as follows:

① one of required bilge pumps is to be an emergency pump of a reliable submersible type having a source of power situated above the bulkhead deck; or

② the bilge pumps and their sources of power are to be so distributed throughout the length of the ship that at least one pump in an undamaged compartment will be available.

(5) With the exception of additional pumps which may be provided for peak compartments only, each required bilge pump is to be so arranged as to draw water from any space required to be drained by the above-mentioned 2.4.1(1).

(6) Each power bilge pump is to be capable of pumping water through the required main bilge pipe at a speed of not less than 2 m/s. Independent power bilge pumps situated in machinery spaces are to have direct suctions from these spaces, except that not more than two such suctions are to be required in any one space. Where two or more such suctions are provided, there is to be at least one on each side of the ship. The Surveyor may require independent power bilge pumps situated in other spaces to have separate direct suctions. Direct suctions are to be suitably arranged and those in a machinery space are to be of a diameter not less than that required for the bilge main.

(7) In addition to the direct bilge suction or suctions required by the above-mentioned (6), a direct suction from the main circulating pump leading to the drainage level of the machinery space and fitted with a non-return valve is to be provided in the machinery space. The diameter of this direct suction pipe is to be at least two thirds of the diameter of the pump inlet in the case of steamships, and of the same diameter as the pump inlet in the case of motor ships.

Where the main circulating pump is considered not suitable for this purpose, a direct emergency bilge suction is to be led from the largest available independent power-driven pump to the drainage level of the machinery space; the suction is to be of the same diameter as the main inlet of the pump used. The capacity of the pump so connected is to exceed that of a required bilge pump by an amount subject to agreement.

The spindles of the sea inlet and direct suction valves are to extend well above the engine-room platform.

(8) All bilge suction piping up to the connection to the pumps are to be independent of other piping.

(9) The diameter d of the bilge main is to be calculated according to the following formula. However, the actual internal diameter of the bilge main may be rounded off to the nearest standard size, but not less than the calculated value by 5 mm:

$$d = 25 + 1.68\sqrt{L(B+D)} \quad \text{mm}$$

where: d — the internal diameter of the bilge main, in mm;

L and B — the length and the breadth of the ship, in m, as defined in 1.2 of this Chapter;

D— the moulded depth of the ship to the bulkhead deck, in m, provided that, in a ship having an enclosed cargo space on the bulkhead deck which is internally drained in accordance with the requirements of 2.4.1(6)② and which extends for the full length of the ship, D is to be measured to the next deck above the bulkhead deck. Where the enclosed cargo spaces cover a lesser length, D is to be taken as the moulded depth to the bulkhead deck plus lh/L where l and h are the aggregate length and height respectively of the enclosed cargo spaces, in m.

The diameter of the bilge branch pipes is to meet the requirements of CCS Rules for Classification of See-going Steel Ships.

(10) Provision is to be made to prevent the compartment served by any bilge suction pipe being flooded in the event of the pipe being severed or otherwise damaged by collision or grounding in any other compartment. For this purpose, where the pipe is at any part situated nearer the side of the ship than one fifth of the breadth of the ship (as defined in 1.2 and measured at right angles to the centreline at the level of the deepest subdivision load line), or is in a duct keel, a non-return valve is to be fitted to the pipe in the compartment containing the open end.

For twin hull passenger ships, “one fifth of the breadth of the ship” above is to be replaced by “transverse damage extent required by 1.5.2(3) of this Chapter”.

(11) Distribution boxes, cocks and valves in connection with the bilge pumping system are to be so arranged that, in the event of flooding, one of the bilge pumps may be operative on any compartment; in addition, damage to a pump or its pipe connecting to the bilge main outboard of a line drawn at one fifth of the breadth of the ship is not to put the bilge system out of action. If there is only one system of pipes common to all the pumps, the necessary valves for controlling the bilge suctions must be capable of being operated from above the bulkhead deck. Where in addition to the main bilge pumping system an emergency bilge pumping system is provided, it is to be independent of the main system and so arranged that a pump is capable of operating on any compartment under flooding condition as specified in 2.4.2(1) of this Chapter; in that case only the

valves necessary or the operation of the emergency system need be capable of being operated from above the bulkhead deck.
For twin hull passenger ships, “one fifth of the breadth of the ship” above is to be replaced by “transverse damage extent required by 1.5.2(3) of this Chapter”.
(12) All cocks and valves referred to in the above-mentioned 2.4.2(11) which can be operated from above the bulkhead deck are to have their controls at their place of operation clearly marked and are to be provided with means to indicate whether they are open or closed.
(13) Bilge pumps except those specifically serving the spaces forward of the collision bulkhead are not to be installed forward of the collision bulkhead.

2.4.3 The additional requirements of bilge pumping arrangements in cargo ships are as follows:
(1) At least two power pumps connected to the main bilge system are to be provided, one of which may be driven by the propulsion machinery. If it is satisfactory that the safety of the ship is not impaired, bilge pumping arrangements may be dispensed with in particular compartments.
For cargo ships of less than 100 gross tonnage, bilge pumping arrangements may be composed of only one machinery-driven pump and one manual pump.
(2) Open-top container ships and open-top container barges are to be provided with suitable arrangements for discharging bilge water in the open-top cargo holds directly overboard in any service condition. Where dangerous cargoes are carried in the open-top cargo holds, bilge pumps except those in the engine room are to be used to discharge bilge water in the cargo holds directly overboard.

2.4.4 Additional requirements for bilge pumping arrangements in special purpose ships
2.4.4.1 In a special purpose ship carrying more than 60 persons, the bilge pumping system is to comply with the additional requirements of 2.4.2 of this Chapter.
2.4.4.2 In a special purpose ship carrying not more than 60 persons, the bilge pumping system is to comply with the additional requirements of 2.4.3 of this Chapter and the following provisions:
Distribution boxes, cocks and valves in connection with the bilge pumping system should be arranged so that, in the event of flooding of a compartment other than the machinery space, one of the bilge pumps may be operative on any compartment; in addition, damage to a pump or pipe located outside the machinery space and connected to the bilge main outboard of the line at *B*/5 from the ship side should not put the bilge pumping system out of action. The valves for controlling the bilge suctions for spaces other than the machinery space should be capable of being operated from within the machinery space or from above the bulkhead deck.

2.4.5 Drainage arrangements for non-self-propelled ships
2.4.5.1 Non-self-propelled ships are to be provided with means for drainage of all watertight compartments which give contribution to the vessel’s buoyancy and floatability (except for compartments permanently used to carry liquid).
2.4.5.2 This Section is the additional requirements to drainage arrangements and ballast piping for non-self-propelled ships. With the exemption specified in the following, the rules and principles for drainage of ship with propulsion machinery are to be referred to.
2.4.5.3 For dock barges and non-self-propelled ships, at least two portable hand pumps are to be fitted to permit the efficient drainage of each compartment. Suitable access hatches for the pumping equipment are to be provided for each compartment.
2.4.5.4 In manned non-self-propelled ships with auxiliary power, permanently installed bilge system with power bilge pumps are to be provided for dealing with the drainage of tanks and principal compartments and the following requirements are to be complied with:
(1) manned ships with auxiliary power for unlimited service are to be equipped with two power-driven bilge pumps;
(2) manned ships with auxiliary power for limited service may have one power-driven bilge pump, but in this case, the bilge pump is not to serve as fire pump;
(3) dry compartments in fore and aft peak may be drained by hand pumps;
(4) rooms situated on freeboard deck or above may be drained directly overboard.
2.4.5.5 Unmanned ships with auxiliary power are to be provided with a power-driven bilge pump. Any engine room or pump room is to have bilge suctions to power bilge pump. Other compartments may be drained by portable pumps. Suitable access hatches for the pumping

equipment are to be provided for each compartment.

2.5 Ventilation in machinery spaces

2.5.1 For self-propelled ships, machinery spaces of category A are to be adequately ventilated so as to ensure that when machinery or boilers therein are operating at full power in all weather conditions including heavy weather, an adequate supply of air is maintained to the spaces for the safety and comfort of personnel and the operation of the machinery.

2.5.2 Any other machinery space is to be adequately ventilated appropriate for the purpose of that machinery space.

2.6 Machinery controls

2.6.1 Where the main propulsion and associated machinery, including sources of main electrical supply, are provided with various degrees of automatic or remote control and are under continuous manual supervision from a control room the arrangements and controls are to be so designed, equipped and installed that the machinery operation will be as safe and effective as if it were under direct supervision.

2.6.2 In general, automatic starting, operational and control systems are to include provisions for manually overriding the automatic controls. Failure of any part of such systems is not to prevent the use of the manual override.

2.6.3 Where remote control of propulsion machinery from the navigation bridge is provided and the machinery spaces are intended to be manned, the following are to apply:

(1) the speed, direction of thrust and, if applicable, the pitch of the propeller are to be fully controllable from the navigation bridge under all sailing conditions, including manoeuvring;

(2) the control is to be performed by a single control device for each independent propeller, with automatic performance of all associated services, including, where necessary, means of preventing overload of the propulsion machinery;

(3) the main propulsion machinery is to be provided with an emergency stopping device on the navigation bridge which is to be independent of the navigation bridge control system;

(4) propulsion machinery orders from the navigation bridge are to be indicated in the main machinery control room, if fitted, and at the maneuvering platform (local control station);

(5) remote control of the propulsion machinery is to be possible only from one location at a time; at such locations inter-connected control positions are permitted. At each location there is to be an indicator showing which location is in control of the propulsion machinery. The transfer of control between the navigation bridge and machinery spaces is to be possible only in the main machinery space or the main machinery control room. This system is to include means to prevent the propelling thrust from altering significantly when transferring control from one location to another;

(6) it is to be possible to control the propulsion machinery locally, even in the case of failure in any part of the remote control system. It is also to be possible to control the auxiliary machinery, essential for the propulsion and safety of the ship, at or near the machinery concerned;

(7) the design of the navigation bridge control system is to be such that in case of its failure an alarm will be given. Unless it is considered impracticable, the preset speed and direction of thrust of the propellers are to be maintained until local control is in operation;

(8) indicators are to be fitted on the navigation bridge, the main machinery control room and at the maneuvering platform, for:

① propeller speed and direction of rotation in the case of fixed pitch propellers; and

② propeller speed and pitch position in the case of controllable pitch propellers;

(9) an alarm is to be provided on the navigation bridge and in the machinery space to indicate low starting air pressure which is to be set at a level to permit further main engine starting operations. If the remote control system of the propulsion machinery is designed for automatic starting, the number of automatic consecutive attempts which fail to produce a start is to be limited to 3 in order to safeguard sufficient starting air pressure for starting locally.

(10) automation systems are to be designed in a manner which ensures that threshold warning of impending or imminent slowdown or shutdown of the propulsion system is given to the officer in

charge of the navigational watch in time to assess navigational circumstances in an emergency. In particular, the systems are to control, monitor, report, alert and take safety action to slow down or stop propulsion while providing the officer in charge of the navigational watch an opportunity to manually intervene, except for those cases where manual intervention will result in total failure of the engine and/or propulsion equipment within a short time, for example in the case of overspeed.

2.7 Steering gear

2.7.1 Definitions

(1) Main steering gear is the machinery, rudder actuators, steering gear power units, if any, and ancillary equipment and the means of applying torque to the rudder stock (e.g. tiller or quadrant) necessary for effecting movement of the rudder for the purpose of steering the ship under normal service conditions.

(2) Auxiliary steering gear is the equipment other than any part of the main steering gear necessary to steer ship in the event of failure of the main steering gear but not including the tiller, quadrant or components serving the same purpose.

(3) Steering gear power unit is:

① in the case of electrical steering gear, an electrical motor and its associated electrical equipment;

② in the case of electric-hydraulic steering gear, an electrical motor and its associated electrical equipment and connected pump;

③ in the case of other hydraulic steering gear, a driving engine and connected pump.

(4) Power actuating system is the hydraulic equipment provided for supplying power to turn the rudder stock, comprising a steering gear power unit or units, together with the associated pipes and fittings, and a rudder actuator. The power actuating systems may share common mechanical components, i.e., tiller, quadrant and rudder stock, or components serving the same purpose;

(5) Steering gear control system is the equipment by which orders are transmitted from the navigation bridge to the steering gear power units. Steering gear control systems comprise transmitters, receivers, hydraulic control pumps and their associated motors, motor controllers, piping and cables;

(6) Maximum ahead service speed is the greatest speed which the ship is designed to maintain in service at sea at the deepest sea-going draught with the maximum revolution of propeller and the maximum continuous power of the corresponding main engine.

(7) Maximum astern speed is the speed which it is estimated the ship can attain at the designed maximum astern power at the deepest sea-going draught.

2.7.2 Basic performance

(1) Unless the main steering gear is in accordance with 2.7.2(6) of this Chapter, every ship is to be provided with a main steering gear and an auxiliary steering gear. The main steering gear and the auxiliary steering gear are to be so arranged that the failure of one of them will not render the other one inoperative.

(2) The main steering gear and rudder stock are to be:

① of adequate strength and capable of steering the ship at maximum ahead service speed;

② capable of putting the rudder over from 35° on one side to 35° on the other side with the ship at its deepest seagoing draught and running ahead at maximum a head service speed and under the same conditions, from 35° on either side to 30° on the other side in not more than 28 seconds;

③ operated by power where necessary to meet the requirements of the above-mentioned paragraph and in the case a rudder stock of over 120 mm diameter is required in way of the tiller, excluding strengthening for navigation in ice; and

④ so designed that they will not be damaged at maximum astern speed; however, this design requirement need not be proved by trials at maximum astern speed and maximum rudder angle.

(3) The auxiliary steering gear is to be:

① of adequate strength and capable of steering the ship at navigable speed and of being brought speedily into action in an emergency;

② capable of putting the rudder over from 15°on one side to 15°on the other side in not more

than 60 seconds with the ship at its deepest seagoing draught and running ahead at one half of the maximum ahead service speed or 7 knots, whichever is the greater; and

③ operated by power where necessary to meet the requirements of the above-mentioned paragraph and in the case a rudder stock of over 230 mm diameter is required in way of the tiller, excluding strengthening for navigation in ice.

(4) Manually operated steering gears are only acceptable when the operation does not require an effect exceeding 160 N under normal conditions.

(5) Main and auxiliary steering gear power units are to be:

① arranged to restart automatically when power is restored after a power failure;

② capable of being brought into operation from a position on the navigation bridge;

③ in the event of a power failure to any one of the steering gear power units, an audible and visual alarm is to be given on the navigation bridge.

(6) Where the main steering gear comprises two or more identical power units, an auxiliary steering gear need not be fitted, provided that:

① in a passenger ship, the main steering gear is capable of operating the rudder as required by 2.7.2(2)② of this Chapter while any one of the power units is out of operation;

② in a cargo ship, the main steering gear is capable of operating the rudder as required by 2.7.2(2)② of this Chapter while operating with all power units;

③ the main steering gear is so arranged that after a single failure in its piping system or in one of the power units the defect can be isolated so that steering capability can be maintained or speedily regained;

④ steering gear, other than of the hydraulic type, is to comply with the standards equivalent to the above-mentioned requirements.

2.7.3 Construction and arrangement

(1) Steering gear control is to be provided:

① for the main steering gear, both on the navigating bridge and in the steering gear compartment;

② where the main steering gear is arranged in accordance with 2.7.2(6) of this Chapter by two independent control systems, both operable from the navigation bridge. This does not require duplication of the steering wheel or steering lever. Where the control system consists of a hydraulic telemotor, a second independent system need not be fitted, except in a tanker, chemical tanker or liquefied gas carrier of 10000 gross tonnage and upwards;

③ for the auxiliary steering gear in the steering gear compartment and, if power-operated, it is also to be operated from the navigation bridge and is to be in dependent of the control system for the main steering gear.

(2) Any main and auxiliary steering gear control system operable from the navigation bridge is to comply with the following:

① if electrical, it is to be served by its own separate circuit supplied from a steering gear power circuit from a point within the steering gear compartment, or directly from switchboard busbars supplying that steering gear power circuit at a point on the switchboard adjacent to the supply to the steering gear power circuit;

② means are to be provided in the steering gear compartment for disconnecting any control system operable from the navigation bridge from the steering gear it serves;

③ the system is to be capable of being brought into operation from a position on the navigation bridge;

④ in the event of a failure of electrical power supply to the control system, an audible and visual alarm is to be given on the navigation bridge;

⑤ short circuit protection is only to be provided for steering gear control supply circuits.

(3) The electrical power circuits and the steering gear control systems with their associated components, cables and pipes required by this Section are to be separated as far as is practicable throughout their length.

(4) A means of communication is to be provided between the navigation bridge and the steering gear compartment.

(5) The angular position of the rudder is to:

① if the main steering gear is power-operated, be indicated on the navigation bridge. The rudder angle indication is to be independent of the steering gear control system;

② be recognizable in the steering gear compartment.

(6) Hydraulic power-operated steering gear is to be provided with the following:

① arrangements to maintain the cleanliness of the hydraulic fluid taking into consideration the type and design of the hydraulic system;

② a low-level alarm for each hydraulic fluid reservoir to give the earliest practicable indication of hydraulic fluid leakage. Audible and visual alarms are to be given on the navigation bridge and in the machinery space where they can be readily observed; and

③ a fixed storage tank having sufficient capacity to recharge at least one power actuating system including the reservoir, where the main steering gear is required to be power-operated. The storage tank is to be permanently connected by piping in such a manner that the hydraulic systems can be readily recharged from a position within the steering gear compartment and are to be provided with a contents gauge.

(7) The steering gear compartments are to be:

① readily accessible and, as far as practicable, separated from machinery spaces; and

② provided with suitable arrangements to ensure working access to steering gear machinery and controls. These arrangements are to include handrails and gratings or other nonslip surfaces to ensure suitable working conditions in the event of hydraulic fluid leakage.

(8) Source of electrical power and cable installation

① Each electrical or electrohydraulic steering gear comprising one or more power units is to be served by at least two exclusive circuits fed directly from the main switchboard, however, one of the circuits may be supplied through the emergency switchboard. An auxiliary electric or electrohydraulic steering gear associated with a main electrical or electrohydraulic steering gear may be connected to one of the circuits supplying this main steering gear. The circuits supplying an electrical or electro-hydraulic steering gear are to have adequate rating for supplying all motors which can be simultaneously connected to them and may be required to operate simultaneously.

② When in a ship of less than 1600 gross tonnage an auxiliary steering gear which is required by 2.7.2(3)③ of this Chapter to be operated by power is not electrically powered or is powered by an electrical motor primarily intended for other services, the main steering gear may be fed by one circuit from the main switchboard.

③ Each main and auxiliary steering gear control system, if electrical and operable from the navigation bridge, is to be served by its own separate circuit supplied from a steering gear power circuit from a point within the steering gear compartment. Or alternatively, this control system may be supplied by a separate circuit directly from the same section of main or emergency switchboard busbars at a point on the switchboard adjacent to that supplying the said steering gear power circuit.

(9) Where the rudder stock is required to be over 230 mm diameter in way of the tiller, excluding strengthening for navigation in ice, an alternative power supply, sufficient at least to supply the steering gear power unit which complies with the requirements of 2.7.2(3)② of this Chapter and also its associated control system and the rudder angle indicator, is to be provided automatically, within 45 seconds, either from the emergency source of electrical power or from an in dependent source of power located in the steering gear compartment. This independent source of power is to be used only for this purpose. In every ship of 10000 gross tonnage and upwards, the alternative power supply is to have a capacity for at least 30 minutes of continuous operation and in any other ship for at least 10 minutes.

(10) For ships navigating in service category 3, the requirements of 2.7.3(9) of this Chapter may be exempted.

2.7.4 Monitoring and alarms

(1) Short circuit protection and an overload alarm are to be provided for the circuits and motors referred to in 2.7.3(8)① of this Chapter. Protection against excess current, including starting current, if provided, is to be for not less than twice the full load current of the motor or circuit so protected, and is to be arranged to permit the passage of the appropriate starting currents. Where a three-phase supply is used, an alarm is to be provided that will indicate failure of any one of the

supply phases. The alarms required in this paragraph are to be both audible and visual.
(2) When in a ship of less than 1600 gross tonnage an auxiliary steering gear which is required by 2.7.3(8)② of this Chapter is powered by an electrical motor primarily intended for other services, the requirements of 2.7.4(1) may be waived if the protection arrangement is deemed satisfactory together with the requirements of 2.7.2(5) and 2.7.3(1) of this Chapter applicable to auxiliary steering gear.

2.7.5 Additional requirements
(1) For every oil tanker, chemical carrier and liquefied gas carrier of 10000 gross tonnage and upwards, every other ship of 70000 gross tonnage and upwards the main steering gear is to comprise two or more identical power units complying with the provisions of 2.7.2(6) of this Chapter.
(2) For every oil tanker, chemical carrier and liquefied gas carrier of 10000 gross tonnage and upwards, in addition to the requirements specified in 2.7.5(3) of this Chapter, the steering gear is to comply with the following requirements:

① The main steering gear is to be so arranged that in the event of loss of steering capability due to a single failure in any part of one of the power actuating systems of the main steering gear, excluding the tiller, quadrant or components serving the same purpose, or seizure of the rudder actuators, steering capability is to be regained in not more than 45 seconds after the loss of one power actuating system.

② The main steering gear is to comprise either:

a. two independent and separate power actuating systems, each capable of meeting the requirements of 2.7.2(2)② of this Chapter; or

b. at least two identical power actuating systems which, acting simultaneously in normal operation, are capable of meeting the requirements of 2.7.2(2)② of this Chapter. Where necessary to comply with these requirements, inter-connection of hydraulic power actuating systems is to be provided. Loss of hydraulic fluid from one system is to be capable of being detected and the defective system is to be automatically isolated so that the other actuating systems remain fully operational;

c. steering gear other than of the hydraulic type is to achieve equivalent standards.

(3) For every oil tanker, chemical carrier and liquefied gas carrier of 10000 gross tonnage and upwards but of less than 100000 tons deadweight, solutions other than those set out in 2.7.5(2) of this Chapter which need not apply the single failure criterion to the rudder actuator or actuators, may be permitted provided that an equivalent safety standard is achieved and that:

① following loss of steering capability due to a single failure of any part of the piping system or in one of the power units, steering capability is regained within 45 seconds;

② where the steering gear includes only a single power actuator, special consideration is given to stress analysis for the design including fatigue analysis and fracture mechanics analysis, as appropriate, the material used, the installation of sealing arrangements and the testing and inspection and provision of effective maintenance.

(4) The requirements for acceptance of non-duplicated power actuators for oil tankers, chemical carrier and liquefied gas carrier of 10000 gross tonnage and upwards but less than 100000 tons deadweight are to be approved in accordance with the applicable standards.

2.7.6 Pusher tug-barge combination
(1) The steering gear of the pusher tug-barge combination is to comply with the steering requirements for operating the combination.

2.7.7 Additional requirements for special purpose ships
2.7.7.1 For special purpose ships carrying more than 240 persons, the steering gear is to comply with the requirements for passenger ships in this Chapter.

2.8 Pusher tug-barge combination connectors
2.8.1 For the rigidly connected pusher tug-barge combination, the connector is to ensure that there is no relative motion between the pusher tug and the barge.

2.8.2 The connector of the articulated connected pusher tug-barge combination is to have the following functions:
(1) there can be allowed relative motion between the pusher tug and the barge;
(2) the connector between the pusher tug and the barge can be easily disconnected and it is required that one person can complete the disconnection within 5 minutes in the dock test;
(3) Display units showing the status of the connector are to be provided both at the navigational bridge and local operation position, to show whether the connector is disconnected or connected, and can carry out connection/disconnection operation.

2.8.3 The structure, strength, machinery equipment, means of operation and control as well as status displaying unit of the connector is to comply with the applicable standards.

3 Electrical installations

3.1 General requirements

3.1.1 The design, construction, testing and installation of main electrical installations involving ship's navigation and safety are to comply with the relevant requirements of this Section and the applicable requirements of CCS rules.

3.1.2 The electrical installations are to comply with the applicable requirements in addition to GENERAL, PART ONE and this Section of this PART of the Guidelines.

3.1.3 The electrical installations are to be such that:
(1) all electrical auxiliary services necessary for maintaining the ship in normal operational and habitable conditions will be assured without recourse to the emergency source of electrical power;
(2) electrical services essential for safety will be assured under various emergency conditions;
(3) the safety of passenger, crew and ship from electrical hazards will be ensured.

3.1.4 Unless provided otherwise, the provisions of this Section apply to ships not propelled by mechanical means.

3.2 Main source of electrical power

3.2.1 A main source of electrical power of sufficient capacity to supply all the services mentioned in 3.1.3(1) of this Chapter. Unless otherwise stated in 3.2.2 and 3.2.9 of this Chapter, this main source of electrical power is to consist of at least two generating sets.

3.2.2 The main source of electrical power for ships navigating in service category 3 and service category 2 for some specified route services as approved is to comply with the following:
(1) for cargo ships, only one generating set may be provided;
(2) for passenger ships where all auxiliary engines, oil pumps for steering gear engines, fire pumps and bilge pumps are driven by the main engine, only one generating set may be provided.

3.2.3 Except for the cases specified in 3.2.2 of this Chapter, the number and ratings of these generating sets are to be such that in the event of any one generating set being stopped it will still be possible to supply those services necessary to provide normal operational conditions of propulsion and safety of the ship. Minimum comfortable conditions of habitability are also to be ensured which include at least adequate services for cooking, heating, domestic refrigeration, mechanical ventilation, sanitary and fresh water. For cargo ships of less than 500 gross tonnage, comfortable conditions of habitability may not be met.

3.2.4 The main source of electrical power is to be capable of maintaining the arrangements mentioned in 3.1.3(1) of this Chapter under working condition regard less of the speed and direction of rotation of the propulsion machinery or shafting.

3.2.5 Except for cargo ships in service category 3, where transformers constitute an essential part of the electrical supply system and lighting system required in 3.2.1 of this Chapter, the number, ratings and arrangements are to be such as to ensure the same continuity of the supply to

essential services as required in 3.2.3 of this Chapter in case any one of the transformers is out of service.

3.2.6 The main switchboard is to be so placed relative to one main generating station that, as far as is practicable, the integrity of the normal electrical supply may be affected only by a fire or other casualty in one space. An environmental enclosure for the main switchboard, such as may be provided by a machinery control room situated within the main boundaries of the space, is not to be considered as separating the switchboards from the generators. Cargo ships of less than 500 gross tonnage may not comply with the requirements of this paragraph.

3.2.7 Where the main electrical source is necessary for ship's propulsion and the total installed electrical power of the main generating sets is in excess of 400 kW, the main busbars are to be subdivided into at least two parts which are to normally be connected by the following appliances, so far as is practicable, and the connection of generators and any other duplicated equipment are to be equally divided between the parts:
(1) circuit breaker without trip; or
(2) disconnect switch or switch that can easily subdivide busbars.

3.2.8 For passenger ships navigating beyond service category 3 and cargo ships of 500 gross tonnage navigating in and beyond service category 1, if the ship is required to start from a dead ship condition, the generating sets are to be such as to ensure that with any one generator or its primary source of power out of operation, the remaining generating sets are to be capable of providing the electrical services necessary to start the main propulsion plant from a dead ship condition. If the emergency source of electrical power must be used for the purpose of starting from a dead ship condition, its capability is to be sufficient to provide the electrical services to:
(1) the equipment required to be supplied by 3.4.1(1) to 3.4.1(3) or 3.5.1(1) to 3.5.1(4) of this Section;
(2) bring the ship propulsion and other machinery (if applicable) in operation from a dead ship condition.

3.2.9 The capacity and the number of main electrical source of ships not propelled by mechanical means are to be arranged in accordance with the engineering operation and comply with the requirements of 3.1.3(1) of this Chapter.

3.2.10 In passenger ships, all cabins are to be provided with floor light to clearly indicate the exits and enable passengers to find the passage to doors. Floor light may be connected to the emergency source of electrical power, or independent power source may be fitted in each cabin so that the floor light is on automatically when the normal lighting goes out and lasts for at least 30 minutes.

3.3 General requirements for emergency source of electrical power

3.3.1 Cargo ships of 500 gross tonnage and above and ships navigating beyond service category 3 are to be provided with a self-contained emergency source of electrical power.

3.3.2 The emergency source of electrical power is to be so arranged as to comply with the following:
(1) the emergency source of electrical power, associated transforming equipment, if any, transitional source of emergency power, emergency switchboard and emergency lighting switchboard are to be located above the uppermost continuous deck and are to be readily accessible from the open deck. They are not to be located forward of the collision bulkhead;
(2) the location of the emergency source of electrical power, associated transforming equipment, if any, the transitional source of emergency power, the emergency switchboard and emergency electric lighting switchboard in relation to the main source of electrical power, associated transforming equipment, if any, and the main switchboard are to be such as to ensure that a fire or other casualty in spaces containing the main source of electrical power, associated transforming equipment, if any, and the main switchboard, or in any machinery space of category A will not interfere with the supply, control and distribution of emergency electrical power. As far as

practicable, the space containing the emergency source of electrical power, associated transforming equipment, if any, the transitional source of emergency electrical power and the emergency switchboard is not to be contiguous to the boundaries of machinery spaces of category A or those spaces containing the main source of electrical power, associated transforming equipment, if any, or the main switchboard.

3.3.3 The emergency source of electrical power may be a generating set, which is to comply with the following requirements:
(1)driven by a suitable prime-mover with an independent supply of cooling and fuel, and with an accessory starting arrangements complying with the requirements of 3.6 of this Chapter;
(2)started automatically upon failure of the main source of electrical power supply and connected automatically to the emergency switchboard, unless for cargo ships a transitional source of emergency electrical power in accordance with 3.3.5 is provided. And those services referred to in 3.4.1 (for passenger ships) or 3.5.1 (for cargo ships) of this Chapter are then to be transferred automatically to the emergency generating set. The automatic starting system and the characteristics of the prime-mover are to be such as to permit the emergency generator to carry its full rated load as quickly as is safe and practicable, subject to a maximum of 45 seconds.

3.3.4 The emergency source of electrical power may also be an accumulator battery, which is to be capable of:
(1) carrying the emergency electrical load without recharging while maintaining the voltage of the battery throughout the discharge period within 12% above or below its nominal voltage;
(2) automatically connecting to the emergency switchboard in the event of failure of the main source of electrical power;
(3) supplying those services (except as otherwise stated) specified in 3.4.1 (for passenger ships) or 3.5.1 (for cargo ships), and immediately supplying at least those services specified in 3.4.2 (for passenger ships), or 3.5.2 (for cargo ships).

3.3.5 Where the emergency source of electrical power is a generator, a transitional source of emergency electrical power which consists of an accumulator battery is to be provided, unless for cargo ships where automatically started emergency generator in accordance with 3.3.3(2) is provided. The transitional source of emergency electrical power is to comply with the following requirements:
(1) it can carry the emergency electrical load without recharging while maintaining the voltage of the battery throughout the discharge period within 12% above or below its normal voltage;
(2) it is so arranged as to supply automatically in the event of failure of either the main or emergency source of electrical power at least those services referred to in 3.4.2 (for passenger ships) or 3.5.2 (for cargo ships) of this Chapter.

3.3.6 The emergency switchboard is to be installed as near as is practicable to the emergency source of electrical power and to comply with the following requirements:
(1) where the emergency source of electrical power is a generator, the emergency switchboard is to be located in the same space unless the operation of the emergency switchboard would thereby be impaired;
(2) where the emergency source of electrical power is an accumulator battery, the accumulator battery is not to be installed in the same space as the emergency switchboard;
(3) water, oil and steam lines, oil tanks and other liquid vessels are not to be installed on the back or top of the emergency switchboard, if it is impracticable, reliable protection means are to be taken.

3.3.7 An indicator is to be mounted in a suitable place on the main switchboard or in the machinery control room to indicate when the batteries constituting either the emergency source of electrical power or transitional source of emergency electrical power are being discharged.

3.3.8 The emergency switchboard is to be supplied during normal operation from the main switchboard by an interconnector feeder which is to be protected against overload and short-circuit at the main switchboard and which is to be disconnected automatically at the emergency

switchboard upon failure of the main source of electrical power.
Where the system is arranged for feedback operation, the interconnector feeder is to also be protected at least against short-circuit at the emergency switchboard.

3.3.9 In order to ensure ready availability of the emergency source of electrical power, arrangements are to be made where necessary to disconnect automatically non-emergency circuits from the emergency switchboard to ensure that electrical power is to be available to the emergency circuits.

3.3.10 Provided that suitable measures are taken for safeguarding independent emergency operation under all circumstances, the emergency generator may be used exceptionally, and for short periods, to supply non-emergency circuits.

3.3.11 The emergency generator and its prime mover and any emergency accumulator battery are to be so designed and arranged as to ensure that they will function at full rated power when the ship is upright and when inclined at any angle of list up to 22.5 °or when inclined up to 10 °either in the fore or aft direction, or is in any combination of angles within those limits.

3.3.12 Manned ships not propelled by mechanical means are to be provided with emergency source of electrical power in accordance with 3.3 or 3.7 of this Chapter; the scope and period of power supply are at least to comply with the requirements of 3.7.3 of this Chapter.

3.3.13 Additional requirements for special purpose ships
(1) for special purpose ships carrying more than 60 persons, the emergency source of power is to comply with the applicable requirements of 3.4;
(2) for special purpose ships carrying not more than 60 persons, the emergency source of power is to comply with the applicable requirements of 3.5. If the ship is more than 50 m in length, the requirement of 3.4.1(1)① are also to be complied with.

3.4 Scope and period of the supply of emergency source of electrical power in passenger ships

3.4.1 The electrical power available is to be sufficient to supply all those services that are essential for safety in an emergency, due regard being paid to such services as may have to be operated simultaneously.
The emergency source of electrical power is to be capable, having regard to starting currents and the transitory nature of certain loads, of supplying simultaneously at least the following services for the periods specified hereinafter, if they depend upon an electrical source for their operation:
(1) emergency lighting: for a period of 36 h for ships with unrestricted service, a period of 12 h for ships navigating in service category 1 and a period of 6 h for ships navigating in service category 2:

① at every muster and embarkation station of lifeboat and liferaft and over the sides;
② in alleyways, stairways and exits, giving access to the muster and embarkation stations;
③ in all service and accommodation alleyways, stairways and exits, personnel lift cars;
④ in the machinery spaces and main generating stations including their control positions;
⑤ in all control stations, machinery control rooms, and at each main and emergency switchboard;
⑥ at all stowage positions for firemen's outfits;
⑦ at the steering gear;
⑧ at the fire pump, the sprinkler pump and the emergency bilge pump referred to in Chapter 2-2 and at the starting position of their motors;

(2) for a period of 36 h for ships with unrestricted service, a period of 12 h for ships navigating in service category 1, a period of 6 h for ships navigating in service category 2:

① the navigation lights and signal lights required by Chapter 8 of this PART;
② the radiocommunication equipment required by Chapter 4 of this PART;
③ all internal communication equipment required in an emergency;
④ the navigational aids as required by Chapter 5, this requirement for ships of 5000 gross

tonnage and upwards;

⑤ the fire detection and fire alarm system, and the fire door holding and release system;

⑥ for intermittent operation of the portable daylight signalling lamp, the ship's whistle, the manually operated call points and all internal signals that are required in an emergency (e.g. general alarms, pre-warning for extinguishing media, etc.);

⑦ one of the fire pumps required by Chapter 2-2 of this PART;

⑧ the automatic sprinkler pump, if any; and

⑨ the emergency bilge pump and all the equipment essential for the operation of electrically powered remote controlled bilge valves.

Unless such services mentioned above in ③ to ⑥ have an independent supply for the specified period of time from an accumulator battery suitably located for us e in an emergency;

(3) for the period of time required by 2.7.3(9) of this Chapter, the steering gear where it is required to be so supplied by that requirement;

(4) for a period of 0.5 h:

① any watertight doors required in this Chapter to be power-operated together with their indicators and warning signals;

② the emergency arrangements (if any) to bring the lift cars to main deck level for the escape of passengers or crew.

3.4.2 The transitional source of emergency power required by 3.3.5 of this Chapter is to be of sufficient capacity to supply at least the following services, if they depend upon an electrical source for their operation:

(1) for a period of 0.5 h:

① the lighting required by 3.4.1(1) and (2) of this Chapter;

② all services required by 3.4.1(2)③, ⑤ and ⑥ unless such services have an independent supply for the period specified from an accumulator battery suitably located for use in an emergency;

(2) power to operate the watertight doors, but not necessarily all of them simultaneously, unless an independent temporary source of stored energy is provided;

(3) power to the control, indication and alarm circuits for operation of watertight doors is to be for 0.5 h.

3.4.3 In addition to the emergency lighting required in 3.4.1 of this Chapter, on the passenger ships with ro-ro cargo spaces or special spaces:

(1) all passenger public spaces and alleyways are to be provided with supplementary emergency lighting complying with the following:

① to be capable of operating for at least 3 hours when all other sources of electrical power have failed and under any condition of heel;

② the illumination provided is to be such that the approach to the means of escape can be readily seen;

③ the source of power for the supplementary lighting is to consist of accumulator batteries located within the lighting units that are continuously charged, where practicable, from emergency switchboard. Alternatively, any other means of lighting which is at least of approved type may be accepted;

④ the supplementary lighting is to be such that any failure of the lamp will be immediately apparent;

⑤ any accumulator battery provided is to be replaced at intervals having regard to the specified service life in the ambient conditions that they are subject to in service;

(2) a portable rechargeable battery operated lamp is to be provided in every crew space alleyway, recreational space and every working space which is normally occupied unless supplementary emergency lighting, as required by 3.4.3(1) of this Chapter is provided.

3.5 Scope and period of the supply of the emergency source of electrical power in cargo ships

3.5.1 The electrical power available is to be sufficient to supply all those services that are

essential for safety in an emergency, due regard being paid to such services as may have to be operated simultaneously.
The emergency source of electrical power is to be capable, having regard to star ting currents and the transitory nature of certain loads, of supplying simultaneously at least the following services for the periods specified hereinafter, if they depend upon an electrical source for their operation:
(1) for a period of 3 h, emergency lighting at every muster and embarkation station and over the sides;
(2) emergency lighting for a period of 18 h for ships with unrestricted service, a period of 6 h for ships navigating in service category 1, and a period of 3 h for ships navigating in service category 2:

① in all alleyways, stairways and exits;
② in the machinery spaces and main generating stations including their control positions;
③ in all control stations, machinery control rooms, and at each main and emergency switchboard;
④ at all stowage positions for firemen's outfits;
⑤ at the steering gear;
⑥ in all cargo pump-rooms of tankers.

(3) for a period of 18 h for ships with unrestricted service, for a period of 6 h for ships navigating in service category 1, a period of 3 h for ships navigating in service category 2:

① the navigation lights and signal lights required by Chapter 8 of this PART;
② for the radiocommunication equipment required by Chapter 4 of this PART;
③ the navigational aids as required by Chapter 5, this requirement for ships of 5000 gross tonnage and upwards;
④ all internal communication equipment as required in an emergency;
⑤ the fire detection and fire alarm system;
⑥ for intermittent operation of the daylight signalling lamp, the ship's whistle, the manually operated call points and all internal signals that are required in an emergency (e.g. general alarms pre-warning for extinguishing media, etc.);
⑦ one of the fire pumps required by Chapter 2-2 (if power supplied from emergency generator).

Unless such services mentioned above in ③ to ⑥ have an independent supply for the specified period of time from an accumulator battery suitably located for us e in an emergency;
(4) for the period of time required by 2.7.3(9) of this Chapter, the steering gear where it is required to be so supplied by that requirement.

3.5.2 The transitional source of emergency electrical power required by 3.3.5 of this Chapter is to be of sufficient capacity to supply at least 0.5 h to the following services, if they depend upon an electrical source for their operation:
(1) the lighting required by 3.5.1(1) and (2) of this Chapter and the navigation lights and signal lights required by 3.5.1(3)① of this Chapter. For this transitional phase, the required emergency electric lighting, in respect of the machinery space and accommodation and service spaces may be provided by permanently fixed, individual, automatically charged, relay operated accumulator lamps; and
(2) all services required by 3.5.1(3)④ to ⑥ of this Chapter unless such services have an independent supply for the period specified from an accumulator battery suitably located for use in an emergency.

3.6 Starting arrangements for emergency generating sets

3.6.1 Except for those ships navigating in tropical zones, emergency generating sets are to be capable of being readily started in their cold condition at a temperature of 0℃. If this is impracticable, or if lower temperatures are likely to be encountered, provision acceptable to CCS are to be made for the maintenance of heating arrangements, to ensure ready starting of the generating sets.

3.6.2 Each emergency generating set arranged to be automatically started is to be equipped with

the approved starting devices with a stored energy capability of at least 3 consecutive starts. Unless a second independent starting unit is fitted, the reserved energy is to be stored as to prevent from wear out of automatic starting of the system. A second source of energy is to be provided for an additional three starts within 30 min unless manual starting can be demonstrated to be effective.

3.6.3 The stored energy is to be maintained at all times, as follows:
(1) electrical and hydraulic starting systems are to be maintained from the emergency switchboard;
(2) compressed air starting systems may be maintained by the main or auxiliary compressed air receivers through a suitable non-return valve or by an emergency air compressor which, if electrically driven, is supplied from the emergency switchboard;
(3) all of these starting, charging and energy storing devices are to be located in the emergency generator space; these devices are not to be used for any purpose other than the operation of the emergency generating set. This does not preclude the supply to the air receiver of the emergency generating set from the main or auxiliary compressed air system through the non-return valve fitted in the emergency generator space.

3.6.4 Where automatic starting is not required, manual starting is permissible, such as manual cranking, inertia starts, manually charged hydraulic accumulators, or powder charge cartridges, where they can be demonstrated as being effective.
When manual starting is not practicable, the requirements of 3.6.2 and 3.6.3 of this Chapter are to be complied with except that starting may be manually initiated.

3.7 Emergency source of electrical power for cargo ships less than 500 gross tonnage and ships navigating in service category 3

3.7.1 For cargo ships less than 500 gross tonnage and all ships navigating in service category 3, emergency sources of electrical power complying with 3.3 and 3.4 of this Chapter (for passenger ships) or 3.3 and 3.5 of this Chapter (for cargo ships) may be provided. Accumulator batteries complying with 3.7.2 of this Chapter may also be the emergency source of electrical power.

3.7.2 Where the accumulator batteries are used as the emergency source of electrical power, the batteries are to:
(1) not to be provided in the same space with the main electrical source and fitted above the uppermost continuous deck as far as possible;
(2) comply with the requirements of 3.3.4(1), 3.3.4(2) and 3.3.11 of this Chapter;
(3) supply power to all services as specified in 3.7.3 of this Chapter.

3.7.3 The capacity of spare source of electrical power is to supply power to the following for at least 3 h:
(1) lighting at muster and embarkation stations of lifeboat and liferaft and overboard, all alleyways, stairways and exits, spaces containing main switchboard, spare source of electrical power as well as control stations;
(2) the navigation lights and other lights as specified in Chapter 8 of this PART;
(3) the internal communication equipment as required in an emergency;
(4) the radiocommunication equipment required by Chapter 4;
(5) the fire detection and fire alarm system (if any);
(6) intermittent operation of the daylight signalling lamp, the ship's whistle, the manually operated call points (if any).

3.8 Lighting

3.8.1 A main electrical lighting system which provides illumination throughout those parts of the ship normally accessible to and used by passengers or crew is to be supplied from the main source of electrical power.

3.8.2 The arrangement of the main electrical lighting system is to be such that a fire or other casualty in spaces containing the emergency source of electrical power, associated transforming equipment, if any, the emergency switchboard an d the emergency lighting switchboard will not

render a damage to the main electrical lighting system throughout the means of escape, including stairways and exits.

3.8.3 The special requirements for emergency lighting:
(1) the emergency lighting points are to comply with the relevant requirements of 3.4, 3.5 and 3.7 of this Chapter;
(2) all emergency lighting fittings are to be provided with a permanent mark or structurally different from other luminaries;
(3) no switch is to be installed in the transitional emergency lighting feeders ;
(4) no local switch is to be installed in the emergency lighting circuits in spaces specified by 3.4.1(1) and 3.5.1(2) of this Chapter except for the emergency lights in the navigating bridge and at the stowage spaces of lifeboats and liferafts;
(5) the emergency electric lighting system is to be so arranged as not to be impaired in the event of a fire or other casualty in spaces containing the main source of electrical power, associated transforming equipment (if any), the main switchboard and the main lighting switchboard.

3.9 Precautions against shock, fire and other hazards of electrical origin

3.9.1 All accessible metal parts of electrical equipment, other than current-carrying accessible parts, are to be earthed with the exception of:
(1) lamp caps;
(2) shades, reflectors and guards, supported on lamp holders or lighting fittings constructed of, or shrouded in, non-conducting material;
(3) metal parts on, or screws in or through, non-conducting material, which are separated by such material from current-carrying parts, and from earthed non-current-carrying parts, in such a way that in normal use they cannot become live or come into contact with earthed parts;
(4) portable appliances having double and/or reinforced insulation, provided that the appliances conform with recognized safety requirements;
(5) bearing housing which are insulated in order to prevent circulation of current in the bearings;
(6) clips for fluorescent lighting tubes;
(7) apparatus supplied working voltage not more than 50 V. For A.C., this voltage is a value of root mean square between conductors. Auto-transformers are not to be used for the purpose of achieving this voltage;
(8) cable clips.

3.9.2 Bonding straps are required for cargo tanks, process plant and piping systems, for inflammable liquid, combustible gas and/or inflammable dust solid, which are not to be permanently connected to the hull of the ship either directly or via their bolted or welded supports and where the resistance between them and the hull exceeds 1 MΩ.
Such bonding straps are to have a cross-sectional area of at least 10 mm^2.

3.9.3 Portable electric apparatus are to be of one of the following types:
(1) earthing by means of an earth-continuity conductor in the soft cables or wires with the working voltage not more than 250V;
(2) double isolation with the working voltage not more than 250 V;
(3) supply from a safety isolating-transformer supplying one consuming apparatus with the working voltage not more than 250 V;
(4) supply at a working voltage not more than 50 V.
Equipment mentioned in (3) to (4) is to be adopted in exceptionally damp or con fined spaces where particular risks may occur due to conductivity.

3.9.4 All electrical apparatus are to be so constructed and so installed as not to cause injury when handled or touched in the normal manner.

3.9.5 The construction and installation of switchboards are to comply with the following requirements:
(1) accessibly to the internal electrical equipment;
(2) two sides and the rear of the switchboard with the suitable protection (including the front, if

necessary);
(3) the bared electrical part with the earthing or working voltage more than 50 V is not to be fitted on the face plate;
(4) skid-proof and oil resistant insolating carpets or insolating grids are to be laid before or after the switchboards where necessary.

3.9.6 Necessary protection is to be taken to ensure the normal work and safety if A.C. high-voltage electrical installations with the voltage from 1 kV ~ 15 kV are employed.

3.9.7 The hull return system of distribution is not to be used for any purpose in an oil tanker, or for power, heating, or lighting in any other ship of 1600 gross tonnage and upwards.

3.9.8 The requirement in 3.9.7 of this Chapter does not preclude the use of:
(1) impressed current cathodic protective systems;
(2) limited and locally earthed systems if any electrical current caused by that not directly passing through the hazardous zones;
(3) insulation level monitoring devices provided the circulation current does not exceed 30 mA under the most unfavourable conditions.

3.9.9 Where the hull return systems is used, all final sub-circuits, i.e. all circuits fitted after the last protective devices, are to be two-wire.

3.9.10 Earthed distribution system is not to be used on oil tankers, except that:
(1) intrinsically safe electrical circuits;
(2) power supply, control and instrument circuits have to adopt earthed system due to technical or safety reasons with the current not exceeding 5 A under normal or trouble conditions;
(3) limited and locally earthed systems if any electrical current caused not directly passing through the hazard spaces;
(4) A.C. distribution system with the voltage of 1000 V and above, if any electrical current so caused not directly passing through the hazard spaces.

3.9.11 When a distribution system, whether primary or secondary, for power, heating or lighting, with no connection to earth is used, a device capable of continuously monitoring the insulation level to earth and of giving an audible or visual indication of abnormally low insulation values is to be provided. Insulated resistance alarm may be substituted by earthed indicator for the ships less than 1600 gross tonnage except the oil tankers or the ships carrying dangerous cargoes.

3.9.12 Except as permitted in exceptional circumstances, all metal sheaths and armour of cables are to be electrically continuous and are to be earthed.

3.9.13 All electric cables and wiring external to equipment are to be at least of a flame-retardant type and are to be so installed as not to impair their original flame-retarding properties. Where necessary for particular applications the use of special types of cables may be permitted, subject to agreement, such as radio frequency cables or cables of transmission system for computer datum, which do not comply with the foregoing.

3.9.14 Cables and wiring serving essential or emergency power, lighting, internal communications or signals are to so far as practicable be routed clear of galleys, laundries, machinery spaces of category A and their casings and other high fire risk areas. Cables connecting fire pumps to the emergency switchboard are to be of a fire-resistant type where they pass through high fire risk areas. Where practicable all such cables are to be run in such a manner as to preclude their being rendered unserviceable by heating of the bulkheads that may be caused by a fire in an adjacent space.

3.9.15 Where cables which are installed in hazardous areas introduce the risk of fire or explosion in the event of an electrical fault in such areas, special precautions against such risks are to be taken.

3.9.16 Cables and wiring are to be installed and supported in such a manner as to avoid chafing or other damage.

3.9.17 Terminations and joints in all conductors are to be so made as to retain the original electrical, mechanical, flame-retarding and, where necessary, fire-resisting properties of the cable.

3.9.18 Each separate circuit is to be protected against short circuit and against overload, except as permitted otherwise, such as electrical circuits of power supply for steering gear or overload protection may be exempted subject to agreement.

3.9.19 The rating or appropriate setting of the overload protective device for each circuit is to be permanently indicated at the location of the protective de vice.

3.9.20 Lighting fittings are to be so arranged as to prevent temperature rises which could damage the cables and wiring, and to prevent surrounding material from becoming excessively hot.

3.9.21 All lighting and power circuits terminating in a bunker or cargo space are to be provided with a multi-pole switch outside the space for disconnecting such circuits.

3.9.22 Accumulator batteries are to be suitably housed, and compartments used primarily for their accommodation are to be properly constructed and efficiently ventilated.

3.9.23 Electrical or other equipment which may constitute a source of ignition of flammable vapours is not to be permitted in these compartments except as permitted in 3.9.25 of this Chapter.

3.9.24 Accumulator batteries are not to be located in accommodation spaces except where hermetically sealed subject to approval.

3.9.25 No electrical equipment is to be installed in any space where flammable mixtures or dust are liable to collect including those on board tankers or in compartments assigned principally to accumulator batteries, in paint lockers, acetylene stores or similar spaces unless such equipment is:
(1) essential for operational purposes;
(2) of a type which will not ignite the mixture concerned;
(3) appropriate to the space concerned; and
(4) appropriately certified for safe usage in the dusts, vapours or gases likely to be encountered.

3.9.26 In a passenger ship, distribution systems are to be so arranged that fire in any main vertical zone as is defined in Chapter 2-2 of this PART will not interfere with services essential for safety in any other such zone. This requirement will be met if main and emergency feeders passing through any such zone are separated both vertically and horizontally as widely as is practicable.

3.9.27 Lightning conductor is to be provided on all the mast made of non-conductor material. The lightening conductor onboard the ship of non-conductor constriction is to be connected with the copper plate of hull firmly fixed below the light waterline by suitable conductor.

3.9.28 In tankers, electrical equipment, cables and wiring are not to be installed in hazardous locations unless it conforms with standards not inferior to those acceptable to CCS①. Electrical equipment, cables and wiring which do not conform to the standards may be installed in hazardous locations subject to special consideration to ensure that an equivalent level of safety is assured.

3.9.29 Additional requirements for special purpose ships
(1) All installations are to be in accordance with 3.9.1 to 3.9.25.
(2) Installations on special purpose ships carrying more than 60 persons are also to be in

① Refer to the standards published by the International Electrotechnical Commission, and in particular IEC 60092-502:1999 *Electrical installations in ships - Tankers.*

accordance with 3.9.28.

3.10 Fire-resisting cables

3.10.1 Cables[①] for services, required to be operable under fire conditions, including those[②] for their power supplies, are to be of a fire resistant type, complying with standards acceptable to CCS[③], where they pass through high fire risk areas[④] and in addition for passenger ships, main vertical fire zones. The following services may be exempted:
(1) fail safe system;
(2) self-monitoring system;
(3) duplicated system with cable runs as widely separated as is practicable.

3.10.2 Services required to be operable under fire conditions include:
(1) general emergency alarm system;
(2) fire detection and fire alarm system;
(3) fire extinguishing system and fire extinguishing medium release alarm;
(4) public address system;
(5) control and power systems of power operated fire doors and status indication systems for all fire doors;
(6) control and power systems of power operated watertight doors and their status indication systems;
(7) emergency lighting;
(8) low location lighting;
(9) remote emergency stop/shutdown arrangements for systems which may support the propagation of fire and/or explosion.

3.10.3 So far as is reasonably practicable, the electrical cables to the emergency fire pump are not to pass through the machinery spaces containing the main fire pumps and their source(s) of power and/or prime mover(s). Where the ship arrangements are such that the cables have to pass through these spaces, the cables are to be of a fire resistant type and specially protected against mechanical damage (e.g. run in heavy gauge pipe).

3.11 Additional requirements for dock pontoons

3.11.1 Dock pontoons of 50 m in length and upwards (intended for dining) are to be provided with accumulator batteries as standby power supply. The capacity of the power are to supply power to the following equipment simultaneously for at least 0.5 h:
(1) emergency lighting of the following spaces:
① the pantries;
② the machinery spaces, main generating stations and main switchboard (if any);
③ all service and accommodation alleyways, stairways and exits, personnel lift cars;
④ at all stowage positions for firemen's outfits;

---

① In case of cables for services required to be operable under fire conditions, the fire resistant cables are to extend from the control/monitoring panel to the nearest local distribution panel serving the relevant area or zone.

② In case of power supply cables used for services required to be operable under fire conditions, the fire resistant cables are to extend from their distribution point within the space containing the emergency source of electrical power to the nearest local distribution panel serving the relevant area or zone.

③ See: outer diameter of the cable > 20 mm: IEC publication 60331-31;
outer diameter of the cable ≤ 20 mm: IEC publication 60331-21; and may be adopted;
electrical data cables: IEC 60331-23;
fibre-optic cables: IEC 60331-25.

④ The definition of "high fire risk areas" is for the following spaces:
(1) machinery spaces as defined by Chapter II-2 of SOLAS;
(2) spaces containing fuel treatment equipment and other highly flammable substances;
(3) galley and Pantries containing cooking appliances;
(4) laundry with drying equipment;
(5) accommodation spaces, machinery spaces and main galley, other spaces for storing flammable liquid with high fire risk as defined by regulation II-2/9 of SOLAS for ships carrying more than 36 passengers;
(6) enclosed or semi-enclosed hazardous spaces, in which certified safe type electric equipment is required.

(2) the fire detection and fire alarm system, the manually operated call points;
(3) all internal communication equipment required in an emergency(if any);
(4) all internal signals that are required in an emergency (if any).

3.11.2 For dock pontoons of less than 50 m in length (intended for dining) may not be provided with standby power supply. However, emergency lighting required by 3.11.1(1) is to be provided, which may be in the form of portable lamps powered by rechargeable batteries.

3.11.3 In dock pontoons providing accommodation at night (intended for dining), all cabins are to be provided with floor light to clearly indicate the exits and enable passengers to find the passage to doors. Floor light may be connected to the standby power supply, or independent power source may be fitted in each cabin so that the floor light is on automatically when the normal lighting goes out and lasts for at least 0.5 h.

4 Automation requirements for periodically unattended machinery spaces

4.1 General requirements

4.1.1 This Section only applies to all cargo ships with periodically unattended machinery spaces including main engine control room or main engine control position, the ships have the automatic control and remote automation system (hereinafter called automation system) for machinery and electrical installation and equipment in the machinery spaces.

4.1.2 The main automation system for ship's navigation and safety is to be designed and manufactured to comply with the related requirements of this Section and CCS rules.

4.1.3 The automation system of 4.1.1 of this Section is to be such as to ensure the safety of the ship in all sailing conditions, and the safety of machinery and electrical installation is to be equivalent to that of a ship having the machinery space manned.
Means are to be taken to ensure the effective manual manoeuvring for machinery an d electrical equipment when the automation system fails.

4.1.4 In addition, the automation system are to comply with the requirements of Section 3 of this Chapter and the other applicable requirements of this PART.

4.1.5 The automation system is to be capable of working continuously and normally under every kind of sea conditions, ship's movement, vibration, humidity, temperature and wave motion of electrical source. And it is to be subject to testing required by the related standards.

4.1.6 Upon failure of normal power supply, the safety and alarm systems, and control systems (e.g. automated systems of an electric generating plant) requiring continuous supply of power in the event of failure of such power supply are to be capable of being automatically changed over to a separate standby power supply. The standby power may be accumulator batteries, with a capacity at least sufficient for a period of supply of 30 min. Upon power failures, the control systems, safety and alarm systems are to activate visual and audible alarms.

4.2 Fire precautions

4.2.1 Means are to be provided to detect and give alarms at an early stage in case of fires:
(1) in boiler air supply casings and exhaust (uptakers); and
(2) in scavenging space of the main engine (only applicable to low-speed diesel engines).
4.2.2 Internal combustion engines of 2250 kW and above or having cylinders of more than 300 mm bore are to be provided with crankcase oil mist detectors or engine bearing temperature monitors or equivalent devices.

4.3 Protection against flooding

4.3.1 Bilge wells in periodically unattended machinery spaces are to be located and monitored in such a way that the accumulation of liquids is detected at normal angles of trim and heel, and are to be large enough to accommodate easily the normal drainage during the unattended period.

4.3.2 For the ships of 500 gross tonnage and upwards, where the bilge pumps are capable of being started automatically, means are to be provided to indicate when the influx of liquid is greater than the pump capacity or when the pump is operating more frequently than would normally be expected. In these cases, smaller bilge wells to cover a reasonable period of time may be permitted. The discharge of bilge water is to comply with the oil pollution prevention requirements at sea.

4.3.3 The location of the controls of any valve serving a sea inlet, a discharge below the waterline or a bilge injection system is to be so sited as to allow adequate time for operation in case of influx of water to the space. If the level to which the space could become flooded with ship in the fully loaded condition so requires, arrangements are to be made to operate the controls form a position above such level.

4.4 Control of propulsion machinery from the navigation bridge

4.4.1 Under all sailing conditions including manoeuvring (frequent manoeuvring), the speed, direction of thrust and, if applicable, direction of thrust of propeller and the pitch of the controllable pitch propeller are to be fully controllable from the navigation bridge.

4.4.2 Such remote control is to be performed by a single control device for each independent propeller, with automatic performance of all associated services, including, where necessary, means of preventing overload of the propulsion machinery.

4.4.3 The main propulsion machinery is to be provided with an emergency stopping device on the navigation bridge which is to be independent of the navigation bridge control system.

4.4.4 Propulsion machinery orders from the navigation bridge are to be indicated in the main machinery control room or at the propulsion machinery control position as appropriate.

4.4.5 Remote control of the propulsion machinery is to be possible only from one location at a time; at such locations interconnected control positions are per mitted. At each location there is to be an indicator showing which location is in control of the propulsion machinery. The transfer of control between the navigation bridge and machinery spaces is to be possible only in the main machinery space or in the main machinery control room. The system are to include means to prevent the propelling thrust from altering significantly when transferring control from one location to another.

4.4.6 It is to be possible for all machinery essential for the safe operation of the ship to be controlled from a local position, even in the case of failure in any part of the automatic or remote control systems.

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

4.4.8 Indications are to be fitted in the navigation bridge for:
(1) propeller speed and direction of rotation in the case of fixed pitch propellers;
(2) propeller speed and pitch position in the case of controllable pitch propellers.

4.4.9 The required low pressure of starting air to restart the main engine is to be indicated in the navigation bridge and machinery space. If the remote system of main engine is designed to start automatically, the failure of automatic consecutive starting is to be limited in 3 times so that it will have sufficient starting air pressure for starting at site.

4.5 Communication

4.5.1 A reliable means of vocal communication is to be provided between the main machinery control room or the propulsion machinery control position as appropriate, the navigation bridge

and the engineer's accommodation.

4.6 Alarm system

4.6.1 An alarm system is to be provided indicating any fault requiring attention and are to:
(1) be capable of sounding an audible alarm in the main machinery control room or at the propulsion machinery control position, and indicate visually each separate alarm function at a suitable position;
(2) have a connection to the engineers' public rooms and to each of the engineers' cabins through a selector switch, to ensure connection to at least one of those cabins. Equivalent arrangements may be used subject to agreement;
(3) activate an audible and visual alarm on the navigation bridge for any situation which requires action by or attention of the officer on watch;
(4) as far as is practicable be designed on the fail-to-safety principle; and
(5) activate the engineer's alarm if an alarm function has not received any reply or attention locally within a limited time.

4.6.2 The alarm system is to be continuously powered and are to have an automatic change-over to a stand-by power supply in case of loss of normal power supply.

4.6.3 Failure of the normal power supply of the alarm system is to be indicated by an alarm.

4.6.4 The alarm system is to be capable of giving alarms to all faults at the same time. The alarm to one fault and/or response to the alarm are not to inhibit another alarm to another fault and /or another response.

4.6.5 After the response of alarm, the audible signal may be cancelled but the visual indication are to remain until the fault has been corrected, when the alar m system are to automatically reset to the normal operating condition.

4.7 Safety systems

4.7.1 A safety system is to be provided to ensure that serious malfunction in machinery or boiler operations, which presents an immediate danger, are to initiate the automatic shutdown of that part of the plant and that an alarm is to be given. Shutdown of the propulsion system is not to be automatically activated except in cases which could lead to serious damage, complete breakdown or explosion.

4.7.2 Where arrangements for overriding the shutdown of the main propelling machinery are fitted, these are to be such as to preclude inadvertent operation, visual means are to be provided to indicate when the override has been acted.

4.8 Special requirements for machinery, boiler and electrical installations

4.8.1 The special requirements for the machinery, boiler and electrical installations are to be subject to agreement and are to include at least the requirements of this paragraph.

4.8.2 The main source of electrical power are to comply with the following requirements.
(1) Where the electrical power can normally be supplied by one generator, suitable load-shedding arrangements are to be provided to ensure the integrity of supplies to services required for propulsion and steering as well as the safety of the ship. In the case of loss of the generator in operation, adequate provision is to be made for automatic starting and connecting to the main switchboard of a standby generator of sufficient capacity to permit propulsion and steering and to ensure the safety of the ship with automatic restarting of the essential auxiliaries including, where necessary, sequential operations. This requirement may be dispensed with for a ship of less than 1600 gross tonnage.
(2) If the electrical power is normally supplied by more than one generator simultaneously in parallel operation, provision is to be made, for instance by load shedding, to ensure that, in case of loss of one of these generating sets, the remaining ones are kept in operation without overload to permit propulsion and steering, and to ensure the safety of the ship.

4.8.3 Where stand-by machines are required for other auxiliary machinery essential to propulsion, automatic change-over devices are to be provided.

4.8.4 Automatic control and alarm system
(1) The control system is to be such that the services needed for the operation of the main propulsion machinery and its auxiliaries are ensured through the necessary automatic arrangements.
(2) An alarm is to be given on the automatic change.
(3) An alarm system complying with 4.6 of this Section is to be provided for all important pressures, temperatures and fluid levels and other essential parameters.
(4) A centralized control position is to be arranged with the necessary alarm panels and instrumentation including any alarm.

4.8.5 Means are to be provided to keep the starting air pressure at the required level where internal combustion engines are used for main propulsion.

4.9 Additional requirements for special purpose ships
(1) Special purpose ships carrying not more than 240 persons are to be in accordance with 4.1 to 4.8.
(2) Special purpose ships carrying more than 240 persons should be specially considered as to whether or not their machinery spaces may be periodically unattended and if so whether additional requirements to those stipulated in this chapter are necessary to achieve equivalent safety to that of normally attended machinery spaces.

5 Structure of ships

5.1 General requirements
5.1.1 All salt water ballast spaces having boundaries formed by the hull plating are to be applied with an efficient protective coating, epoxy or equivalent. Except seawater ballast tanks, spaces in hull internal structure and inside hull plating such as bilges in double bottom ships, spaces below solid floors of single bottom ships and cofferdams are to be applied with suitable protective coating, according to the service of the spaces.

5.1.2 Emergency towing arrangements complying with Chapter 3, PART TWO of CCS Rules for Classification of Sea-going Steel Ships are to be fitted on board every tanker, including oil tankers, chemical tankers and gas carriers, of not less than 20,000 tonnes deadweight. The design and construction as well as prototype tests of emergency towing arrangements are to be approved by CCS.

5.1.3 New installation of materials which contain asbestos are to be prohibited.

5.1.4 Access to cargo area of oil tankers and bulk carriers and spaces forward as well as openings of internal passages are to comply with the following provisions:
(1) Safe access to cofferdams, ballast tanks, cargo holds and other spaces in the cargo area is to be direct from the open deck and such as to ensure their complete inspection. Safe access to double bottom spaces may be from a cargo hold, pump-room, deep cofferdam, pipe tunnel and similar compartment not intended for the carriage of oils or dangerous goods.
(2) For access through horizontal openings, hatches or manholes, the dimensions are to be sufficient to allow a person wearing a self-contained air-breathing apparatus and protective equipment to ascend or descend any ladder without obstruction and also provide a clear opening to facilitate the hoisting of an injured person from the bottom of the space. The minimum clear opening is not to be less than 600 mm × 600 mm.
(3) For access through vertical openings, or manholes, in swash bulkheads, floors, girders and web frames providing passage through the length and breadth of the space, the minimum opening is to be not less than 600 mm×800 mm at a height of not more than 600 mm from the bottom shell plating unless gratings or other foot holds are provided.

(4) For oil tankers of less than 5,000 tonnes deadweight and bulk carriers of less than 20,000 gross tonnage, in special circumstances, subject to agreement, smaller dimensions for the openings may be accepted if the ability to traverse such openings or to remove an injured person can be proved. However, in any cases, the openings are not to be less than 400 mm × 600 mm or 450 mm × 550 mm and after being pierced, the members are to be of sufficient strength.

5.1.5 Ships are to be provided with the loading computer in accordance with CCS Rules for Classification of Sea-going Steel Ships.

5.1.6 A set of as-built construction drawings and other plans showing any subsequent structural alterations are to be kept on board a ship. An additional set of such drawings is to be kept ashore by the Company or ship operator.

Chapter 2-2 CONSTRUCTION — FIRE PROTECTION, FIRE DETECTION AND FIRE EXTINCTION

1 General provisions

1.1 Application

1.1.1 In addition to the requirements of this Chapter, fire protection, fire detection and fire extinction systems of ships engaged on non-international voyages are to comply with the applicable requirements in GENERAL, PART ONE and Chapter 1 of this PART of the Guidelines.

1.1.2 Requirements for passenger ships

(1) Construction — fire protection, fire detection and fire extinction of passenger ships of class I are to comply with relevant provisions of Chapter II-2 of SOLAS and 2.5.7 of this Chapter.

(2) Passenger ships carrying the following number of passengers are to comply with the relevant requirements for higher class:

① passenger ships of class II carrying 500 or more persons are to comply with the relevant requirements for passenger ships of class I;

② passenger ships of class III carrying 500 or more persons are to comply with the relevant requirements for passenger ships of class II;

③ passenger ships of class III carrying 1000 or more persons are to comply with the relevant requirements for passenger ships of class I.

(3) Except for passenger ships of class I with unrestricted service, passenger ships of other class and service areas do not need to comply with the requirements of Reg.21, 22 and 23, Chapter II-2 of SOLAS regardless of the number of passengers.

1.2 Definitions

(1) *Non-combustible material* is a material which neither burns nor gives off flammable vapours in sufficient quantity for self-ignition when heated to approximately 750℃, this being determined by the Fire Test Procedures Code. Any other material is a combustible material.

(2) *Steel or other equivalent material*, where the words “steel or other equivalent material" occur, “equivalent material" means any non-combustible material which, by itself or due to insulation provided, has structural and integrity proper ties equivalent to steel at the end of the applicable exposure to the standard fire test (e.g. aluminum alloy with appropriate insulation).

(3) *Low flame spread* means that the surface thus described will adequately restrict the spread of flame, this being determined by the Fire Test Procedures Code.

(4) *A standard fire test* is one in which specimens of the relevant bulkheads or decks are exposed in a test furnace to temperatures corresponding approximately to the standard time-temperature curve. The specimen is to have an exposed surf ace of not less than 4.65 m^2 and height (or length of deck) of 2.44 m, resembling as closely as possible the intended construction and including where appropriate at least one joint. The standard time-temperature curve is defined by a smooth curve drawn through the following temperature points measured above the initial furnace temperature:

at the end of the first 5 min ……556℃
at the end of the first 10 min ……659℃
at the end of the first 15 min ……718℃
at the end of the first 30 min ……821℃
at the end of the first 60 min ……925℃

(5) *“A" class divisions* are those divisions formed by bulkheads and decks which comply with the following:

① they are to be constructed of steel or other equivalent material;

② they are to be suitably stiffened;

③ they are to be so constructed as to be capable of preventing the passage of smoke and flame to the end of the one-hour standard fire test;

④ they are to be insulated with approved non-combustible materials such that the average temperature of the unexposed side will not rise more than 140℃ above the original

temperature, nor will the temperature, at any one point, including any joint, rise more than 180℃ above the original temperature, within the time listed below:

class "A-60" ……60 min
class "A-30" ……30 min
class "A-15" ……15 min
class "A-0"[①] ……0 min

⑤ a test of a prototype bulkhead or deck may be required, where necessary, to ensure that it meets the above requirements for integrity and temperature rises.

(6) *"B" class divisions* are those divisions formed by bulkheads, decks, ceilings or linings which comply with the following:

① they are to be so constructed as to be capable of preventing the passage of flame to the end of the first half hour of the standard fire test;

② they are to have an insulation value such that the average temperature of the unexposed side will not rise more than 140℃ above the original temperature, nor will the temperature at any one point, including any joint, rising more than 225℃ above the original temperature, within the time listed below:

class "B-15" ……15 min
class "B-0" ……0 min

③ they are to be constructed of approved non-combustible materials and all materials entering into the construction and erection of "B" class divisions are to be non-combustible, with the exception that combustible veneers may be permitted provided they meet other requirements of this Chapter;

④ a test of a prototype division may be required, where necessary, to ensure that it meets the above requirements for integrity and temperature rise.

(7) *"C" class divisions* are divisions constructed of approved non-combustible materials. They need meet neither requirements relative to the passage of smoke and flame nor limitations relative to the temperature rise. Combustible veneers are permitted provided they meet other requirements of this Chapter.

(8) *Continuous "B" class ceilings or linings* are those "B" class ceilings or linings which terminate only at "A" or "B" class division.

(9) *Main vertical zones* are those sections into which the hull, superstructure, and deckhouses are divided by "A" class divisions, the mean length and breadth of which on any deck does not in general exceed 40 m.

(10) *Accommodation spaces* are those spaces used for public spaces, corridors, lavatories, cabins, offices, hospitals, cinemas, games and hobbies rooms, barber shops, pantries containing no cooking appliances and similar spaces.

(11) *Public spaces* are those portions of the accommodation which are used for halls, dining rooms, lounges and similar permanently enclosed spaces.

(12) *Service spaces* are those spaces used for galleys, pantries containing cooking appliances, lockers, mail and specie rooms, storerooms, workshops other than those forming part of the machinery spaces, and similar spaces and trunks to such spaces.

(13) *Cargo spaces* are all spaces used for cargo (including liquid cargo tanks) and trunks to such spaces.

(14) *Ro-ro cargo spaces* are spaces not normally subdivided in any way and extending to either a substantial length or the entire length of the ship in which goods (packaged or in bulk, in or on rail or road cars, vehicles (including road or rail tankers), trailers, containers, pallets, demountable tanks or in or on similar stowage units or other receptacles) can be loaded and unloaded normally in a horizontal direction.

(15) *Open ro-ro cargo spaces* are ro-ro cargo spaces either open at both ends, or open at one end and provided with adequate natural ventilation effective over their entire length through permanent openings in the side plating or deckhead.

(16) *Closed ro-ro cargo spaces* are ro-ro cargo spaces which are neither open ro-ro cargo spaces nor weather decks.

(17) *Weather deck* is a deck which is completely exposed to the weather from above and from at

① The equivalent structure of class A-0 is to comply with the requirements of the Fire Test Procedures Code.

least two sides.

(18) *Central control station* is a control station in which the following control and indicator functions are centralized:

① fixed fire detection and fire alarm systems;
② automatic sprinkler, fire detection and fire alarm systems;
③ fire door indicator panels;
④ fire door closure;
⑤ watertight door indicator panels;
⑥ watertight door closures;
⑦ ventilation fans;
⑧ general/fire alarms;
⑨ communication systems including telephones;
⑩ microphones to public address systems.

(19) *Rooms containing furniture and furnishings of restricted fire risk* are those rooms containing furniture and furnishings of restricted fire risk (whether cabins, public spaces, offices or other types of accommodation) in which:

① case furniture such as desks, wardrobes, dressing tables, bureaux, or dressers are constructed entirely of approved non-combustible materials, except that a combustible veneer not exceeding 2 mm may be used on the working surface of such articles;
② free-standing furniture such as chairs, sofas, or tables are constructed with frames of non-combustible materials;
③ draperies, curtains and other suspended textile materials have qualities of resistance to the propagation of flame not inferior to those of wool having a mass of 0.8 kg/m^2, this being determined in accordance with the Fire Test Procedures Code;
④ floor coverings have low flame-spread characteristics;
⑤ exposed surfaces of bulkheads, linings and ceilings have low flame-spread characteristics;
⑥ upholstered furniture has qualities of resistance to the ignition and propagation of flame, this being determined in accordance with the Fire Test Procedures Code;
⑦ bedding components have qualities of resistance to the ignition and propagation of flame, this being determined in accordance with the Fire Test Procedures Code.

(20) *Machinery spaces of category A* are those spaces and trunks to such spaces which contain:

① internal combustion machinery used for main propulsion;
② internal combustion machinery used for purposes other than main propulsion where such machinery has in the aggregate a total power output of not less than 375 kW;
③ any oil-fired boiler or oil fuel unit;
④ oil-fired inert gas generators.

(21) *Machinery spaces* are all machinery spaces of category A and all other spaces containing propulsion machinery, boilers, oil fuel units, steam and internal combustion engines, generators and major electrical machinery, oil filling stations, refrigerating, stabilizing, ventilation and air-conditioning machinery, and similar spaces, and trunks to such spaces.

(22) *Oil fuel unit* is the equipment used for the preparation of oil fuel for de livery to an oil-fired boiler, or equipment used for the preparation for delivery of heated oil to an internal combustion engine, and includes any oil pressure pumps, filters and heaters dealing with oil at a pressure of more than 0.18 MPa.

(23) *Control stations* are those spaces in which the ship's radio or main navigating equipment or the emergency source of power is located or where the fire recording or fire control equipment is centralized. Spaces where the fire recording or fire control equipment is centralized are also considered to be a fire control station.

(24) *Crude oil* is any oil occurring naturally in the earth whether or not treated to render it suitable for transportation and includes:

① crude oil from which certain distillate fractions may have been removed;
② crude oil to which certain distillate fractions may have been added.

(25) *Combination carrier* is a tanker designed to carry oil or alternatively solid cargoes in bulk.

(26) *Dangerous goods* are those goods referred to in Chapter VII of SOLAS.

(27) *Inert condition* means a condition in which the oxygen content throughout the atmosphere of a tank has been reduced to 8% or less by volume by the addition of inert gas.
(28) *Inerting* means the introduction of inert gas into a tank with the object of attaining the condition defined in 1.2(27) of this Chapter.
(29) *Purging* means the introduction of inert gas into a tank already in the inerting condition with the object of:

① further reducing the oxygen content;
② reducing the hydrocarbon gas content to a level below which combustion cannot be supported if air is subsequently introduced into the tank.

(30) *Gas freeing* means the introduction of fresh air into a tank with the object of removing the toxic, flammable and inert gases, and increasing oxygen content to 21% volume.
(31) *Cargo area* is that part of the ship 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.
(32) *Continuously manned central control station* is a central control station which is continuously manned by a responsible member of the crew.
(33) *Vehicle spaces* are cargo spaces intended for carriage of motor vehicles with fuel in their tanks for their own propulsion.
(34) *Open vehicle spaces* are those vehicle spaces which are either open at both ends or have an opening at one end and are provided with adequate natural ventilation effective over their entire length through permanent openings distributed in the side plating or deck head or from above, having a total area of at least 10% of the total area of the space sides.
(35) *Closed vehicle spaces* are vehicle spaces which are neither open vehicle spaces nor weather decks.
(36) *Sauna* is a hot room with temperatures normally varying between 80℃ and 120℃ where the heat is provided by a hot surface (e.g., by an electrically heated oven). The hot room may also include the space where the oven is located and adjacent bathrooms.
(37) *Fire Test Procedures Code* means the International Code for Application of Fire Test Procedures 2010 adopted by resolution MSC.307(88), as may be amended by IMO.
(38) *Bulkhead deck* is the uppermost deck up to which the transverse watertight bulkheads are carried.
(39) *Cabin balcony* is an open deck space which is provided for the exclusive use of the occupants of a single cabin and has direct access from such a cabin.
(40) *Ship length* is the ship length defined in 1.2.1(15), Chapter 2-1 of this PART.
(41) *Fire Safety Systems Code* means the International Code for Fire Safety Systems adopted by resolution MSC.98(73), as may be amended by IMO.
(42) *IBC Code* means the International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk adopted by resolution MSC.4(48), as may be amended by IMO.
(43) *IGC Code* means the International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk adopted by resolution MSC.177(79), as may be amended by IMO.

1.3 Water fire-extinguishing system

1.3.1 Every ship is to be provided with water fire-extinguishing system complying with the requirements of this paragraph.
1.3.2 Capacity of fire pumps
(1) The required fire pumps are to be capable of delivering for fire-fighting purposes a quantity of water, at the pressure specified in 1.3.4 of this Chapter, as follows:

① pumps in passenger ships, not less than two thirds of the quantity required to be dealt with by the bilge pumps when employed for bilge pumping; and
② pumps in cargo ships, other than any emergency fire pump, not less than four thirds of the quantity required to be dealt with by each of the independent bilge pumps when employed in bilge pumping, provided that in no cargo ship need the total required capacity of the fire pumps exceed 180 m^3/h.

(2) Each of the required fire pumps (other than any emergency fire pump for cargo ships) is to

have a capacity not less than 80% of the total required capacity divided by the minimum number of required fire pumps but in any case not less than 25 m^3/h and each such pump is in any event to be capable of delivering at least the two required jets of water. These fire pumps are to be capable of supplying the fire main system under the required conditions. For ships of less than 500 gross tonnage, the capacity of the fire pump is to be at least 15 m^3/h.

1.3.3 Arrangements of fire pumps and of fire mains

(1) Ships are to be provided with independently driven fire pumps as follows:

in passenger ships of:

4000 gross tonnage and upwards	at least three
500 gross tonnage and upwards but less than 4000 gross tonnage	at least two
less than 500 gross tonnage	at least one

in cargo ships of:

2000 gross tonnage and upwards	at least two
500 gross tonnage and upwards but less than 2000 gross tonnage	at least two power-driven pumps, one of which is to be independently driven
less than 500 gross tonnage	at least one

(2) Sanitary, ballast, bilge or general service pumps may be accepted as fire pumps, provided that they are not normally used for pumping oil and that if they are subject to occasional duty for the transfer or pumping of oil fuel, suitable change-over arrangements are fitted.

(3) The arrangement of sea connections, fire pumps and their sources of power is to be such as to ensure that:

① in passenger ships of 1000 gross tonnage and upwards, in the event of a fire in any one compartment all the fire pumps will not be put out of action;

② in cargo ships of 2000 gross tonnage and upwards, if a fire in any one compartment could put all the pumps out of action there is to be an alternative means consisting of a fixed independently driven emergency pump which is to be capable of supplying two jets of water. The pump and its location are to comply with the following requirements:

(a) the capacity of the pump is not to be less than 40% of the total capacity of the fire pumps required by this paragraph and in any case not less than 25 m^3/h;

(b) when the pump is delivering the quantity of water required by (a) above, the pressure at any hydrant is not to be less than the minimum pressures given in 1.3.4(2) of this Chapter;

(c) Any diesel-driven power source for the pump is to be capable of being readily started in its cold condition down to the temperature of 0℃ by hand (manual) cranking. Where ready starting cannot be assured, if this is impracticable, or if lower temperatures are likely to be encountered, and if the room for the diesel driven power source is not heated, electric heating of the diesel engine cooling water or lubricating oil system is to be fitted. If hand (manual) starting is impracticable, compressed air, electricity, or other sources of stored energy, including hydraulic power or starting cartridges may be permitted to be used as a means of starting. These means are to be such as to enable the diesel-driven power source to be started at least six times within a period of 30 min and at least twice within the first 10 min;

(d) any service fuel tank is to contain sufficient fuel to enable the pump to run on full load for at least 3 h and sufficient reserves of fuel are to be available outside the main machinery space to enable the pump to be run on full load f or an additional 3 h;

(e) the total suction head and the net positive suction head of the pump are to be such that the requirements of 1.3.3(3)②(a), (b) and 1.3.4 of this Chapter are to be obtained under all conditions of list, trim, roll and pitch likely to be encountered in service;

(f) the boundaries of the space containing the fire pump are not to be adjacent to the machinery space of category A or space containing the main fire pump. When this is impracticable, the bulkhead between the two spaces is to be insulated to a standard of structural fire protection equivalent to that required for a control station in 3.2 of this Chapter;

(g) no direct access is to be permitted between the machinery space of category A or the space containing the main fire pump and the space containing the emergency fire pump and its source of power. When this is impracticable, an arrangement where the access is

by means of an airlock may be accepted, the door to the machinery space of "A-60" standard and the other at least of steel, each of the two doors being self-closing, or through a watertight door cap able of being operated from a space remote from the machinery space and the space containing the emergency fire pump and unlikely to be cut off in the event of fire in those spaces. In such cases a second means of access to the space containing the emergency fire pump and its source of power is to be provided;

(h) ventilation arrangements to the space containing the independent source of power for the emergency fire pump are to be such as to preclude, as far as practicable, the possibility of smoke from a machinery space fire entering or being drawn into that space;

③ in passenger ships of less than 1000 gross tonnage and cargo ships of less than 2000 gross tonnage but more than 500 gross tonnage, if a fire in any one compartment could put all the pumps out of action the alternative means of providing water for fire-fighting purposes are to be provided. The alternative means to be provided is to be an independently driven, power-operated emergency fire pump with its source of power and sea connection located outside the machinery space. The capacity is to be at least 25 m^3/h for passenger ships and 15 m^3/h for cargo ships, and pressure is to be maintained at 0.25 MPa for both kinds of ships. The arrangement of the emergency fire pump is to comply with the relevant requirements of 1.3.3(3)②.

④ For passenger ships of less than 500 gross tonnage, one mobile emergency fire pump is to be provided in addition to the fire pump required in 1.3.3(1). The pump is to be in spaces other than machinery spaces. The capacity is to be at least 15 m^3/h and pressure is to be maintained at 0.25 MPa.

⑤ in cargo ships where other pumps, such as general service, bilge and ballast, etc., are fitted in a machinery space, arrangements are to be made to ensure that at least one of these pumps, having the capacity and pressure required by 1.3.2 and 1.3.4 of this Chapter is capable of providing water to the fire main.

(4) The arrangements for the ready availability of water supply are to be:

① in passenger ships of 1000 gross tonnage and upward such that at least one effective jet of water is immediately available from any hydrant in an interior location and so as to ensure the continuation of the output of water by the automatic starting of a required fire pump. In passenger ships of less than 1000 gross tonnage by the remote starting from the navigational bridge of at least one fire pump. If the bottom valve cannot be opened from where the pump is remotely started, the bottom valve is always to be kept open;

② in passenger ships, if fitted with periodically unattended machinery spaces, provisions for fixed water fire-extinguishing arrangement for such spaces are to be determined equivalent to those required for normally attended machinery spaces;

③ in cargo ships with a periodically unattended machinery space or when only one person is required on watch, there is to be immediate water delivery from the fire main system at a suitable pressure, either by remote starting of one of the main fire pumps with remote starting from the navigation bridge and fire control station, if any, or permanent pressurization of the fire main system by one of the main fire pumps, except that this requirement for cargo ships of less than 1600 gross tonnage may be waived subject to agreement if the starting installation of the fire pump in the machinery space access is easily accessible.

(5) Relief valves are to be provided in conjunction with all fire pumps if the pumps are capable of developing a pressure exceeding the design pressure of the water service pipes, hydrants and hoses. These valves are to be so placed and adjusted as to prevent excessive pressure in any part of the fire main system.

(6) In tankers isolation valves are to be fitted in the fire main at poop front in a protected position and on the tank deck at intervals of not more than 40 m to preserve the integrity of the fire main system in case of fire or explosion.

1.3.4 Diameter of, and pressure in, the fire mains

(1) The diameter of the fire main and water service pipes is to be sufficient for the effective distribution of the maximum required discharge from two fire pumps operating simultaneously, except that in the case of cargo ships the diameter need only be sufficient for the discharge of 140 m^3/h.

(2) With the two pumps simultaneously delivering through nozzles specified in 1.3.8 of this Chapter, the quantity of water specified in 1.3.4(1) of this Chapter, through any adjacent hydrants, the following minimum pressures are to be maintained at all hydrants:

Passenger ships:

4000 gross tonnage and upwards ……0.40 MPa

under 4000 gross tonnage ……0.30 MPa

Cargo ships:

6000 gross tonnage and upwards ……0.27 MPa

500 gross tonnage and upwards

but under 6000 gross tonnage ……0.25 MPa

under 500 gross tonnage ……one jet of water not less than 12 m

(3) The maximum pressure at any hydrant is not to exceed that at which the effective control of a fire hose can be demonstrated.

1.3.5 Number and position of hydrants

(1) The number and position of hydrants are to be such that at least two jets of water not emanating from the same hydrant, one of which is to be from a single length of hose, may reach any part of the ship normally accessible to the passengers or crew while the ship is being navigated and any part of any cargo space when empty, any ro-ro cargo space or any special category space in which latter case the two jets are to reach any part of such space, each from a single length of hose. Furthermore, such hydrants are to be positioned near the accesses to the protected spaces.

(2) In the accommodation, service and machinery spaces of passenger ships the number and position of hydrants are to be such that the requirements of 1.3.5(1) of this Chapter may be complied with when all watertight doors and all doors in main vertical zone bulkheads are closed.

(3) Where, in a passenger ship, access is provided to a machinery space of category A at a low level from an adjacent shaft tunnel, two hydrants are to be provided external to, but near the entrance to that machinery space. Where such access is provided from other spaces, in one of those spaces two hydrants are to be provided near the entrance to the machinery space of category A. Such provision need not be made where the tunnel or adjacent spaces are not part of the escape route.

1.3.6 Pipes and hydrants

(1) Materials readily rendered ineffective by heat are not to be used for fire mains and hydrants unless adequately protected. The pipes and hydrants are to be so placed that the fire hoses may be easily coupled to them. The arrangement of pipes and hydrants is to be such as to avoid the possibility of freezing. In ships where deck cargo may be carried, the positions of the hydrants are to be such that they are always readily accessible and the pipes are to be arranged as far as practicable to avoid risk of damage by such cargo. Unless one hose and nozzle is provided for each hydrant in the ship, there is to be complete interchangeability of hose couplings and nozzles.

(2) A valve is to be fitted to serve each fire hose so that any fire hose may be removed while the fire pumps are at work.

(3) Isolating valves to separate the section of the fire main within the machinery space containing the main fire pump or pumps from the rest of the fire main are to be fitted in an easily accessible and tenable position outside the machinery spaces. However, cargo ships of less than 500 gross tonnage may be exempted from this requirement. The fire main is to be so arranged that when the isolating valves are shut all the hydrants on the ship, except those in the machinery space referred to above, can be supplied with water by a fire pump not located in this machinery space through pipes which do not enter this space. The emergency fire pump, its seawater inlet, and suction and delivery pipes and isolating valves are to be located outside the machinery space. If this arrangement cannot be made, the sea-chest may be fitted in the machinery space if the valve is remotely controlled from a position in the same compartment as the emergency fire pump and the suction pipe is as short as practicable. Short lengths of suction or discharge piping may penetrate the machinery space, provided they are enclosed in a substantial steel casing or are insulated to "A-60" class standards. The pipes are to have substantial wall thickness, but in no case less than 11 mm, and are to be welded except for the flanged connection to the sea inlet valve.

1.3.7 Fire hoses

(1) Fire hoses are to be of approved non-perishable material. Fire hoses are to be sufficient in length to project a jet of water to any of the spaces in which they may be required to be used. Each

hose is to be provided with a nozzle and the necessary couplings. Hoses specified as “fire hoses" are, together with any necessary fittings and tools, to be kept ready for use in conspicuous positions near the water service hydrants or connections. In interior locations in passenger ships of 500 gross tonnage and upwards, fire hoses are to be connected to the hydrants at all times. Fire hoses are to have a length of at least 10 m, but not more than 15 m in machinery spaces, 20 m in other spaces and open decks, and 25 m for open decks on ships with a maximum breadth in excess of 30 m.

(2) Ships are to be provided with fire hoses the number and diameter of which are to be subject to agreement.

(3) In passenger ships there is to be at least one fire hose for each of the hydrants required by this paragraph and these hoses are to be used only for the purposes of extinguishing fires or testing the fire-extinguishing apparatus at fire drills and surveys.

(4) In cargo ships of 1000 gross tonnage and upwards the number of fire hoses to be provided is to be one for each 30 m length of the ship and one spare but in no case less than five in all. This number does not include any hoses required in any engine or boiler room. The number of hoses required may be increased so as to ensure that hoses in sufficient number are available and accessible at all times, having regard to the type of ship and the nature of trade in which the ship is employed. In cargo ships of 500 gross tonnage and upwards but less than 1000 gross tonnage, the number of fire hoses to be provided is to be at least three. In cargo ships of less than 500 gross tonnage, the number of fire hoses to be provided is to be at least one.

1.3.8 Nozzles

(1) For the purposes of this Chapter, standard nozzle sizes are to be 12 mm, 16 mm and 19 mm or as near thereto as possible. Larger diameter nozzles may be permitted subject to agreement.

(2) For accommodation and service spaces, a nozzle size greater than 12 mm need not be used.

(3) For machinery spaces and exterior locations, the nozzle size is to be such as to obtain the maximum discharge possible from two jets at the minimum pressure under-mentioned in this Chapter from the smallest pump (except emergency fire pump), provide d that a nozzle size greater than 19 mm need not be used.

(4) All nozzles are to be of an approved dual-purpose type (i.e. spray/jet type) incorporating a shutoff.

1.3.9 Location and arrangement of water pumps, etc., for other fire-extinguishing systems

Pumps required for the provision of water for other fire-extinguishing systems required by this Chapter, their sources of power and their controls are to be installed outside the space or spaces protected by such systems and are to be so arranged that a fire in the space or spaces protected will not put any such system out of action.

1.3.10 International shore connection

All ships of 500 gross tonnage and upwards are to be provided with the international shore connection as follows:

(1) facilities are to be available enabling such a connection to be used on either side of the ship;

(2) standard dimensions of flanges for the international shore connection are to be in accordance with Table 1.3.10(2);

(3) the connection is to be of steel or other suitable material and is to be designed for 1.0 MPa services. The flange is to have a flat face on one side and on the other is to be permanently attached to a coupling that will fit the ship's hydrant and hose. The connection is to be kept aboard the ship together with a gasket of any material suitable for 1.0 MPa services, together with four 16 mm bolts, 50 mm in length and eight washers.

Dimensions of Flanges for International Shore Connection Table 1.3.10(2)

Description	Dimensions (mm)
Outside diameter	178
Inside diameter	64
Bolt circle diameter	132
Slots in flange	4 holes, 19 mm in diameter spaced equidistantly on a bolt circle of the above diameter, slotted to the flange periphery
Flange thickness	14.5 mm minimum
Bolts and nuts	4, each of 16 mm in diameter, 50 mm in length

1.4 Fixed gas fire-extinguishing systems

1.4.1 General requirements

(1) The use of a fire-extinguishing medium which either by itself or under expected conditions of use gives off toxic gases in such quantities as to endanger persons is not to be permitted.

(2) The necessary pipes for conveying fire-extinguishing medium into protected spaces are to be provided with control valves so marked as to indicate clearly the spaces to which the pipes are led. Suitable provision is to be made to prevent inadvertent admission of the medium to any space. Where a cargo space fitted with a gas fire-extinguishing system is used as a passenger space, the gas connection is to be blanked during such use. The pipes may pass through accommodations providing that they are of substantial thickness and that their tightness is verified with a pressure test, after their installation, at a pressure head not less than 5 MPa. In addition, pipes passing through accommodation areas are to be joined only by welding and are not to be fitted with drains or other openings within such spaces. The pipes are not to pass through refrigerated spaces.

(3) The piping for the distribution of fire-extinguishing medium is to be arranged and discharge nozzles so positioned that a uniform distribution of medium is obtained.

(4) Means are to be provided to close all openings which may admit air to or allow gas to escape from a protected space.

(5) Where the volume of free air contained in air receivers in any space is such that, if released in such space in the event of fire, such release of air with in that space would seriously affect the efficiency of the fixed fire-extinguishing system, the provision of an additional quantity of fire-extinguishing medium may be required.

(6) Means are to be provided for automatically giving audible and visual warning of the release of fire-extinguishing medium into any ro-ro spaces, container holds equipped with integral reefer containers, spaces accessible by doors or hatches, and other spaces in which persons normally work or to which they have access. The audible alarms are to be located so as to be audible throughout the protected space with all machinery operating, and the alarms should be distinguished from other audible alarms by adjustment of sound pressure or sound patterns. The pre-discharge alarm is to be automatically activated (e.g., by opening of the release cabinet door). The alarm is to operate for the length of time needed to evacuate the space, but in no case less than 20 s before the medium is released. Conventional cargo spaces and small spaces (such as compressor rooms, paint lockers, etc.) with only a local release need not be provided with such an alarm.

Air operated alarm may be used for automatically giving audible warning of the release of fire-extinguishing medium into cargo pump-rooms of the tankers carrying crude oil or petroleum products having a flashpoint not exceeding 60℃ (closed cup test), provided that air supply is clean and dry. Where electrically operated alarms are used for cargo pump-rooms, the arrangements are to be such that the electrical operating mechanism is located outside the cargo pump-rooms, unless the intrinsically safe audible warning, as approved, is used.

(7) The means of control of any fixed gas fire-extinguishing system are to be readily accessible and simple to operate and are to be grouped together in as few locations as possible at positions not likely to be cut off by a fire in a protected space. Such space is to be well illuminated and provided with emergency lighting in addition to main lighting. At each location there are to be clear instructions relating to the operation of the system having regard to the safety of personnel.

(8) Automatic release of fire-extinguishing medium is not to be permitted.

(9) Where the quantity of extinguishing medium is required to protect more than one space, the quantity of medium available need not be more than the largest quantity required for any one space so protected. Adjacent spaces with independent ventilation systems not separated by at least A-0 class divisions should be considered as the same space. The system is to be fitted with normally closed control valves arranged to direct the agent into the appropriate space.

(10) The volume of starting air receivers, converted to free air volume, is to be added to the gross volume of the machinery space when calculating the necessary quantity of the fire-extinguishing medium. Alternatively, a discharge pipe from the safety valves may be fitted and led directly to the open air.

(11) Pressure containers required for the storage of fire-extinguishing medium, other than steam, are to be located outside protected spaces in accordance with (14) below.

(12) Means are to be provided for the crew to safely check the quantity of medium in the

containers. It is not to be necessary to move the containers completely from their fixing position for this purpose. For carbon dioxide systems, hanging bars for a weighing device above each bottle row, or other means are to be provided. For other types of extinguishing media, suitable surface indicators may be used.

(13) Containers for the storage of fire-extinguishing medium and associated pressure components are to be designed according to the rules or standards accepted having regard to their locations and maximum ambient temperatures expected in service.

(14) When the fire-extinguishing medium is stored outside a protected space, it is to be stored in a room which is located behind the forward collision bulkhead, and is used for no other purposes. Any entrance to such a storage room is preferably to be from the open deck and is to be independent of the protected space. If the storage space is located below deck, it is to be located no more than one deck below the open deck and is to be directly accessible by a stairway or ladder from the open deck. Spaces which are located below deck or spaces where access from the open deck is not provided are to be fitted with a mechanical ventilation system designed to take exhaust air from the bottom of the space and are to be sized to provide at least 6 air changes per hour. Access doors are to open outwards, and bulkheads and decks including doors and other means of closing any opening therein, which form the boundaries between such rooms and adjoining enclosed spaces are to be gas-tight. For the purpose of the application of the integrity tables in 2.4, 3.2 and 4.4 of this Chapter, such storage rooms are to be treated as control stations.

(15) In piping sections where valve arrangements introduce sections of closed piping, such sections are to be fitted with a pressure relief valve and the outlet of the valve is to be led to open deck.

(16) All discharge piping, fittings and nozzles in the protected spaces are to be constructed of materials having a melting temperature which exceeds 925℃. The piping and associated equipment are to be adequately supported.

(17) A fitting is to be installed in the discharge piping to permit the air testing as required by 1.4.2(10)④.

(18) Spare parts for the system are to be stored on board and are to comply with the requirements of this Chapter.

1.4.2 High-pressure carbon dioxide systems

(1) For cargo spaces the quantity of carbon dioxide available is, unless otherwise provided, to be sufficient to give a minimum volume of free gas equal to 30% of the gross volume of the largest cargo space so protected in the ship.

(2) For machinery spaces the quantity of carbon dioxide carried is to be sufficient to give a minimum volume of free gas equal to the larger of the following volumes, either:

① 40% of the gross volume of the largest machinery space so protected, the volume to exclude that part of the casing above the level at which the horizontal a rea of the casing is 40% or less of the horizontal area of the space concerned taken midway between the tank top and the lowest part of the casing; or

② 35% of the gross volume of the largest machinery space protected, including the casing; provided that the above-mentioned percentages may be reduced to 35% and 30% respectively for cargo ships of less than 2000 gross tonnage; provided also that if two or more machinery spaces are not entirely separate they are to be considered as forming one space.

(3) When carbon dioxide is used as an extinguishing medium, for cargo pump-rooms in tankers, the quantity of carbon dioxide is to be sufficient to give a minim um volume of free gas equal to 45% of the gross volume of the cargo pump-rooms including the casing.

(4) For vehicle spaces and ro-ro spaces, which are not special category spaces and are capable of being sealed from a location outside of the cargo spaces, the quantity of carbon dioxide available is to be at least sufficient to give a minimum volume of free gas equal to 45% of the gross volume of the largest such cargo space which is capable of being sealed, and the arrangements are to be such as to ensure that at least two thirds of the gas required for the relevant space is to be introduced within 10 min. Carbon dioxide systems are not to be used for the protection of special category spaces.

(5) For the purpose of this paragraph the volume of free carbon dioxide is to be calculated at 0.56 m^3/kg.

(6) For machinery spaces the fixed piping system is to be such that 85% of the gas can be

discharged into the space within 2 min. For container and general cargo spaces (primarily intended to carry a variety of cargoes separately secured or packed) the fixed piping system is to be such that at least two thirds of the gas can be discharged into the space within 10 min. For solid bulk cargo spaces the fixed piping system is to be such that at least two thirds of the gas can be discharged into the space within 20 min. The system controls are to be arranged to allow one third, two thirds or the entire quantity of gas to be discharged based on the loading condition of the hold.

(7) Carbon dioxide systems for the protection of ro-ro spaces, container holds equipped with integral reefer containers, spaces accessible by doors or hatches, and other spaces in which persons normally work or to which they have access are to comply with the following requirements:

① two separate controls are to be provided for releasing carbon dioxide into a protected space and to ensure the activation of the alarm. One control is to be used for opening the valve of the piping which conveys the gas into the protected space and a second control is to be used to discharge the gas from its storage containers. Positive means are to be provided so they can only be operated in that order;

② the two controls are to be located inside a release box clearly identified for the particular space. If the box containing the controls is to be locked, a key to the box is to be in a break-glass-type enclosure conspicuously located adjacent to the box.

(8) Carbon dioxide bottles

① Carbon dioxide bottles are to be seamless steel bottles and are to be subjected to a hydraulic test with a pressure of 24.5 MPa. Each bottle is to be furnished with a certificate and to have on its body permanent identifications of weight, capacity, hydraulic test pressure, test date, serial number and inspection stamp.

②The bottles are to be wholly painted in red but white in way of the markings, and with yellow letter of "CO^2" for easy inspection.

③ The charging ratio for carbon dioxide bottles is not to be more than 0.67 kg per liter.

④ Bottle head valves are to be associated with steel or copper seamless tube having a diameter of 10 to 12 mm and snipped off at their lower end and terminated near the bottom of the bottles.

⑤ Bottle head valves are to be provided with safety diaphragms or other approved safety devices. The bursting pressure of the safety diaphragms is to be 18.6 ±1 MPa. After bursting of safety diaphragms, the escape gas is to be led to the open atmosphere through suitable piping. If the storage room for carbon dioxide bottles is well ventilated and temperature-reducing means are to be provided to maintain ambient temperature at not more than 45℃ (if fitted with temperature alarm devices), the discharge pipes may be exempted. This requirement is to also be met if other safety devices are used.

⑥ Bottle head valves are to be made of forged bronze, stainless steel or other suitable materials.

⑦ Carbon dioxide bottles are to be divided into groups according to the required quantity for different spaces to be protected. If releasing of the carbon dioxide is by hand-operated mechanical means, the number of bottles in each group is not to exceed 12.

(9) Carbon dioxide piping

① Each connection pipe led from each bottle head valve to the collecting pipe is to be provided with a non-return valve.

② The manifold connecting the collecting pipes and control valves is to be provided with a pressure gauge, the maximum range being 1.5 times of the working pressure.

③ The carbon dioxide piping, when led through the accommodation spaces, is to comply with the requirements of 1.4.1(2) of this Chapter, and is to avoid passing through the service spaces. If it is impracticable to avoid CO^2 piping passing through the service spaces, carbon dioxide piping within the service spaces is not to be fitted with detachable joints.

④ For the fixed piping system led to the machinery spaces of category A and cargo pump-rooms, the piping is to be of adequate size and provided with sufficient number of nozzles so that 85% of carbon dioxide can be discharged into the space within two minutes.

⑤ The diameter of carbon dioxide piping leading to the spaces mentioned in ④ above is to be determined in accordance with the proposed quantity conveyed by the piping. The

maximum quantity of carbon dioxide conveyed by the corresponding pipe diameters is given in Table 1.4.2(9)⑤.

⑥ The minimum wall thickness of carbon dioxide pipes is given in Table 1.4.2(9)⑥. Slight difference from the thickness listed in the table will be accepted for the purpose of selecting standard pipes.

⑦ Distribution pipes leading to cargo spaces are not to be less than 20 mm bore, and those leading to the nozzles are not to be less than 15 mm bore.

⑧ There are to be provided with compressed air cleaning connections at its manifold or control valves.

⑨ Carbon dioxide pipes are to be seamless steel pipes except connection pipes between bottle head valves and manifolds which may use flexible metal pipes complying with the recognized standards.

Maximum quantity of carbon dioxide conveyed by pipes **Table 1.4.2(9)⑤**

Internal diameter of pipes (mm)	Maximum quantity of carbon dioxide conveyed by the pipe (kg)	Internal diameter of pipes (mm)	Maximum quantity of carbon dioxide conveyed by the pipe (kg)
15	60	80	2400
20	100	90	3300
25	135	100	4750
32	275	114	6800
40	500	127	9500
50	1100	152	15250
65	1600		

Minimum wall thickness of carbon dioxide pipes **Table 1.4.2(9)⑥**

External diameter (mm)	Wall thickness(mm)	
	Piping forward of control valves	Piping after control valves
21.3～26.9	3.2	2.6
30.0～48.3	4.0	3.2
51.0～60.3	4.5	3.6
63.5～76.1	5.0	3.6
82.5～88.9	5.6	4.0
101.6	6.3	4.0
108.0～114.3	7.1	4.5
127.0	8.0	4.5
133.0～139.7	8.0	5.0
152.4～168.3	8.8	5.6

Notes: 1. Pipes are at least to be internally galvanized except for those installed in the engine room not required to be galvanized.
2. For threaded pipes, where allowed, the minimum thickness is to be measured at the bottom of the thread.
3. The external diameters and thicknesses have been selected from ISO Recommendations R 336 for welded and seamless steel pipes. Diameter and thickness in compliance with other national or international standards may also be accepted.
4. Minimum wall thickness of pipes with large diameter is subject to special consideration.
5. In general, minimum wall thickness is the nominal wall thickness and no allowance need be made for negative tolerance and reduction in thickness due to bending.

(10) Testing of carbon dioxide fire-extinguishing systems

① Carbon dioxide bottles and bottle head valves are to be subjected to a hydraulic test with a pressure of 24.5 MPa. Safety diaphragms are to be burst-tested in accordance with 1.4.2(8)

⑤ of this Chapter by selecting 10% at random.

② On completion of fitting the bottle head valves, carbon dioxide bottles are to be subjected to an air-tightness test in the workshop to a pressure equal to the design pressure of the bottle.

③ The pipes and valves of carbon dioxide piping systems are to be subjected to a hydraulic test with a pressure of at least 11.8 MPa for control valves and for pipes between bottle head valves and control valves, and 1 MPa for pipes between control valves and nozzles. The above test may be carried out in the workshop. On completion of installation on board, carbon dioxide piping is to be subjected to an air-tightness test with a pressure of at least 0.69 MPa with the discharge ends tightly closed.

④ On completion of installation on board, the carbon dioxide piping systems are to be function-tested with a pneumatical pressure not less than 2.47 MPa for checking the operation of releasing mechanism.

1.4.3 Low-pressure carbon dioxide systems

(1) The amount of carbon dioxide in the fire-extinguishing systems, time for releasing carbon dioxide in the protected spaces, the location of nozzles in the protected spaces and the alarm devices activated by the fire-extinguishing systems, etc. are to comply with the relevant requirements for high-pressure carbon dioxide systems specified in 1.4.2 of this Chapter.

(2) The vessels, refrigerating units, controls and other devices of the fire-extinguishing systems are to be located in the spaces complying with the requirements for high-pressure carbon dioxide systems specified in 1.4.2 of this Chapter.

(3) The system control devices and the refrigerating plants are to be located within the same room where the pressure vessels are stored.

(4) The rated amount of liquid carbon dioxide is to be stored in vessel(s) under the working pressure in the range of 1.8 to 2.2 MPa. The normal liquid charge in the container is to be limited to provide sufficient vapour space to allow for expansion of the liquid under the maximum storage temperatures than can be obtained corresponding to the setting of the pressure relief valves but is not to exceed 95% of the volumetric capacity of the container.

(5) Provision is to be made for:

① pressure gauge;

② high pressure alarm: not more than setting of the relief valve;

③ low pressure alarm: not less than 1.8 MPa;

④ branch pipes with stop valves for filling the vessel;

⑤ discharge pipes;

⑥ liquid CO^2 level indicator, fitted on the vessel(s);

⑦ two safety valves.

(6) The two safety relief valves are to be arranged so that either valve can be shut off while the other is connected to the vessel. The setting of the relief valves is not to be less than 1.1 times working pressure. The capacity of each valve is to be such that the vapours generated under fire condition can be discharged with a pressure rise not more than 20% above the setting pressure. The discharge from the safety valves is to be led to the open.

(7) The vessel(s) and outgoing pipes permanently filled with carbon dioxide are to have thermal insulation preventing the operation of the safety valve in 24 h after de-energizing the plant, at ambient temperature of 45℃ and an initial pressure equal to the starting pressure of the refrigeration unit.

(8) The vessel(s) are to be serviced by two automated completely independent refrigerating units solely intended for this purpose, each comprising a compressor and the relevant prime mover, evaporator and condenser.

(9) The refrigerating capacity and the automatic control of each unit are to be so as to maintain the required temperature under conditions of continuous operation during 24 h at sea temperatures up to 32℃ and ambient air temperatures up to 45℃.

(10) Each electric refrigerating unit is to be supplied from the main switchboard busbars by a separate feeder.

(11) Cooling water supply to the refrigerating plant (where required) is to be provided from at least two circulating pumps one of which being used as a stand-by. The stand-by pump may be a pump used for other services so long as its use for cooling would not interfere with any other

essential service of the ship. Cooling water is to be taken from not less than two sea connections, preferably one port and one starboard.
(12) Safety relief devices are to be provided in each section of pipe that may be isolated by block valves and in which there could be a build-up of pressure in excess of the design pressure of any of the components.
(13) Audible and visual alarms are to be given in a central control station or, in accordance with 4.6, Chapter 2-1 of this PART, where a central control station is not provided, when:

① the pressure in the vessel(s) reaches the low and high values according to 1.4.3(14) of this Chapter;

② any one of the refrigerating units fails to operate;

③ the lowest permissible level of the liquid in the vessels is reached.

(14) If the system serves more than one space, means for control of discharge quantities of CO^2 are to be provided, e.g. automatic timer or accurate level indicators located at the control position(s).
(15) If a device is provided which automatically regulates the discharge of the rated quantity of carbon dioxide into the protected spaces, it is to be also possible to regulate the discharge manually.

1.4.4 Steam systems

In general, the use of steam as a fire-extinguishing medium in fixed fire-extinguishing systems is not to be permitted. It may be used, subject to agreement, only in restricted areas as an addition to the required fire-extinguishing medium and with the provision that the boiler or boilers available for supplying steam are to have an evaporation of at least 1.0 kg of steam per hour for each 0.75 m^3 of the gross volume of the largest space so protected. In addition to complying with the foregoing requirements the systems in all respects are to comply with the relevant requirements of the Guidelines.

1.4.5 Other gas systems

(1) Where gas other than carbon dioxide or steam as permitted by 1.4.4 of this Chapter is produced on the ship and is used as a fire-extinguishing medium, it is to be a gaseous product of fuel combustion in which the oxygen content, the carbon monoxide content, the corrosive elements and any solid combustible elements have been reduced to a permissible minimum.
(2) Where such gas is used as the fire-extinguishing medium in a fixed fire-extinguishing system for the protection of machinery spaces, it is to afford protection equivalent to that provided by a fixed system using carbon dioxide as the medium.
(3) Where such gas is used as the fire-extinguishing medium in a fixed fire-extinguishing system for the protection of cargo spaces, a sufficient quantity of such gas is to be available to supply hourly a volume of free gas at least equal to 25% of the gross volume of the largest space protected in this way for a period of 72 h.

1.5 Fire extinguishers

1.5.1 Type and design

(1) All fire extinguishers, including spare ones, are to be of approved types and designs. Charges for fire extinguishers, including spare charges, are to be approved.
(2) Each powder or carbon dioxide extinguisher is to have a capacity of at least 5 kg and each foam extinguisher is to have a capacity of at least 9 *l*. The mass of all portable fire extinguishers is not to exceed 23 kg and they are to have a fire-extinguishing capability at least equivalent to that of a 9 *l* fluid extinguisher.
(3) The equivalents of fire extinguishers are to be confirmed.

1.5.2 Fire extinguishers containing an extinguishing medium which either by itself or under expected conditions of use gives off toxic gases in such quantities as to endanger persons are not to be permitted.

1.5.3 Arrangement of fire extinguishers

(1) Accommodation spaces, service spaces and control stations are to be provided with portable fire extinguishers of appropriate types and in sufficient number. Ships of 1000 gross tonnage and upwards are to carry at least five portable fire extinguishers.
(2) One of the portable fire extinguishers intended for use in any space is to be stowed near the entrance to that space.
(3) Carbon dioxide fire extinguishers are not to be placed in accommodation spaces. In control

stations and other spaces containing electrical or electronic equipment or appliances necessary for the safety of the ship, fire extinguishers are to be provided whose extinguishing media are neither electrically conductive nor harmful to the equipment and appliances.
(4) Fire extinguishers are to be situated ready for use at easily visible places, which can be reached quickly and easily at any time in the event of a fire, and in such a way that their serviceability is not impaired by the weather, vibration or other external factors. Portable fire extinguishers are to be provided with devices which indicate whether they have been used.
1.5.4 Spare charges
1.5.4.1 Spare charges are to be provided for 100% of the first ten extinguishers and 50% of the remaining fire extinguishers capable of being recharged on board. Not more than sixty total spare charges are required. Instructions for charging are to be carried on board.
1.5.4.2 For fire extinguishers which cannot be recharged on board, additional portable fire extinguishers of the same quantity, type, capacity and number as determined in 1.5.4(1) of this Chapter are to be provided in lieu of spare charges.
1.5.5 Portable foam applicators
(1) A portable foam applicator unit is to consist of a foam nozzle/branch pipe, either of a self-inducing type or in combination with a separate inductor, capable of being connected to the fire main by a fire hose, together with a portable tank containing at least 20 *l* of foam concentrate and at least one spare tank of foam concentrate of the same capacity.
(2) The nozzle/branch pipe and inductor are to be capable of producing effective foam suitable for extinguishing an oil fire, at a foam solution flow rate of at least 200 *l*/min at the nominal pressure in the fire main.
(3) Approved foam concentrates are to be used (reference may be made to the guidelines of the International Maritime Organization (IMO)[①].
(4) The values of the foam expansion and drainage time of the foam produced by the portable foam applicator unit are not to differ more than ±10% of that determined in (3) above.
(5) The portable foam applicator unit is to be designed to withstand clogging, ambient temperature changes, vibration, humidity, shock, impact and corrosion normally encountered on ships.

1.6 Fire-extinguishing arrangements in machinery spaces

1.6.1 Spaces containing oil-fired boilers or oil fuel units
(1) Machinery spaces of category A containing oil-fired boilers or oil fuel units are to be provided with any one of the following fixed fire-extinguishing systems:

① a gas system complying with the provisions of 1.4 of this Chapter;
② a high-expansion foam system complying with the provisions of 1.8 of this Chapter;
③ a pressure water-spraying system complying with the provisions of 1.9 of this Chapter.

In each case if the engine and boiler rooms are not entirely separate, or if fuel oil can drain from the boiler room into the engine-room, the combined engine and boiler rooms are to be considered as one compartment.
(2) There is to be in each boiler room at least one set of portable foam applicator units complying with the provisions of 1.5.5 of this Chapter. For passenger ships carrying less than 100 passengers, this requirement may be exempted.
(3) There are to be at least two portable foam extinguishers or equivalent in each firing space in each boiler room and in each space in which a part of the oil fuel installation is situated. There is to be not less than one approved large foam extinguisher of at least 135 *l* capacity or equivalent extinguisher in each boiler room. These extinguishers are to be provided with hoses on reels suitable for reaching any part of the boiler room. In the case of domestic boilers having an evaporating capacity of less than 175 kW (the evaporating capacity is 250 kg/h) in cargo ships, this requirement may be relaxed.
(4) In each firing space there is to be a receptacle not less than 0.28 m^3 containing sand, sawdust impregnated with soda, or other approved dry material. An approved portable extinguisher may be substituted as an alternative.
1.6.2 Machinery spaces of category A containing internal combustion machinery
(1) Machinery spaces of category A containing internal combustion machinery are to be provided

① Refer to the Revised Guidelines for the performance and testing criteria, and surveys of foam concentrates for fire extinguishing systems (MSC.1/Circ.1312).

with one of the fire-extinguishing systems required by 1.6.1(1) of this Chapter.
(2) At least one set of portable air-foam equipment complying with the provisions of 1.5.5 of this Chapter is to be provided. For passenger ships carrying less than 100 passengers, this requirement may be exempted.
(3) In each such space foam-type fire extinguishers, each of at least 45 *l* capacity or equivalent, sufficient in number to enable foam or its equivalent to be directed on to any part of the fuel and lubricating oil pressure systems, gearing and other fire hazards. For passenger ships carrying less than 100 passengers, one set is enough.
(4) In addition, there are to be provided a sufficient number of portable foam extinguishers or equivalent which are to be so located that no point in the space is more than 10 m walking distance from an extinguisher and that there are at least two such extinguishers in each such space. For smaller spaces of cargo ships, this requirement may be relaxed subject to agreement.
1.6.3 For passenger ships, each machinery space of category A is to be provided with at least two suitable water-fog applicators.
A water fog applicator might consist of a metal L-shaped pipe, the long limb being about 2 m in length capable of being fitted to a fire hose and the short limb being about 250 mm in length fitted with a fixed water fog nozzle or capable of being fitted with a water spray nozzle.
1.6.4 In spaces containing steam turbines (for main propulsion or other purposes), when such machinery has in the aggregate a total output of not less than 375 kW there are to be provided:
(1) approved foam fire extinguishers each of at least 45 *l* capacity or equivalent sufficient in number to enable foam or its equivalent to be directed on to any part of the pressure lubrication system, on to any part of the casings enclosing pressure lubricated parts of the turbines, engines or associated gearing, and any other fire hazards. However, such extinguishers are not to be required if equivalent protection is provided in such spaces by a fixed fire-extinguishing system fitted in compliance with 1.6.1(1) of this Chapter;
(2) a sufficient number of portable foam extinguishers or equivalent which are to be so located that no point in the space is more than 10 m walking distance from an extinguisher and that there are at least two such extinguishers in each such space, except that such extinguishers are not to be required in addition to any provided in compliance with 1.6.1(3) of this Chapter;
(3) one of the fire-extinguishing systems required by 1.6.1(1) of this Chapter, where such spaces are periodically unattended.
1.6.5 Passenger ships of class II carrying less than 500 persons and of less than 500 gross tonnage and tankers of less than 500 gross tonnage as well as passenger ships of class III carrying less than 500 persons and of more than 500 gross tonnage
(1) The engine and boiler rooms may be only provided with the water fire-extinguishing system as to substitute that required in 1.6.1(1) and 1.6.2(1) of this Chapter.
(2) The engine and boiler rooms are to be provided with the following fire-extinguishers as to substitute these required in 1.6.1(2), (3), (4) and 1.6.2(2), (3), (4) of this Chapter:

① a set of foam fire-extinguisher of at least 45 *l* capacity or equivalent comp lying with the requirements of 1.5.1(2) of this Chapter to enable foam or its equivalent to be directed on to any part of fire hazards;
② a receptacle containing sand, sawdust impregnated with soda or other approved dry material. An approved portable extinguisher may be substituted as an alternative.

1.6.6 Cargo ships of less than 1000 gross tonnage
(1) The engine and boiler rooms may be only provided with the water fire-extinguishing system as to substitute that required in 1.6.1(1) and 1.6.2(1) of this Chapter.
(2) The engine and boiler rooms are to be provided with the following fire-extinguishers as to substitute those required in 1.6.1(2), (3), (4) and 1.6.2(2), (3), (4) of this Chapter:

① a set of foam fire-extinguisher of at least 45 *l* capacity or equivalent comp lying with the requirements of 1.5.1(2) of this Chapter, to enable foam or its equivalent to be directed on to any part of fire hazards. For cargo ships of less than 500 gross tonnage, this requirement may be substituted by two approved portable fire extinguishers;
② a receptacle containing sand, sawdust impregnated with soda or other approved dry material. An approved portable extinguisher may be substituted as an alternative.

1.6.7 Fire-extinguishing appliances in other machinery spaces
Where a fire hazard exists in any machinery space, there are to be provided in, or adjacent to, that space a sufficient number of approved portable fire-extinguishers or other means of fire extinction.

1.6.8 For passenger ships of class III carrying less than 500 persons and of less than 500 gross tonnage, the machinery spaces are to be provided with at least three approved portable fire extinguishers.

1.7 Fixed fire-extinguishing systems

1.7.1 Types of fixed fire-extinguishing systems

(1) A fixed fire-extinguishing system required by this Chapter may be any of the following systems:

① a gas system complying with the provisions of 1.4 of this Chapter;

② a high-expansion foam system complying with the provisions of 1.8 of this Chapter;

③ a pressure water-spraying system complying with the provisions of 1.9 of this Chapter.

(2) Where a fixed fire-extinguishing system not required by this chapter is installed, it is to meet the requirements of the relevant Guidelines of this chapter or refer to the requirements of the guidelines of the International Maritime Organization (IMO)[①].

(3) Fire-extinguishing systems using Halon 1211, 1301, and 2402 and perfluorocarbons are to be prohibited.

(4) In general, the use of steam as a fire-extinguishing medium in fixed fire-extinguishing systems is not to be permitted. Where the use of steam is permitted, it is to be used only in restricted areas as an addition to the required fire-extinguishing system and is to comply with the relevant Guidelines of this chapter.

1.7.2 Water pumps for other fire-extinguishing systems

Pumps, other than those serving the fire main, required for the provision of water for fire-extinguishing systems required by this chapter, their sources of power and their controls are to be installed outside the space or spaces protected by such systems and are to be so arranged that a fire in the space or spaces protected will not put any such system out of action.

1.8 Fixed foam fire-extinguishing systems

1.8.1 This paragraph details the specifications for fixed foam fire-extinguishing systems for the protection of machinery spaces in accordance with 1.6.1(1)② of this Chapter, cargo spaces in accordance with 2.1.3, cargo pump-rooms in accordance with 3.9.2 and vehicle, special category and ro-ro spaces in accordance with 4.15.

1.8.2 Definitions

1.8.2.1 *Design filling rate* is at least the minimum nominal filling rate used during the approval tests.

1.8.2.2 *Foam* is the extinguishing medium produced when foam solution passes through a foam generator and is mixed with air.

1.8.2.3 *Foam solution* is a solution of foam concentrate and water.

1.8.2.4 *Foam concentrate* is a liquid which, when mixed with water in the appropriate concentration forms a foam solution.

1.8.2.5 *Foam delivery ducts* are supply ducts for introducing high-expansion foam into the protected space from foam generators located outside the protected space.

1.8.2.6 *Foam mixing ratio* is the percentage of foam concentrate mixed with water forming the foam solution.

1.8.2.7 *Foam generators* are discharge devices or assemblies through which high-expansion foam solution is aerated to form foam that is discharged into the protected space. Foam generators using inside air typically consist of a nozzle or set of nozzles and a casing. The casing is typically made of perforated steel/stainless steel plates shaped into a box that enclose the nozzle(s). Foam generators using outside air typically consist of nozzles enclosed within a casing that spray onto a screen. An electric, hydraulic or pneumatically driven fan is provided to aerate the solution.

1.8.2.8 *High-expansion foam fire-extinguishing systems* are fixed total flooding extinguishing systems that use either inside air or outside air for aeration of the foam solution. A high-expansion foam system consists of both the foam generators and the dedicated foam concentrate approved during the fire testing specified in 1.8.3.1(3).

1.8.2.9 *Inside air foam system* is a fixed high-expansion foam fire-extinguishing system with

---

① Such as the Revised Guidelines for the approval of fixed aerosol fire-extinguishing systems equivalent to fixed gas fire-extinguishing systems, as referred to in SOLAS 74, for machinery spaces (MSC.1/Circ.1270).

foam generators located inside the protected space and drawing air from that space.

1.8.2.10 *Nominal flow rate* is the foam solution flow rate expressed in *l*/min.

1.8.2.11 *Nominal application rate* is the nominal flow rate per area expressed in *l*/min/m^2.

1.8.2.12 *Nominal foam expansion ratio* is the ratio of the volume of foam to the volume of foam solution from which it was made, under non-fire conditions, and at an ambient temperature of e.g. around 20 ℃.

1.8.2.13 *Nominal foam production* is the volume of foam produced per time unit, i.e. nominal flow rate times nominal foam expansion ratio, expressed in m^3/min.

1.8.2.14 *Nominal filling rate* is the ratio of nominal foam production to the area, i.e. expressed in m^2/min.

1.8.2.15 *Nominal filling time* is the ratio of the height of the protected space to the nominal filling rate, i.e. expressed in minutes.

1.8.2.16 *Outside air foam system* is a fixed high-expansion foam system with foam generators installed outside the protected space that are directly supplied with fresh air.

1.8.3 Fixed high-expansion foam fire-extinguishing systems

1.8.3.1 Principal performance

(1) The system is to be capable of manual release, and is to be designed to produce foam at the required application rate within 1 minute of release. Automatic release of the system is not to be permitted unless appropriate operational measures or interlocks are provided to prevent any local application systems from interfering with the effectiveness of the system.

(2) The foam concentrates are to be approved based on the guidelines developed by IMO①. Different foam concentrate types are not to be mixed in a high-expansion foam system.

(3) The system is to be capable of fire extinction and manufactured and tested based on the guidelines developed by IMO②.

(4) The system and its components are to be suitably designed to withstand ambient temperature changes, vibration, humidity, shock, clogging and corrosion normally encountered on ships. Piping, fittings and related components inside the protected spaces (except gaskets) are to be designed to withstand 925 ℃.

(5) System piping, foam concentrate storage tanks, components and pipe fittings in contact with the foam concentrate are to be compatible with the foam concentrate and be constructed of corrosion resistant materials such as stainless steel, or equivalent. Other system piping and foam generators are to be full galvanized steel or equivalent. Distribution pipework is to have self-draining capability.

(6) Means for testing the operation of the system and assuring the required pressure and flow are to be provided by pressure gauges at both inlets (water and foam concentrate supply) and at the outlet of the foam proportioner. A test valve is to be installed on the distribution piping downstream of the foam proportioner, along with orifices which reflect the calculated pressure drop of the system. All sections of piping are to be provided with connections for flushing, draining and purging with air. All nozzles are to be able to be removed for inspection in order to prove clear of debris.

(7) Means are to be provided for the crew to safely check the quantity of foam concentrate and take periodic control samples for foam quality.

(8) Operating instructions for the system are to be displayed at each operating position.

(9) Spare parts are to be provided based on the manufacturer's instruction.

(10) If an internal combustion engine is used as a prime mover for the seawater pump for the system, the fuel oil tank to the prime mover is to contain sufficient fuel to enable the pump to run on full load for at least 3 h and sufficient reserves of fuel are to be available outside the machinery space of category A to enable the pump to be run on full load for an additional 15 h. If the fuel tank serves other internal combustion engines simultaneously, the total fuel tank capacity is to be adequate for all connected engines.

(11) The arrangement of foam generators and piping in the protected space are not to interfere with access to the installed machinery for routine maintenance activities.

(12) The system source of power supply, foam concentrate supply and means of controlling the system are to be readily accessible and simple to operate, and are to be arranged at positions

---

① Refer to the Guidelines for the performance and testing criteria and surveys of high-expansion foam concentrates for fixed fire-extinguishing systems (MSC/Circ.670).

② Refer to the Guidelines for the approval of fixed high-expansion foam systems (MSC.1/Circ.1384).

outside the protected space not likely to be cut off by a fire in the protected space. All electrical components directly connected to the foam generators are to have at least an IP 54 rating.
(13) The piping system is to be sized in accordance with a hydraulic calculation technique① to ensure availability of flows and pressures required for correct performance of the system.
(14) The arrangement of the protected spaces is to be such that they may be ventilated as the space is being filled with foam. Procedures are to be provided to ensure that upper level dampers, doors and other suitable openings are kept open in case of a fire. For inside air foam systems, spaces below 500 m^3 need not comply with this requirement.
(15) Onboard procedures are to be established to require personnel re-entering the protected space after a system discharge to wear breathing apparatus to protect them from oxygen deficient air and products of combustion entrained in the foam blanket.
(16) Installation plans and operating manuals are to be supplied to the ship and be readily available on board. A list or plan is to be displayed showing spaces covered and the location of the zone in respect of each section. Instructions for testing and maintenance are to be available on board.
(17) All installation, operation and maintenance instructions/plans for the system are to be in the working language of the ship. If the working language of the ship is not English, French, nor Spanish, a translation into one of these languages is to be included.
(18) The foam generator room is to be ventilated to protect against overpressure, and is to be heated to avoid the possibility of freezing.
(19) The quantity of foam concentrate available is to be sufficient to produce a volume of foam equal to at least five times the volume of the largest protected space enclosed by steel bulkheads, at the nominal expansion ratio, or enough for 30 min of full operation for the largest protected space, whichever is greater.
(20) Machinery spaces, cargo pump-rooms, vehicle spaces, ro-ro spaces and special category spaces are to be provided with audible and visual alarms within the protected space warning of the release of the system. The alarms are to operate for the length of time needed to evacuate the space, but in no case less than 20 s.

1.8.3.2 Inside air foam systems

(1) Systems for the protection of machinery spaces and cargo pump-rooms

① The system is to be supplied by both main and emergency sources of power. The emergency power supply is to be provided from outside the protected space.

② Sufficient foam-generating capacity is to be provided to ensure the minimum design filling rate for the system is met and in addition is to be adequate to completely fill the largest protected space within 10 min.

③ The arrangement of foam generators is in general to be designed based on the approval test results. A minimum of two generators are to be installed in every space containing combustion engines, boilers, purifiers, and similar equipment. Small workshops and similar spaces may be covered with only one foam generator.

④ Foam generators are to be uniformly distributed under the uppermost ceiling in the protected spaces including the engine casing. The number and location of foam generators are to be adequate to ensure all high risk areas are protected in all parts and at all levels of the spaces. Extra foam generators may be required in obstructed locations. The foam generators are to be arranged with at least 1 m free space in front of the foam outlets, unless tested with less clearance. The generators are to be located behind main structures, and above and away from engines and boilers in positions where damage from an explosion is unlikely.

(2) Systems for the protection of vehicle, ro-ro, special category and cargo spaces

① The system is to be supplied by the ship's main power source. An emergency power supply is not required.

---

① Where the Hazen-Williams method is used, the following values of the friction factor C for different pipe types which may be considered should apply:

Pipe type	C
Black or galvanized mild steel	100
Copper or copper alloys	150
Stainless steel	150

② Sufficient foam-generating capacity is to be provided to ensure the minimum design filling rate for the system is met and in addition is to be adequate to completely fill the largest protected space within 10 min. However, for systems protecting vehicle and ro-ro spaces and special category spaces, with decks that are reasonably gas-tight and that have a deck height of 3 m or less, the filling rate is to be not less than two thirds of the design filling rate and in addition sufficient to fill the largest protected space within 10 min.

③ The system may be divided into sections, however, the capacity and design of the system are to be based on the protected space demanding the greatest volume of foam. Adjacent protected spaces need not be served simultaneously if the boundaries between the spaces are "A" class divisions.

④ The arrangement of foam generators is in general to be designed based on the approval test results. The number of generators may be different, but the minimum design filling rate determined during approval testing is to be provided by the system. A minimum of two generators are to be installed in every space. The foam generators are to be arranged to uniformly distribute foam in the protected spaces, and the layout is to take into consideration obstructions that can be expected when cargo is loaded on board. As a minimum, generators are to be located on every second deck, including movable decks. The horizontal spacing of the generators is to ensure rapid supply of foam to all parts of the protected space. This is to be established on the basis of full scale tests.

⑤ The foam generators are to be arranged with at least 1 m free space in front of the foam outlets, unless tested with less clearance.

1.8.3.3 Outside air foam systems

(1) Systems for the protection of machinery spaces and cargo pump-rooms

① The system is to be supplied by both main and emergency sources of power. The emergency power supply is to be provided from outside the protected machinery space.

② Sufficient foam-generating capacity is to be provided to ensure the minimum design filling rate for the system is met and in addition is to be adequate to completely fill the largest protected space within 10 min.

③ The arrangement of foam delivery ducts is in general to be designed based on the approval test results. The number of ducts may be different, but the minimum design filling rate determined during approval testing is to be provided by the system. A minimum of two ducts are to be installed in every space containing combustion engines, boilers, purifiers, and similar equipment. Small workshops and similar spaces may be covered with only one duct.

④ Foam delivery ducts are to be uniformly distributed under the uppermost ceiling in the protected spaces including the engine casing. The number and location of ducts are to be adequate to ensure all high risk areas are protected in all parts and at all levels of the spaces. Extra ducts may be required in obstructed locations. The ducts are to be arranged with at least 1 m free space in front of the foam delivery ducts, unless tested with less clearance. The ducts are to be located behind main structures, and above and away from engines and boilers in positions where damage from an explosion is unlikely.

⑤ The arrangement of the foam delivery ducts is to be such that a fire in the protected space will not affect the foam-generating equipment. If the foam generators are located adjacent to the protected space, foam delivery ducts are to be installed to allow at least 450 mm of separation between the generators and the protected space, and the separating divisions are to be class "A-60" rated. Foam delivery ducts are to be constructed of steel having a thickness of not less than 5 mm. In addition, stainless steel dampers (single or multi-bladed) with a thickness of not less than 3 mm are to be installed at the openings in the boundary bulkheads or decks between the foam generators and the protected space. The dampers are to be automatically operated (electrically, pneumatically or hydraulically) by means of remote control of the foam generator related to them, and arranged to remain closed until the foam generators begin operating.

⑥ The foam generators are to be located where an adequate fresh air supply can be arranged.

(2) Systems for the protection of vehicle and ro-ro spaces and special category and cargo spaces

① The system is to be supplied by the ship's main power source. An emergency power supply is not required.

② Sufficient foam-generating capacity is to be provided to ensure the minimum design filling rate for the system is met and in addition is to be adequate to completely fill the largest protected space within 10 min. However, for systems protecting vehicle and ro-ro spaces and special category spaces, with decks that are reasonably gas-tight and that have a deck height of 3 m or less, the filling rate is to be not less than two thirds of the design filling rate and in addition sufficient to fill the largest protected space within 10 min.

③ The system may be divided into sections, however, the capacity and design of the system are to be based on the protected space demanding the greatest volume of foam. Adjacent protected spaces need not be served simultaneously if the boundaries between the spaces are "A" class divisions.

④ The arrangement of foam delivery ducts is to in general be designed based on the approval test results. The number of ducts may be different, but the minimum design filling rate determined during approval testing is to be provided by the system. A minimum of two ducts are to be installed in every space. The foam generators are to be arranged to uniformly distribute foam in the protected spaces, and the layout is to take into consideration obstructions that can be expected when cargo is loaded on board. As a minimum, ducts are to be led to every second deck, including movable decks. The horizontal spacing of the ducts is to ensure rapid supply of foam to all parts of the protected space. This is to be established on the basis of full scale tests.

⑤ The system is to be arranged with at least 1 m free space in front of the foam outlets, unless tested with less clearance.

⑥ The arrangement of the foam delivery ducts is to be such that a fire in the protected space will not affect the foam-generating equipment. If the foam generators are located adjacent to the protected space, foam delivery ducts are to be installed to allow at least 450 mm of separation between the generators and the protected space, and the separating divisions are to be class "A-60" rated. Foam delivery ducts are to be constructed of steel having a thickness of not less than 5 mm. In addition, stainless steel dampers (single or multi-bladed) with a thickness of not less than 3 mm are to be installed at the openings in the boundary bulkheads or decks between the foam generators and the protected space. The dampers are to be automatically operated (electrically, pneumatically or hydraulically) by means of remote control of the foam generator related to them, and arranged to remain closed until the foam generators begin operating.

⑦ The foam generators are to be located where an adequate fresh air supply can be arranged.

1.8.3.4 Installation testing requirements

(1) After installation, the pipes, valves, fittings and assembled systems are to be tested, including functional testing of the power and control systems, water pumps, foam pumps, valves, remote and local release stations and alarms. Flow at the required pressure is to be verified for the system using orifices fitted to the test line. In addition, all distribution piping is to be flushed with freshwater and blown through with air to ensure that the piping is free of obstructions.

(2) Functional tests of all foam proportioners or other foam mixing devices are to be carried out to confirm that the mixing ratio tolerance is within +30 to -0% of the nominal mixing ratio defined by the system approval. For foam proportioners using foam concentrates of Newtonian type with kinematic viscosity equal to or less than 100 cSt at 0℃ and density equal to or less than 1,100 kg/m^3, this test can be performed with water instead of foam concentrate. Other arrangements are to be tested with the actual foam concentrate.

1.8.3.5 Systems using outside air with generators installed inside the protected space

Systems using outside air but with generators located inside the protected space and supplied by fresh air ducts may be accepted provided that these systems have been shown to have performance and reliability equivalent to systems defined in 1.8.3.3 of this Chapter. For acceptance, the following minimum design features should be considered:

(1) lower and upper acceptable air pressure and flow rate in supply ducts;

(2) function and reliability of damper arrangements;

(3) arrangements and distribution of air delivery ducts including foam outlets; and

(4) separation of air delivery ducts from the protected space.

1.8.4 Fixed low-expansion foam fire-extinguishing systems

1.8.4.1 Quantity and foam concentrates

(1) The foam concentrates of low-expansion foam fire-extinguishing systems are to be approved

based on the guidelines developed by IMO[①]. Different foam concentrate types are not to be mixed in a low-expansion foam system. Foam concentrates of the same type from different manufacturers are not to be mixed unless they are approved for compatibility.
(2) The system is to be capable of discharging through fixed discharge outlets, in no more than 5 min, a quantity of foam sufficient to produce an effective foam blanket over the largest single area over which oil fuel is liable to spread.
1.8.4.2 Installation requirements
(1) Means are to be provided for effective distribution of the foam through a permanent system of piping and control valves or cocks to suitable discharge outlets, and for the foam to be effectively directed by fixed sprayers onto other main fire hazards in the protected space. The means for effective distribution of the foam are to be proven acceptable through calculation or by testing.
(2) The means of control of any such systems are to be readily accessible and simple to operate and are to be grouped together in as few locations as possible at positions not likely to be cut off by a fire in the protected space.

1.9 Fixed pressure water-spraying fire-extinguishing systems

1.9.1 Application
Unless specified otherwise, the fixed pressure water-spraying fire-extinguishing systems required by this Chapter are to comply with the relevant provisions of this paragraph.
1.9.2 Engineering specifications
1.9.2.1 Fixed pressure water-spraying fire-extinguishing systems
Fixed pressure water-mist fire-extinguishing systems for machinery spaces and cargo pump-rooms are to be approved based on the guidelines developed by IMO[②].
1.9.2.2 Fixed water-based fire-fighting systems for ro-ro spaces, vehicle spaces and special category spaces
Fixed water-based fire-fighting systems for ro-ro spaces, vehicle spaces and special category spaces are to be approved based on guidelines developed by IMO[③].

1.10 Special arrangements in machinery spaces

1.10.1 The following provisions are to apply to machinery spaces of category A and, to other machinery spaces where considered necessary.
1.10.2 For passenger ships of class II and III
(1) The arrangements of skylights, etc. are to be as follows:
① the number of skylights, doors, ventilators, openings in funnels to permit exhaust ventilation and other openings to machinery spaces is to be reduced to a minimum consistent with the needs of ventilation and the proper and safe working of the ship;
② skylights are to be of steel and are not to contain glass panels. Other equivalent means may be substituted as an alternative. Suitable arrangements are to be made to permit the release of smoke, in the event of fire, from the space to be protected;
③ doors other than power-operated watertight doors are to be so arranged that positive closure is assured in case of fire in the space, by power-operated closing arrangements or by the provision of self-closing doors capable of closing against an inclination of 3.5° opposing closure and having a fail-safe hook-back facility, provided with a remotely operated release device;
④ windows are not to be fitted in machinery space boundaries. This does not preclude the use of glass in control rooms within the machinery spaces.
(2) Means of control are to be provided for:
① opening and closure of skylights, closure of openings in funnels which normally allow exhaust ventilation, and closure of ventilator dampers;
② permitting the release of smoke;

---

① Refer to the Revised Guidelines for the performance and testing criteria, and surveys of foam concentrates for fire extinguishing systems (MSC.1/Circ.1312) of IMO.
② Refer to the Revised Guidelines for the approval of equivalent water-based fire-extinguishing systems for machinery spaces and cargo pump-rooms (MSC.1/Circ.1165) of IMO.
③ Refer to the Revised guidelines for approval of fixed water-based fire-fighting systems for ro-ro spaces and special category spaces (MSC.1/Circ.1430) of IMO.

③ closing power-operated doors or actuating release mechanism on doors other than power-operated watertight doors;
④ stopping ventilating fans;
⑤ stopping forced and induced draught fans, oil fuel transfer pumps, oil fuel unit pumps and other similar fuel pumps.

(3) The controls required in (2) above and 1.15.1(2)⑤ of this Chapter are to be located outside the space concerned, where they will not be cut off in the event of fire in the space they serve. Such controls and the controls for any required fire-extinguishing system are to be situated at one control position or grouped in as few positions as possible. Such positions are to have a safe access from the open deck.

(4) When access to any machinery space of category A is provided at a low level from an adjacent shaft tunnel, there is to be provided in the shaft tunnel, near the watertight door, a light steel fire-screen door operable from each side.

(5) For periodically unattended machinery spaces, the requirements for fire integrity of the machinery spaces, the location and centralization of the fire-extinguishing system controls, the required shutdown arrangements (e.g. ventilation, fuel pumps, etc.) are to be at least equivalent to those of machinery spaces normally attended.

(6) A fixed fire detection and alarm system complying with 1.12 of this Chapter is to be fitted in any machinery space:

① where the installation of automatic and remote control systems and equipment has been approved in lieu of continuous manning of the space;
② where the main propulsion and associated machinery including sources of main electrical supply are provided with various degrees of automatic or remote control and are under continuous manned supervision from a control room;
③ enclosed spaces containing incinerators.

1.10.3 Cargo ships of 1000 gross tonnage and upwards and tankers of 500 gross tonnage and upwards

(1) Control facilities from outside machinery spaces and cargo spaces are to be provided to stop using ventilating fans and close any access, ventilators and openings in funnels or other openings in the event of fire.

(2) The number of skylights, doors, ventilators, openings in funnels to permit exhaust ventilation and other openings to machinery spaces is to be reduced to a minimum consistent with the needs of ventilation and the proper and safe working of the ship. Skylights are to be of steel and are not to contain glass panels. Other equivalent means may be substituted as an alternative. Suitable arrangements are to be made to permit the release of smoke, in the event of fire, from the space to be protected.

(3) Forced or induced draught fans, oil fuel transfer pumps, oil fuel unit pumps and other similar fuel pumps are to be provided with remote control equipment to stop fans or pumps in the event of fire.

(4) For periodically unattended machinery spaces of cargo ships (including tankers), fire integrity of the machinery spaces, the location and centralization of the fire-extinguishing system controls, the required shutdown arrangements (e.g. ventilation, fuel pumps, etc.) are to be specially considered and additional fi re-extinguishing appliances and other fire-fighting equipment and breathing apparatus may be required.

(5) A fixed fire detection and alarm system complying with 1.12 of this Chapter is to be fitted in any machinery space:

① where the installation of automatic and remote control systems and equipment has been approved in lieu of continuous manning of the space;
② where the main propulsion and associated machinery including sources of main electrical supply are provided with various degrees of automatic or remote control and are under continuous manned supervision from a control room;
③ enclosed spaces containing incinerators.

1.10.4 Cargo ships of less than 1000 gross tonnage and tankers of less than 500 gross tonnage

(1) The number of skylights, doors, ventilators, openings in funnels to permit exhaust ventilation and other openings to machinery spaces is to be reduced to a minimum consistent with the needs of ventilation and the proper and safe working of the ship.

(2) Means required in 1.10.2(2)①, ④ and ⑤ of this Chapter are to be provided.
(3) Skylights are to be of steel and are not to contain glass panels. Other equivalent means may be substituted as an alternative.

1.11 Automatic sprinkler, fire detection and fire alarm systems

1.11.1 General requirements

(1) Any required automatic sprinkler, fire detection and fire alarm system are to be capable of immediate operation at all times and no action by the crew is to be necessary to set it in operation. It is to be of the wet pipe type but small exposed sections may be of the dry pipe type subject to agreement where this is a necessary precaution. Any parts of the system which may be subjected to freezing temperatures in service are to be suitably protected against freezing. It is to be kept charged at the necessary pressure and is to have provision for a continuous supply of water as required.
(2) Each section of sprinklers is to include means for giving a visual and audible alarm signal automatically at one or more indicating units whenever any sprinkler comes into operation. Such alarm systems are to be such as to indicate if any fault occurs in the system.

① In passenger ships such units are to give an indication of any fire and its location in any space served by the system and are to be centralized on the navigation bridge or in the main fire control station, which are to be so manned or equipped as to ensure that any alarm from the system is immediately received by a responsible member of the crew.

② In cargo ships such units are to indicate in which section served by the system fire has occurred and are to be centralized on the navigation bridge and in addition, visible and audible alarms from the unit are to be placed in a position other than on the navigation bridge, so as to ensure that the indication of fire is immediately received by the crew.

(3) The sprinkler system is to have a connection from the ship's fire main in way of a lockable screw-down non-return valve at the connection which will prevent a backflow from the sprinkler system to the fire main.

1.11.2 Sprinkler

(1) Sprinklers are to be grouped into separate sections, each of which is to contain not more than 200 sprinklers. In passenger ships any section of sprinklers is not to serve more than two decks and is not to be situated in more than one main vertical zone. However, such a section of sprinklers may be permitted to serve more than two decks or be situated in more than one main vertical zone, if the protection of the ship against fire will not thereby be reduced.
(2) Each section of sprinklers is to be capable of being isolated by one stop valve only. The stop valve in each section is to be readily accessible and its location is to be clearly and permanently indicated. Means are to be provided to prevent the operation of the stop valves by any unauthorized person.
(3) A gauge indicating the pressure in the system is to be provided at each section stop valve and at a central station.
(4) The sprinklers are to be resistant to corrosion by marine atmosphere. In accommodation and service spaces the sprinklers are to come into operation within the temperature range from 68℃ to 79℃, except that in locations such as drying rooms, where high ambient temperature might be expected, the operating temperature may be increased by not more than 30℃ above the maximum deckhead temperature.
(5) A list or plan is to be displayed at each indicating unit showing the spaces covered and the location of the zone in respect of each section. Suitable instructions for testing and maintenance are to be available.
(6) Sprinklers are to be placed in an overhead position and spaced in a suitable pattern to maintain an average application rate of not less than 5 l/m^2 per minute over the nominal area covered by the sprinklers. For this purpose, nominal area is to be taken as the gross horizontal projection of the area to be covered. However, the use of sprinklers providing such an alternative amount of water suitably distributed may be permitted as has been shown to be not less effective.

1.11.3 Pressure tank

(1) A pressure tank having a volume equal to at least twice that of the charge of water specified below is to be provided. The tank is to contain a standing charge of fresh water, equivalent to the amount of water which would be discharged in one minute by the pump referred to in 1.11.4(2) of this Chapter, and the arrangements are to provide for maintaining an air pressure in the tank such

as to ensure that where the standing charge of fresh water in the tank has been used the pressure will be not less than the working pressure of the sprinkler, plus the pressure exerted by a head of water measured from the bottom of the tank to the highest sprinkler in the system. Suitable means of replenishing the air under pressure and of replenishing the fresh water charge in the tank are to be provided. A glass gauge is to be provided to indicate the correct level of the water in the tank.
(2) Means are to be provided to prevent the passage of seawater into the tank.

1.11.4 Water supply pumps and their arrangements

(1) An independent power pump is to be provided solely for the purpose of continuing automatically the discharge of water from the sprinklers. The pump is to be brought into action automatically by the pressure drop in the system before the standing fresh water charge in the pressure tank is completely exhausted.
(2) The pump and the piping system are to be capable of maintaining the necessary pressure at the level of the highest sprinkler to ensure a continuous output of water sufficient for the simultaneous coverage of a minimum area of 280 m^2 at the application rate specified in 1.11.2(6) of this Chapter.
(3) The pump is to have fitted on the delivery side a test valve with a short open-ended discharge pipe. The effective area through the valve and pipe is to be adequate to permit the release of the required pump output while maintaining the pressure in the system specified in 1.11.3(1) of this Chapter.
(4) The sea inlet to the pump is wherever possible to be in the space continuing the pump and is to be so arranged that when the ship is afloat it will not be necessary to shut off the supply of seawater to the pump for any purpose other than the inspection or repair of the pump.
(5) The sprinkler pump and tank are to be situated in a position reasonably remote from any machinery space of category A and are not to be situated in any space required to be protected by the sprinkler system.

1.11.5 Sources of power supply in passenger ships

(1) There are to be not less than two sources of power supply for the seawater pump and automatic alarm and detection system.
(2) Where the sources of power for the pump are electrical, these are to be a main generator and an emergency source of power. An automatic change-over switch is to be situated near the sprinkler pump so that upon failure of that supply it will automatically change over to the supply from the emergency switchboard. The switches on the main switchboard and the emergency switchboard are to be clearly labeled.
(3) Automatic fire detection and fire alarm systems are to be supplied by main and emergency sources of power.
(4) Where one of the sources of power for the pump is an internal combustion engine it is, in addition to complying with the provisions of 1.11.4(5) of this Chapter, to be so situated that a fire in any protected space will not affect the air supply to the machinery.

1.11.6 Sources of power supply in cargo ships

(1) Where the sources of power for the seawater pump are electrical, these is to be a main source of power.
(2) Automatic fire detection and fire alarm systems are to be supplied by main and emergency sources of power.
(3) Where one of the sources of power for the pump is an internal combustion engine it is to, in addition to complying with the provisions of 1.11.4(5) of this Chapter, be so situated that a fire in any protected space will not affect the air supply to the machinery.

1.11.7 Testing

(1) A test valve is to be provided for testing the automatic alarm for each section of sprinklers by a discharge of water equivalent to the operation of one sprinkler. The test valve for each section is to be situated near the stop valve f or that section.
(2) Means are to be provided for testing the automatic operation of the pump on reduction of pressure in the system.
(3) Switches are to be provided at one of the indicating positions referred to in 1.11.1(2) of this Chapter which will enable the alarm and the indicators for each section of sprinklers to be tested.

1.12 Fixed fire detection and fire alarm systems

1.12.1 General requirements

(1) Any required fixed fire detection and fire alarm system with manually operated call points are to be capable of immediate operation at all times.
(2) Power supplies and electric circuits necessary for the operation of the system are to be monitored for loss of power or fault conditions as appropriate. Occurrence of a fault condition is to initiate a visual and audible fault signal at the control panel which is to be distinct from a fire signal.
(3) There are to be not less than two sources of power supply for the electrical equipment used in the operation of the fire detection and fire alarm system, one of which is to be an emergency source. The supply is to be provided by separate feeders reserved solely for that purpose. Such feeders are to run to an automatic change-over switch situated in or adjacent to the control panel for the fire detection system. The main (respective emergency) feeder is to run from the main (respective emergency) switchboard to the change-over switch without passing through any other distributing switchboard. The changeover switch is to be arranged such that a fault will not result in the loss of both power supplies.
(4) The operation of the automatic changeover switch or a failure of one of the power supplies is not to result in loss of fire detection capability. Where a momentary loss of power would cause degradation of the system, a battery of adequate capacity is to be provided to ensure continuous operation during changeover.
(5) Detectors and manually operated call points are to be grouped into sections. The activation of any detector or manually operated call point is to initiate a visual and audible fire signal at the control panel and indicating units. If the signals have not received attention within 2 min an audible alarm is to be automatically sounded throughout the crew accommodation and service spaces, control stations and machinery spaces of category A. This alarm sounder system need not be an integral part of the detection system.
(6) The emergency source of power specified in (3) above may be supplied by accumulator batteries or from the emergency switchboard. The power source is to be sufficient to maintain the operation of the fire detection and fire alarm system for the periods required under chapter II-1, Guidelines 42 and 43, of the Convention and, at the end of that period, is to be capable of operating all connected visual and audible fire alarm signals for a period of at least 30 min.
(7) Where the system is supplied from accumulator batteries, they are to be located in or adjacent to the control panel for the fire detection system, or in another location suitable for use in an emergency. The rating of the battery charge unit is to be sufficient to maintain the normal output power supply to the fire detection system while recharging the batteries from a fully discharged condition.
(8) The control panel is to be located on the navigation bridge or in the main fire control station.
(9) Indicating units are to, as a minimum, denote the section in which a detector or manually operated call point has operated. At least one unit is to be so located that it is easily accessible to responsible members of the crew at all times, when at sea or in port, except when the ship is out of service. One indicating unit is to be located on the navigation bridge if the control panel is located in the main fire control station. With a cargo control room, an additional indicating unit is to be located in the cargo control room.
(10) Clear information is to be displayed on or adjacent to each indicating unit about the spaces covered and the location of the sections.
(11) Where the fire detection system does not include means of remotely identifying each detector individually, no section covering more than one deck within accommodation, service and control stations is normally to be permitted except a section which covers an enclosed stairway. In order to avoid delay in identifying the source of fire, the number of enclosed spaces included in each section is to be limited subject to agreement. In no case are more than 50 enclosed spaces to be permitted in any section. If the fire detection system is fitted with remotely and individually identifiable fire detectors, the sections may cover several decks and serve any number of enclosed spaces.
(12) In passenger ships, if there is no fire detection system capable of remotely and individually identifying each detector, a section of detectors is not to serve spaces on both sides of the ship nor on more than one deck and neither is it to be situated in more than one main vertical zone except that, if the protection of the ship against fire will not thereby be reduced, such a section of detectors to serve both sides of the ship and more than one deck may be permitted. In passenger ships fitted with individually identifiable fire detectors, a section may serve spaces on both sides

of the ship and several decks but may not be situated in more than one main vertical zone.
(13) A section of fire detectors which covers a control station, a service space or an accommodation space is not to include a machinery space of category A.
(14) Detectors are to be operated by heat, smoke or other products of combustion, flame, or any combination of these factors. Detectors operated by other factors indicative of incipient fires may be considered provided that they are no less sensitive than such detectors. Flame detectors are only to be used in addition to smoke or heat detectors.
(15) Suitable instructions and component spares for testing and maintenance are to be provided.
(16) The function of the detection system is to be periodically tested satisfactorily by means of equipment producing hot air at the appropriate temperature, or smoke or aerosol particles having the appropriate range of density or particle size, or other phenomena associated with incipient fires to which the detector is designed to respond. All detectors are to be of a type such that they can be tested for correct operation and restored to normal surveillance without the renewal of any component. Detectors installed within cold spaces such as refrigerated compartments are to be tested using procedures having due regard for such locations①.
(17) The fire detection system is not to be used for any other purpose, except that closing of fire doors and similar functions may be permitted at the control panel.
(18) Newly fitted fire detection systems with a zone address identification capability are to be so arranged that:

① a loop cannot be damaged at more than one point by a fire;
② means are provided to ensure that any fault (e.g. power break, short circuit, earth) occurring in the loop will not render the whole loop ineffective;
③ all arrangements are made to enable the initial configuration of the system to be restored in the event of failure (electrical, electronic, informatic);
④ the first initiated fire alarm will not prevent any other detector from initiating further fire alarms.

1.12.2 Installation requirements
(1) Manually operated call points are to be installed throughout the accommodation spaces, service spaces and control stations. One manually operated call point is to be located at each exit. Manually operated call points are to be readily accessible in the corridors of each deck such that no part of the corridor is more than 20 m from a manually operated call point.
(2) Smoke detectors are to be installed in all stairways, corridors and escape routes within accommodation spaces. Consideration is to be given to the installation of special purpose smoke detectors within ventilation ducting.
(3) Where a fixed fire detection and fire alarm system is required for the protection of spaces other than those specified in (2) above, at least one detector complying with 1.12.1(11) of this Chapter is to be installed in each such space.
(4) Detectors are to be located for optimum performance. Positions near beams and ventilation ducts, or other positions where patterns of air flow could adversely affect performance and positions where impact or physical damage is likely to occur, are to be avoided. In general, detectors which are located on the overhead are to be a minimum distance of 0.5 m away from bulkheads, except those in the corridors, small store-rooms and stairways.
(5) The maximum spacing of detectors is to be in accordance with Table 1.12.2(5) of this Chapter. Other spacings may be permitted based upon test data which demonstrate the characteristics of the detectors.

Installation Positions of Detectors **Table 1.12.2(5)**

Type of detector	Maximum floor area per detector (m^2)	Maximum distance apart between centres (m)	Maximum distance away from bulkheads (m)
Heat	37	9	4.5
Smoke	74	11	5.5

(6) Electrical wiring which forms part of the system is to be so arranged as to avoid galleys, machinery spaces of category A, and other enclosed spaces of high fire risk except where it is

① Refer to the recommendations of the International Electrotechnical Commission, in particular publication IEC 60068-2-1 – Section one -Test Ab, Environmental Testing – Part 2-1: Tests –Test A: Cold.

necessary to provide for fire detection or fire alarm in such spaces or to connect to the appropriate power supply.

1.12.3 Design requirements

(1) The system and equipment are to be suitably designed to withstand supply voltage variation and transients, ambient temperature changes, vibration, humidity, shock, impact and corrosion normally encountered in ships.

(2) Smoke detectors required by 1.12.2(2) of this Chapter are to be certified to operate before the smoke density exceeds 12.5% obscuration per metre, but not until the smoke density exceed 2% obscuration per meter. Smoke detectors to be installed in other spaces are to operate within sensitivity limits having regard to the avoidance of detector insensitivity or oversensitivity.

(3) Heat detectors are to be certified to operate before the temperature exceeds 78℃ but not until the temperature exceed 54℃, when the temperature is raised to those limits at a rate less than 1℃ per minute. At higher rates of temperature rise, the heat detector is to operate within temperature limits having regard to the avoidance of detector insensitivity or oversensitivity.

(4) The permissible temperature of operation of heat detectors may be increased to 30℃ above the maximum deckhead temperature in drying rooms and similar spaces of a normal high ambient temperature.

1.13 Sample extraction smoke detection systems

1.13.1 General requirements

(1) Wherever in the text of 1.13 of this Chapter, the word “system" appears, it is to mean sample extraction smoke detection system.

(2) A sample extraction smoke detection system consists of the following main components:

① smoke accumulators: air collection devices installed at the open ends of the sampling pipes in each cargo hold that perform the physical function of collecting air samples for transmission to the control panel through the sampling pipes, and may also act as discharge nozzles for the fixed-gas fire-extinguishing system, if installed;

② sampling pipes: a piping network that connects the smoke accumulators to the control panel, arranged in sections to allow the location of the fire to be readily identified;

③ three-way valves: if the system is interconnected to a fixed-gas fire-extinguishing system, three-way valves are used to normally align the sampling pipes to the control panel and, if a fire is detected, the three-way valves are re-aligned to connect the sampling pipes to the fire-extinguishing system discharge manifold and isolate the control panel; and

④ control panel: the main element of the system which provides continuous monitoring of the protected spaces for indication of smoke. It typically may include a viewing chamber or smoke sensing units. Extracted air from the protected spaces is drawn through the smoke accumulators and sampling pipes to the viewing chamber, and then to the smoke sensing chamber where the airstream is monitored by electrical smoke detectors. If smoke is sensed, the repeater panel (normally on the bridge) automatically sounds an alarm (not localized). The crew can then determine at the smoke sensing unit which cargo hold is on fire and operate the pertinent three-way valve for discharge of the extinguishing agent.

(3) Any required system is to be capable of continuous operation at all times except that systems operating on a sequential scanning principle may be accepted, provided that the interval between scanning the same position twice gives a maximum allowable interval determined as follows:

The interval (I) should depend on the number of scanning points (N) and the response time of the fans (T), with a 20% allowance:

$$I = 1.2 \times T \times N$$

However, the maximum allowable interval should not exceed 120 s (I_{max} = 120 s).

(4) The system is to be designed, constructed and installed so as to prevent the leakage of any toxic or flammable substances or fire-extinguishing media into any accommodation space, service space, control station or machinery space.

(5) The system and equipment are to be suitably designed to withstand supply voltage variations and transients, ambient temperature changes, vibration, humidity, shock, impact and corrosion normally encountered in ships and to avoid the possibility of ignition of a flammable gas-air mixture.

(6) The system is to be of a type that can be tested for correct operation and restored to normal

surveillance without the renewal of any component.
(7) An alternative power supply for the electrical equipment used in the operation of the system is to be provided.

1.13.2 Component requirements

(1) The sensing unit is to be certified to operate before the smoke density within the sensing chamber exceeds 6.65% obscuration per metre.
(2) Duplicate sample extraction fans are to be provided. The fans are to be of sufficient capacity to operate with the normal conditions or ventilation in the protected area and the connected pipe size is to be determined with consideration of fan suction capacity and piping arrangement to satisfy the conditions of 1.13.4(2)② of this Chapter. Sampling pipes are to be a minimum of 12 mm internal diameter. The fan suction capacity should be adequate to ensure the response of the most remote area within the required time criteria in 1.13.4(2)② of this Chapter. Means to monitor airflow are to be provided in each sampling line.
(3) The control panel is to permit observation of smoke in the individual sampling pipes.
(4) The sampling pipes are to be so designed as to ensure that, as far as practicable, equal quantities of airflow are extracted from each interconnected accumulator.
(5) Sampling pipes are to be provided with an arrangement for periodically purging with compressed air.
(6) The control panel for the smoke detection system is to be tested according to standards EN 54-2 (1997), EN 54-4 (1997) and IEC 60092-504 (2001). Alternative standards may be used as determined by CCS.

1.13.3 Installation requirements

(1) Smoke accumulators
① At least one smoke accumulator is to be located in every enclosed space for which smoke detection is required. However, where a space is designed to carry oil or refrigerated cargo alternatively with cargoes for which a smoke sampling system is required, means may be provided to isolate the smoke accumulators in such compartments for the system. Such means are to be to the satisfaction of the Administration.
② Smoke accumulators are to be located on the overhead or as high as possible in the protected space, and are to be spaced so that no part of the overhead deck area is more than 12 m measured horizontally from an accumulator. Where systems are used in spaces which may be mechanically ventilated, the position of the smoke accumulators is to be considered having regard to the effects of ventilation. At least one additional smoke accumulator is to be provided in the upper part of each exhaust ventilation duct. An adequate filtering system is to be fitted at the additional accumulator to avoid dust contamination.
③ Smoke accumulators are to be positioned where impact or physical damage is unlikely to occur.
④ Sampling pipe networks are to be balanced to ensure compliance with 1.13.2(4) of this Chapter. The number of accumulators connected to each sampling pipe is to ensure compliance with paragraph 1.13.4(2)② of this Chapter.
⑤ Smoke accumulators from more than one enclosed space are not to be connected to the same sampling pipe.
⑥ In cargo holds where non-gastight "'tween deck panels" (movable stowage platforms) are provided, smoke accumulators are to be located in both the upper and lower parts of the holds.

(2) Sampling pipes
① The sampling pipe arrangements are to be such that the location of the fire can be readily identified.
② Sampling pipes are to be self-draining and suitably protected from impact or damage from cargo working.

1.13.4 System control requirements

(1) Visual and audible fire signals
① The detection of smoke or other products of combustion is to initiate a visual and audible signal at the control panel and indicating units.
② The control panel is to be located on the navigation bridge or in the fire control station. An indicating unit is to be located on the navigation bridge if the control panel is located in the

fire control station.

③ Clear information is to be displayed on or adjacent to the control panel and indicating units designating the spaces covered.

④ Power supplies necessary for the operation of the system are to be monitored for loss of power. Any loss of power is to initiate a visual and audible signal at the control panel and the navigating bridge which is to be distinct from a signal indicating smoke detection.

⑤ Means to manually acknowledge all alarm and fault signals are to be provided at the control panel. The audible alarm sounders on the control panel and indicating units may be manually silenced. The control panel is to clearly distinguish between normal, alarm, acknowledged alarm, fault and silenced conditions.

⑥ The system is to be arranged to automatically reset to the normal operating condition after alarm and fault conditions are cleared.

(2) Testing

① Suitable instructions and component spares are to be provided for the testing and maintenance of the system.

② After installation, the system is to be functionally tested using smoke generating machines or equivalent as a smoke source. An alarm is to be received at the control unit in not more than 180 s for vehicle decks, and not more than 300 s for container and general cargo holds, after smoke is introduced at the most remote accumulator.

1.14 Fixed fire detection and fire alarm systems for periodically unattended machinery spaces

1.14.1 A fixed fire detection and fire alarm systems of an approved type in accordance with the relevant provisions of 1.12 of this Chapter is to be installed in periodically unattended machinery spaces.

1.14.2 This fire detection system is to be so designed and the detectors so positioned as to detect rapidly the onset of fire in any part of those spaces and under any normal conditions of operation of the machinery and variations of ventilation as required by the possible range of ambient temperatures. Except in spaces of restricted height and where their use is especially appropriate, detection systems using only thermal detectors are not to be permitted. The detection system is to initiate audible and visual alarms distinct in both respects from the alarms of any other system not indicating fire, in sufficient places to ensure that the alarms are heard and observed on the navigation bridge and by a responsible engineer officer. When the navigation bridge is unmanned the alarm is to sound in a place where a responsible member of the crew is on duty.

1.14.3 After installation the system is to be tested under varying conditions of engine operation and ventilation.

1.15 Arrangements for oil fuel, lubricating oil and other flammable oils

1.15.1 Unless otherwise specified, all passenger ships, cargo ships of 2000 gross tonnage and upwards and tankers of 500 gross tonnage and upwards are to meet the following requirements in (1) to (6).

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

① except as otherwise permitted below, no oil fuel with a flashpoint of less than 60℃ is to be used;

② in emergency generators oil fuel with a flashpoint of not less than 43℃ may be used;

③ subject to such additional precautions as may be considered necessary and on condition that the ambient temperature of the space in which such oil fuel is stored or used is not to be allowed to rise to within 10℃ below the flashpoint of the oil fuel, the general use of oil having a flashpoint of less than 60℃ but not less than 43℃ may be permitted;

④ in cargo ships the use of fuel having a lower flashpoint than otherwise specified above, for example crude oil, may be permitted provided that such fuel is not stored in any machinery space and subject to approval of the complete installation.

The flashpoint of oils are to be determined by an approved closed cup method.

(2) Oil fuel arrangements

In a ship in which oil fuel is used, the arrangements for the storage, distribution and utilization of the oil fuel are to be such as to ensure the safety of the ship and persons on board and are to at

least comply with the following provisions.

① As far as practicable, parts of the oil fuel system containing heated oil under pressure exceeding 0.18 MPa are not to be placed in a concealed position such that defects and leakage cannot readily be observed. The machinery spaces in way of such parts of the oil fuel system are to be adequately illuminated.

② The ventilation of machinery spaces is to be sufficient under all nor mal conditions to prevent accumulation of oil vapour.

③ As far as practicable, oil fuel tanks are to be part of the ship's structure and are to be located outside machinery spaces of category A. Where oil fuel tanks, other than double bottom tanks, are necessarily located adjacent to or within machinery spaces of category A, at least one of their vertical sides is to be contiguous to the machinery space boundaries, and is preferably to have a common boundary with the double bottom tanks, and the area of the tank boundary common with the machinery spaces is to be kept to a minimum. Where such tanks are situated within the boundaries of machinery spaces of category A they are not to contain oil fuel having a flashpoint of less than 60℃. In general the use of free-standing oil fuel tanks is to be avoided. When such tanks are employed their use is to be prohibited in category A machinery spaces on passenger ships. Where permitted, they are to be placed in an oil-tight spill tray of ample size having a suitable drain pipe leading to a suitably sized spill oil tank.

④ No oil fuel tank is to be situated where spillage or leakage therefrom can constitute a hazard by falling on heated surfaces. Precautions are to be taken to prevent any oil that may escape under pressure from any pump, filter or heater from coming into contact with heated surfaces.

⑤ Oil fuel pipes, which, if damaged, would allow oil to escape from a storage, settling or daily service tank having a capacity of 500 *l* and above situated above the double bottom, are to be fitted with a cock or valve directly on the tank capable of being closed from a safe position outside the space concerned in the event of a fire occurring in the space in which such tanks are situated. Valves or cocks of oil tanks, excluding daily service oil tanks, having a capacity of less than 500 *l* may not be fitted with the remotely controlled closing devices. In the special case of deep tanks situated in any shaft or pipe tunnel or similar space, valves on the tank are to be fitted, but control in the event of fire may be effected by means of an additional valve on the pipe or pipes outside the tunnel or similar space. If such an additional valve is fitted in the machinery space, it is to be operated from a position outside this space. The controls for remote operation of the valve for the emergency generator fuel tank are to be in a separate location from the controls for remote operation of other valves for tanks located in machinery spaces.

⑥ Safe and efficient means of ascertaining the amount of oil fuel contained in any oil fuel tank are to be provided.

(a) Where sounding pipes are used, they are not to terminate in any space where the risk of ignition of spillage from the sounding pipe might arise. In particular, they are not to terminate in passenger or crew spaces. As a general rule, they are not to terminate in machinery spaces. However, where these latter requirements are impracticable, termination of sounding pipes in machinery spaces may be permitted on condition that all the following requirements are met:

ⓐ in addition, an oil-level gauge is provided meeting the requirements of (b) below;

ⓑ the sounding pipes terminate in locations remote from ignition hazards unless precautions are taken, such as the fitting of effective screens, to prevent the oil fuel in the case of spillage through the terminations of the sounding pipes from coming into contact with a source of ignition;

ⓒ the termination of sounding pipes are fitted with self-closing blanking devices and with a small-diameter self-closing control cock located below the blanking device for the purpose of ascertaining before the blanking device is opened that oil fuel is not present. Provision is to be made so as to ensure that any spillage of oil fuel through the control cock involves no ignition hazard.

(b) Other oil-level gauges may be used in place of sounding pipes. Such means, like the means provided in above-mentioned (a)ⓐ are subject to the following conditions:

ⓐ in passenger ships, such means are not to require penetration below the top of the tank and their failure or overfilling of the tanks is not to permit release of fuel;

ⓑ in cargo ships, any of the following methods can be replaced:
the failure of such means or overfilling of the tank is not to permit release of fuel into the space. The use of cylindrical gauge glasses is prohibited. The use of oil-level gauges with flat glasses and self-closing valves between the gauges and fuel tanks may be permitted; penetration below the top of the tank without resulting danger; other means subject to approval;

ⓒ these means are to be maintained in the proper condition to ensure their continued accurate functioning in service.

(c) for fuel oil tanks above the double bottom compartments, if such tanks are fitted with overflow pipes or high-level alarms complying with the requirements, when sounding pipes terminate in machinery spaces, only ⓑ and ⓒ of (a) above need to be complied with.

For fuel oil tanks in the double bottom compartments, when sounding pipes terminate in machinery spaces, only ⓑ and ⓒ of (a) above need to be complied with.

⑦ Provision is to be made to prevent overpressure in any oil tank or in any part of the oil fuel system, including the filling pipes. Any relief valves and air or overflow pipes are to discharge to a safe position.

⑧ Oil fuel pipes and their valves and fittings are to be of steel or other approved material, except that restricted use of flexible pipes is to be permissible in positions where they are necessary. Such flexible pipes and end attachments are to be of approved fire-resisting materials of adequate strength and are to be constructed subject to agreement. For valves fitted to oil fuel tanks and under static pressure, steel or spheroidal-graphite cast iron may be accepted. However, ordinary cast iron valves may be used in piping systems where the design pressure is lower than 0.7 MPa and the design temperature is below 60℃.

⑨ Except for diesel engines installed on lifeboats, external high-pressure fuel delivery lines between the high-pressure fuel pumps and fuel injectors are to be protected with a jacketed piping system capable of containing fuel from a high-pressure line failure. A jacketed pipe incorporates an outer pipe into which the high-pressure fuel pipe is placed, forming a permanent assembly. The jacketed piping system is to include a means for collection of leakages and arrangements are to be provided with an alarm in case of a fuel line failure. However, for diesel engines of which high-pressure fuel pumps and fuel injectors as well as high-pressure fuel lines in between are enclosed in the protective casing without exposed components, if they are fitted with internal drain passages and the corresponding fuel leakage alarms, this requirement needs not be complied with.

⑩ Oil fuel lines are not to be located immediately above or near units of high temperature, including boilers, steam pipelines, exhaust manifolds, silencers or other equipment required to be insulated by ⑬ and ⑭ of the paragraph. As far as practicable, oil fuel lines are to be arranged far apart from hot surfaces, electrical installations or other sources of ignition and are to be screened or otherwise suitably protected to avoid oil spray or oil leakage onto the sources of ignition. The number of joints in such piping systems is to be kept to a minimum.

⑪ Components of a diesel engine fuel system are to be designed considering the maximum peak pressure which will be experienced in service, including any high-pressure pulses which are generated and transmitted back into the fuel supply and spill lines by the action of fuel injection pumps. Connections within the fuel supply and spill lines are to be constructed having regard to their ability to prevent pressurized oil fuel leaks while in service and after maintenance.

⑫ In multi-engine installations which are supplied from the same fuel source, means of isolating the fuel supply and spill piping to individual engines are to be provided. The means of isolation are not to affect the operation of the other engines and are to be operable from a position not rendered inaccessible by a fire on any of the engines.

⑬ Surfaces with temperatures above 220℃ which may be impinged as a result of a fuel system failure are to be properly insulated.

⑭ Precautions are to be taken to prevent any oil that may escape under pressure from any

pump, filter or heater from coming into contact with heated surfaces.

(3) Lubricating oil arrangements

The arrangements for the storage, distribution and utilization of oil used in pressure lubrication systems are to be such as to ensure the safety of the ship and persons on board. The arrangements made in machinery spaces of category A, and whenever practicable in other machinery spaces, are at least to comply with the provisions of ①, ④ to ⑧, ⑩, ⑬ and ⑭ of 1.15.1(2) of this Chapter, except that:

① this does not preclude the use of sight-flow glasses in lubricating systems provided that they are shown by test to have a suitable degree of fire resistance;

② sounding pipes may be authorized in machinery spaces; the requirements of ⓐ and ⓑ of ⑥(a) of 1.15.1(2) of this Chapter need not be applied on condition that the sounding pipes are fitted with appropriate means of closure.

(4) Arrangements for other flammable oils

The arrangements for the storage, distribution and utilization of other flammable oils employed under pressure in power transmission systems, control and activating systems and heating systems are to be such as to ensure the safety of the ship and persons on board. In locations where means of ignition are present, such arrangements are at least to comply with the provisions of ④, ⑥ to ⑧, ⑩, ⑬ and ⑭ of 1.1 5.1(2) of this Chapter.

(5) Periodically unattended machinery spaces

In addition to the requirements of 1.15.1(1) to 1.15.1(4) of this Chapter, the oil fuel and lubricating oil systems are to comply with the following.

① Where daily service oil fuel tanks are filled automatically, or by re mote control, means are to be provided to prevent overflow spillages. Other equipment which treats flammable liquids automatically, e.g. oil fuel purifiers, which, when ever practicable, is to be installed in a special space reserved for purifiers and their heaters, are to have arrangements to prevent overflow spillages.

② Where daily service oil fuel tanks or settling tanks are fitted with heating arrangements, a high temperature alarm is to be provided if the flashpoint of the oil fuel can be exceeded.

(6) Prohibition of carriage of flammable oils in forepeak tanks

Fuel oil, lubrication oil and other flammable oils are not to be carried in forepeak tanks.

1.15.2 Cargo ships of less than 2000 gross tonnage and tankers of less than 500 gross tonnage are to meet at least the requirements of 1.15.1(1), (2)①～⑭, (5) and (6) of this Chapter. However, for cargo ships and tankers of less than 500 gross tonnage, with regards to 1.15.1(2)⑨, irrespective of the power output of the diesel engine, appropriate shielding, such as protective casing or splash plate, may be used to protect high-pressure fuel pumps and fuel injectors as well as high-pressure fuel lines in between so as to prevent leaked oil from coming into contact with heated surfaces.

1.16 Ventilation

1.16.1 Ventilation ducts are to be of non-combustible material. Short ducts, however, not generally exceeding 2 m in length and with a cross-section not exceeding 0.02 m^2 need not be non-combustible, subject to the following conditions:

(1) these ducts are to be of an approved material which has a low fire risk;

(2) they may only be used at the end of the ventilation device;

(3) they are not to be situated less than 600 mm, measured along the duct, from an opening in an “A" or “B" class division including continuous “B" class ceilings.

1.16.2 Where the ventilation ducts with a free-sectional area exceeding 0.02 m^2 pass through class “A" bulkheads or decks, the opening is to be lined with a steel sheet sleeve unless the ducts passing through the bulkheads or decks are of steel in the vicinity of passage through the deck or bulkhead and the ducts and sleeves are to comply in this part with the following.

(1) The sleeves are to have a thickness of at least 3 mm and a length of at least 900 mm. When passing through bulkheads, this length is to be divided preferably into 450 mm on each side of the bulkhead. These ducts, or sleeves lining such ducts, are to be provided with fire insulation. The insulation is to have at least the same fire integrity as the bulkhead or deck through which the duct passes. Equivalent penetration protection may be provided subject to agreement.

(2) Ducts with a free cross-sectional area exceeding 0.075 m^2 are to be fitted with fire dampers in

addition to the requirements of (1) above. The fire damper is to operate automatically but is also to be capable of being closed manually from both sides of the bulkhead or deck. The damper is to be provided with an indicator which shows whether the damper is open or closed. Fire dampers are not required, however, where ducts pass through spaces surrounded by "A" class divisions, without serving those spaces, provided those ducts have the same fire integrity as the divisions which they pierce.

1.16.3 Ducts provided for the ventilation of machinery spaces of category A, galleys, vehicle spaces, ro-ro spaces are not to pass through accommodation spaces, service spaces or control stations unless they comply with the conditions specified in (1) or (2) below:

(1) ① the ducts are constructed of steel having a thickness of at least 3 mm and 5 mm for ducts the widths or diameters of which are up to and including 300 mm and 760 mm and over respectively and, in the case of such ducts, the widths or diameters of which are between 300 mm and 760 mm having a thickness to be obtained by interpolation;

② the ducts are suitably supported and stiffened;

③ the ducts are fitted with automatic fire dampers close to the boundaries penetrated;

④ the ducts are insulated to "A-60" standard or at least the same fire integrity as the division penetrated from the machinery spaces, galleys, vehicle spaces, ro-ro spaces to a point at least 5 m beyond each fire damper. For passenger ships of class III carrying less than 100 passengers, cargo ships of less than 1000 gross tonnage and tankers of less than 500 gross tonnage, this requirement may be exempted;

(2) ① the ducts are constructed of steel in accordance with 1.16.3(1)① and ② of this Chapter;

② the ducts are insulated to "A-60" standard or at least the same fire integrity as the division penetrated throughout the accommodation spaces, service spaces or control stations; except that penetration of main zone divisions is also to comply with the requirements of 1.16.8 of this Chapter. For passenger ships of class III carrying less than 100 passengers, cargo ships of less than 1000 gross tonnage and tankers of less than 500 gross tonnage, the ducts are constructed or insulated to "A-0" standard throughout the accommodation spaces, service spaces or control stations.

1.16.4 Ducts provided for ventilation to accommodation spaces, service spaces or control stations are not to pass through machinery spaces of category A, galleys, vehicle spaces, ro-ro spaces unless they comply with the conditions specified in (1) or (2) below:

(1) ① the ducts where they pass through a machinery space of category A, galley, vehicle space, ro-ro space are constructed of steel in accordance with 1.16.3(1)① and ② of this Chapter;

② automatic fire dampers are fitted close to the boundaries penetrated;

③ the integrity of the machinery space, galley, vehicle space, ro-ro space boundaries is maintained at the penetration; or

(2) ① the ducts where they pass through a machinery space of category A, galley, vehicle space, ro-ro space are constructed of steel in accordance with 1.16.3(1)① and ② of this Chapter;

② the ducts are constructed or insulated to "A-60" standard or at least the same fire integrity as the division penetrated within the machinery space, galley, vehicle space, ro-ro space; except that penetrations of main zone divisions are also to comply with the requirements of 1.16.8 of this Chapter. For passenger ships of class III carrying less than 100 passengers, cargo ships of less than 1000 gross tonnage and tankers of less than 500 gross tonnage, the ducts are insulated to "A-0" standard within the machinery space, galley, vehicle space, ro-ro space.

1.16.5 Ventilation ducts with a free cross-sectional area exceeding 0.02 m^2 passing through "B" class bulkheads are to be lined with steel sheet sleeves of 900 mm in length divided preferably into 450 mm on each side of the bulkheads unless the duct is of steel for this length.

1.16.6 Such measures as are practicable are to be taken in respect of control stations outside machinery spaces in order to ensure that ventilation, visibility and freedom from smoke are maintained, so that in the event of fire the machinery and equipment contained therein may be supervised and continue to function effectively. Alternative and separate means of air supply are to be provided; air in lets of the two sources of supply are to be so disposed that the risk of both inlets drawing in smoke simultaneously is minimized. Such requirements need not apply, subject

to agreement, to control stations situated on, and opening on to, an open deck, or where local closing arrangements would be equally effective.

1.16.7 Where they pass through accommodation spaces or spaces containing combustible materials, the exhaust ducts from galley ranges are to be constructed of "A" class division. Each exhaust duct is to be fitted with:

(1) a grease trap readily removable for cleaning;

(2) a fire damper located in the lower end of the duct;

(3) arrangements, operable from within the galley, for shutting off the exhaust fans;

(4) fixed means for extinguishing a fire within the duct.

1.16.8 Where in a passenger ship it is necessary that a ventilation duct passes through a main vertical zone division, a fail-safe automatic closing fire damper is to be fitted adjacent to the division. The damper is also to be capable of being manually closed from each side of the division. The operating position is to be readily accessible and be marked in red light-reflecting color. The duct between the division and the damper is to be of steel or other equivalent material and, if necessary, insulated to comply with the requirements of 1.25.2 of this Chapter. The damper is to be fitted on at least one side of the division with a visible indicator showing whether the damper is in the open position.

1.16.9 The main inlets and outlets of all ventilation systems are to be capable of being closed from outside the spaces being ventilated.

1.16.10 Power ventilation of accommodation spaces, service spaces, cargo spaces, control stations and machinery spaces is to be capable of being stopped from an easily accessible position outside the space being served. This position should not be readily cut off in the event of a fire in the spaces served. The means provided for stopping the power ventilation of the machinery spaces are to be entirely separate from the means provided for stopping ventilation of other spaces.

1.16.11 The ventilation systems for machinery spaces of category A, vehicle spaces, ro-ro spaces, galleys, special category spaces and cargo spaces are, in general, to be separated from each other and from the ventilation systems serving other spaces, except that the galley ventilation systems on cargo ships of less than 4,000 gross tonnage and in passenger ships of class III carrying less than 100 persons need not be completely separated, but may be served by separate ducts from a ventilation unit serving other spaces. In any case, an automatic fire damper is to be fitted in the galley ventilation duct near the ventilation unit.

1.16.12 The ventilation of cargo spaces intended for carriage of dangerous goods is to meet the requirements of 3.10 of this Chapter as well as the requirements of this paragraph.

1.17 Fireman's outfit

1.17.1 A fireman's outfit is to consist of personal equipment, a breathing apparatus and a fireproof lifeline.

(1) Personal equipment comprising:

① protective clothing of material to protect the skin from the heat radiating from the fire and from burns and scalding by steam. The outer surface is to be water-resistant;

② boots and gloves of rubber or other electrically non-conducting material;

③ a rigid helmet providing effective protection against impact;

④ an electric safety lamp (hand lantern) of an approved type with a minimum burning period of 3 h;

⑤ an approved axe.

(2) A breathing apparatus of an approved type which may be either:

① a smoke helmet or smoke mask which is to be provided with a suitable air pump and a length of air hose sufficient to reach from the open deck, well clear of hatch or doorway, to any part of the holds or machinery spaces. If, in order to comply with this requirement, an air hose exceeding 36 m in length would be necessary, a self-contained breathing apparatus is to be substituted or provided in addition; or

② a self-contained compressed-air-operated breathing apparatus, the volume of air contained in the cylinders of which is to be at least 1200 L, or other self-contained breathing apparatus which are to be capable of functioning for at least 30 min. Two spare charges are to be provided for each required breathing apparatus. Ships that are equipped with suitably located means for fully recharging the air cylinders free from contamination need carry

only one spare charge for each required apparatus. All air cylinders for breathing apparatus are to be interchangeable.

For passenger ships carrying 100 passengers and above, at least two spare charges for each breathing apparatus are to be provided.

③ Compressed air breathing apparatus are to be fitted with an audible alarm and a visual or other device which will alert the user before the volume of the air in the cylinder has been reduced to no less than 200 *l*.

(3) For each breathing apparatus a fireproof lifeline of sufficient length and strength is to be provided. The lifeline is to be capable of being attached by means of a snap-hook to the harness of the apparatus or to a separate belt in order to prevent the breathing apparatus becoming detached when the lifeline is operated.

1.17.2 Arrangement requirements

The fireman's outfits or sets of personal equipment are to be so stored as to be easily accessible and ready for use and, where, more than one fireman's outfit or more than one set of personal equipment is carried, they are to be stored in widely separated positions. In passenger ships carrying more than 100 passengers, each breathing apparatus is to be provided with one water fog applicator which is stored adjacent to such apparatus.

1.17.3 Equipment requirements

The number of fireman's outfit on board each ship is to meet at least the following requirements.

(1) For passenger ships:

of class II ·····	two sets of fireman's outfit;
of class III carrying passengers ····· of 100 and upwards but less than 500	one set of fireman's outfit; one set of personal equipment;
of class III carrying less than 100 passengers ·····	one set of fireman's outfit. Where it is considered impracticable, fireman's outfit may be exempted subject to agreement.

In addition, in passenger ships of class II there are to be provided for every 80 m of the aggregate of the lengths of all passenger spaces and service spaces on the deck which carries such spaces or, if there is more than one such deck, on the deck which has the largest aggregate of such lengths, two fire-man’s outfits and two sets of personal equipment

(2) For cargo ships:

of 2000 gross tonnage and upwards ·····	two sets of fireman's outfit;
of 500 gross tonnage and upwards but less than 2000 gross tonnage ·····	one set of fireman's outfit;
of less than 500 gross tonnage ·····	exemption;

(3) For tankers:

of 500 gross tonnage and upwards ·····	four sets of fireman's outfit;
of less than 500 gross tonnage ·····	two sets of fireman's outfit.

1.18 Fire control plans

1.18.1 All passenger ships, cargo ships and tankers of 500 gross tonnage and upwards are to be provided with fire control plans. Other ships may only be provided with arrangement plans of fire-fighting equipment.

1.18.2 Requirements of fire control plans

(1) General arrangement plans are to be permanently exhibited on board for the guidance of this ship's officers, showing clearly for each deck the control stations, the various fire sections enclosed by “A" class divisions, the sections enclosed by “B" class divisions together with particulars of the fire detection and fire alarm systems, the sprinkler installation, the fire-extinguishing appliances, means of access to different compartments, decks, etc. and the ventilating system including particulars of the fan control positions, the position of dampers and identification numbers of the ventilating fans serving each section. Alternatively, the aforementioned details may be set out in a booklet, a copy of which is to be supplied to each officer, and one copy is at all times to be available on board in an accessible position. Plans and booklets are to be kept up to date, any alterations being recorded thereon as soon as practicable.

(2) Instructions concerning the maintenance and operation of all the equipment and installations on board for the fighting and containment of fire are to be kept under one cover, readily available in an accessible position.

(3) A duplicate set of fire control plans or a booklet containing such plans is to be permanently stored on board in a prominently marked weather tight enclosure outside the deckhouse for the assistance of shoreside fire-fighting personnel.
(4) Unified “Graphical Symbols for Fire Control Plans" is to be adopted in fire control plans (refer to resolution A.952(23) Graphical symbols for shipboard fire control plans).

1.19 Operational readiness and maintenance, testing and inspections

1.19.1 Operational readiness

(1) All structural fire protection (including fire-resisting divisions, and protection of openings and penetrations in these divisions, fire detection and fire alarm systems and means of escape systems and appliances are to be kept in good order so as to ensure their required performance if a fire occurs.
(2) All fire-fighting systems and appliances on board the ship are to be kept in good order and readily available for immediate use.

1.19.2 Maintenance, testing and inspections

The maintenance and inspection plan is to be kept on board the ship and designated persons are to be responsible for the maintenance and inspection of the fire protection system and fire-fighting system and appliances and make relevant records.

1.20 Acceptance of substitutes

1.20.1 Where any special type of appliance, apparatus, extinguishing medium or arrangement is specified in any ship, any other type of appliance etc., may be allowed subject to agreement, provided it is not less effective.

1.21 Fire-fighting appliances of paint lockers and spaces containing flammable liquid

1.21.1 Paint lockers and spaces containing flammable liquid are not to give access to accommodation spaces and are to be provided with fire-extinguishing appliances the arrangement enabling the crew to extinguish a fire without entering the space..

1.21.2 For lockers and spaces containing flammable liquid of a deck area of than 4 m^2 and more, one of the arrangements as specified below is to be provided:
(1) a carbon dioxide system, designed for 40% of the gross volume of the space;
(2) a dry powder system, designed for at least 0.5 kg powder/m^3;
(3) a water spraying or sprinkler system, designed for 5 *l*/m^2 min.

1.21.3 Water spraying systems may be connected to the fire main of the ship.

1.21.4 Systems or appliances other than those mentioned in 1.21.2(1), (2), (3) above may also be accepted provided that relevant technical and test data are provided.

1.21.5 For lockers and spaces containing flammable liquid of a deck area of less than 4 m^2, a portable carbon dioxide fire extinguisher sized to provide a minimum volume of free gas equal to 40% of the gross volume of the space may be accepted in lieu of a fixed system. A discharge port is to be arranged in the locker. The required portable fire extinguisher is to be stowed adjacent to the port. Alternatively, a port or hose connection may be provided to facilitate the use of fire main water.

1.22 Arrangements for gaseous fuel for domestic purposes

1.22.1 Ranges, gas cylinders, pipelines and pressure reduction valves that constitute gaseous fuel systems used for domestic purposes are to be approved products and satisfy their intended usage.

1.22.2 For any ships, the arrangements for the storage, distribution and utilization of the gaseous fuel used for domestic purposes are to be such that, having regard to the hazards of fire and explosion which the use of such fuel may entail, the safety of the ship and the persons on board is preserved.

1.22.3 The doors and windows in the boundary of the galley are to open outwards and to the open deck. Natural ventilation or mechanical ventilation is to be provided to ensure the air flowing between upper and lower spaces inside the galley and purge the smoke and the gas liable to escape to a safe place.

1.22.4 The supply of gaseous fuel for domestic purposes is to be capable of being cut off from a readily accessible position outside the space in the event of a fire occurring in the space.

1.22.5 All pipelines for delivering oil or gas from containers to the stoves or water heaters are to

be of steel or other approved materials before the pressure reduction valve and may be flexible hoses after the pressure reduction valve. All joints (connections) of pipelines are to be provided with means to ensure gastightness. Safety appliances for automatic shutoff are to be provided so that they will automatically shut off oil fuel and gas supply when the flame in the stoves goes out.

1.22.6 Gas cylinders are to be of steel and stored on the open deck or in well ventilated spaces with access only to the open deck. Gas cylinders are to be fixed securely. Fixed hoops are to be capable of being released easily and quickly. Cylinders are to be provided with wood blocks under the bottom to avoid impact.

1.23 Construction and arrangement of saunas

1.23.1 Passenger ships, cargo ships and tankers are to comply with the following requirements if they are provided with saunas:

(1) the perimeter of the sauna is to be of "A" class boundaries and may include changing rooms, showers and toilets. The sauna is to be insulated to "A-60" standard against other spaces except those inside of the perimeter and open deck spaces, sanitary and similar spaces, spaces having little or no fire risk;

(2) bathrooms with direct access to saunas may be considered as part of them. In such cases, the door between sauna and the bathroom need not comply with fire safety requirements;

(3) the traditional wooden lining on the bulkheads and ceiling are permitted in the sauna. The ceiling above the oven is to be lined with a non-combustible plate with an air gap of at least 30 mm. The distance from the hot surfaces to combustible materials is to be at least 500 mm or the combustible materials is to be protected (e.g., non-combustible plate with an air gap of at least 30 mm);

(4) the traditional wooden benches are permitted to be used in the sauna;

(5) the sauna door is to open outwards by pushing;

(6) electrically heated ovens are to be provided with a timer.

1.24 On-board training and fire drills

1.24.1 Crew members are to be trained to be familiar with the arrangements of the ship as well as the location and operation of any fire-fighting systems and appliances that they may be called upon to use.

1.24.2 Performance of crew members is to be periodically evaluated by conducting on-board training and drills to identify areas in need of improvement, to ensure competency in fire-fighting skills is maintained, and to ensure the operational readiness of the fire-fighting organization.

1.24.3 Crew members are to receive on-board training on fire-fighting systems and appliances onboard ships used within their responsibility before reporting for work.

1.24.4 Fire drills are to be carried out in conjunction with the relevant provisions (fire drills) of Chapter 3 of this PART and be recorded.

(1) Every crew member is to participate in at least one fire drill every month. The drills of the crew are to take place within 24 h of the ship leaving a port if more than 25% of the crew members have been replaced.

(2) Fire drills should be planned in such a way that due consideration is given to the type of ships and the cargo.

(3) Each fire drill is to include:

① reporting to stations and preparing for the duties described in the muster list required by Chapter 3 of this PART;

② starting of a fire pump, using at least the two required jet of water to show that the system is in proper working order;

③ checking of fireman's outfit and other personal rescue equipment;

④ checking of relevant communication equipment;

⑤ checking the operation of watertight doors, fire doors, fire dampers and main inlets and outlets of ventilation systems in the drill area;

⑥ checking the necessary arrangements for subsequent abandoning of the ship.

(4) The equipment used during drills is immediately to be brought back to its fully operational condition and any faults and defects discovered during the drills are to be remedied as soon as possible.

1.24.5 Additional requirements for passenger ships

(1) For passenger ships, one fire drill is to be held once every week. All crew members need not to participate in every drill, but every crew member is to participate in at least one fire drill every month as required above.
(2) Passengers are to be encouraged to participate in these drills and due consideration is to be given to informing the passengers and the movement of passengers to muster stations and embarkation decks.

1.25 Miscellaneous items

1.25.1 After a standard fire test, if the temperature rise characteristics of deck/bulkhead meet the requirements of A class or B class division and no sufficient self-inflammable vapour and toxic gas will produce, the heat insulating object on deck/bulkhead may be substituted by approved coating or other materials.

1.25.2 For passenger ships of class II, cargo ships of 2000 gross tonnage and upwards and tankers of 500 gross tonnage and upwards, where "A" class divisions are penetrated for the passage of electric cables, pipes, trunks, ducts, etc., such penetrations are to be tested in accordance with the Fire Test Procedures Code. However, where a pipe penetration is made of steel or equivalent material having a thickness of 3 mm or greater and a length of not less than 900 mm (preferably 450 mm on each side of the division), and there are no openings, testing is not required. Such penetrations are to be suitably insulated by extension of the insulation at the same level of the division.

For passenger ships of class III, cargo ships of less than 2000 gross tonnage and tankers of less than 500 gross tonnage, where "A" class divisions are penetrated for the passage of electric cables, pipes, trunks, ducts, etc., necessary measures, such as laying a heat-insulating material of at least 100 mm in thickness, are to be taken to ensure that the fire resistance of the division is not impaired.

1.25.3 For passenger ships of class II, cargo ships of 2000 gross tonnage and upwards and tankers of 500 gross tonnage and upwards, where "B" class divisions are penetrated for the passage of electric cables, pipes, trunks, ducts, etc., or for the fitting of ventilation terminals, lighting fixtures and similar devices, pipes other than steel or copper that penetrate "B'" class divisions are to be protected by either:

① a fire-tested penetration device suitable for the fire resistance of the division pierced and the type of pipe used;

② a steel sleeve, having a thickness of not less than 1.8 mm and a length of not less than 900 mm for pipe diameters of 150 mm or more and not less than 600 mm for pipe diameters of less than 150 mm (preferably equally divided to each side of the division). The pipe is to be connected to the ends of the sleeve by flanges or couplings; or the clearance between the sleeve and the pipe is not to exceed 2.5 mm; or any clearance between pipe and sleeve is to be made tight by means of non-combustible or other suitable material.

For passenger ships of class III, cargo ships of less than 2000 gross tonnage and tankers of less than 500 gross tonnage, where "B" class divisions are penetrated for the passage of electric cables, pipes, trunks, ducts, etc., or for the fitting of ventilation terminals, lighting fixtures and similar devices, necessary measures are to be taken to ensure that the fire resistance of the division is not impaired.

1.25.4 Uninsulated metallic pipes penetrating "A" or "B" class divisions are to be of materials having a melting temperature which exceeds 950℃ for "A-0" class division and 850℃ for "B-0" class division. Where the oil and combustible liquids are conveyed through accommodation and service spaces, the pipes conveying oil or combustible liquids are to be of an approved material having regard to the fire risk. Materials readily rendered ineffective by heat are not to be used for overboard scuppers, sanitary discharges, and other outlets which are close to the waterline and where the failure of the material in the event of fire would give rise to danger of flooding.

1.25.5 In approving structural fire protection details, regard is to be given to the risk of heat transmission at intersections and terminal points of required thermal barriers. The insulation of a deck or bulkhead is to be carried past the penetration, intersection or terminal point for a distance of at least 450 mm in the case of steel and aluminium structures. If a space is divided with a deck or a bulkhead of "A" class standard having insulation of different values, the insulation with the higher value is to continue on the deck or bulkhead with the insulation of the lesser value for a distance of at least 450 mm.

1.25.6 Electric radiators, if used, are to be fixed in position and so constructed as to reduce fire risks to a minimum. No such radiators are to be fitted with an element so exposed that clothing, curtains, or other similar materials can be scorched or set on fire by heat from the element.
1.25.7 Cellulose-nitrate-based films are not to be used for cinematograph installations.
1.25.8 All waste receptacles are to be constructed of non-combustible materials with no openings in the sides or bottom.
1.25.9 In spaces where penetration of oil products is possible, the surface of insulation is to be impervious to oil or oil vapors.
1.25.10 Crosshead type diesel engine scavenge spaces in open connection with cylinders are to be provided with an approved fire-extinguishing appliance which is to be independent of the fire-extinguishing system of the machinery spaces.

1.26 Arrangement of oxygen, acetylene cylinders

1.26.1 Gas cylinders are to be approved products. Each gas cylinder is to be provided with proper pressure relief device such as a fusible plug or a rupture disc.
1.26.2 Pipes, pipe fittings, pipe joints and valves are to comply with the requirements for Class I piping systems of PART THREE of CCS Rules for Construction of See-going Steel Ships. Materials for acetylene on the high-pressure side between the cylinders and the regulator are to be steel. Copper or copper alloys containing more than 65% copper are not to be used in the whole fixed acetylene piping. Materials for oxygen piping are to be of steel or copper. Materials for both oxygen and acetylene systems are to be corrosion resistant, all the pipes of the fixed piping are to be seamless drawn.
1.26.3 The connections between fixed pipe sections are to be carried out by means of butt welding. Other types of connections including threaded connections and flange connections are not permitted.
1.26.4 Where there are two or more cylinders of each gas, separate dedicated storage rooms are to be provided for each gas.
1.26.5 Storage rooms are to be constructed of steel, not located below the open deck, and be well ventilated and accessible from the open deck. The ventilation arrangement is to be separate from the ship's ventilation systems.
1.26.6 Possible sources of ignition are not to be fitted in acetylene storage room. Electrical installation, if fitted, is to be of explosion-proof type.
1.26.7 Securing arrangements of gas cylinders are to be released easily and quickly for the expeditious removal of cylinders in the event of fire.
1.26.8 Prominent and permanent "NO SMOKING" signs are to be displayed at the gas cylinder storage room.
1.26.9 Where cylinders are stowed in open locations means are to be provided to:
(1) protect cylinders and associated piping from physical damage;
(2) minimize exposure to hydrocarbons;
(3) ensure suitable drainage.
1.26.10 If pipes between the work area for oxyacetylene welding and the gas storage room need to pass through deck or bulkhead, fixed pipes are to be provided between gas cylinder and work area for welding and are not to pass through the accommodation spaces, service spaces and control stations. Suitable protection is to be provided at the position passing through deck or bulkhead. Outlet stations are to be fitted with shut-off valves.

1.27 Helicopter facilities

1.27.1 Where the ship is provided with helicopter facilities, including hangar and refueling facilities, these facilities are to comply with the relevant provisions of Reg.18, Chapter II-2 of SOLAS.

2 Fire safety measures for passenger ships

2.1 Structure

2.1.1 The hull, superstructures, structural bulkheads, decks and deckhouses are to be constructed of steel or other equivalent material.
2.1.2 However, in cases where any part of the structure is of aluminum alloy, the following are

to apply.
(1) The insulation of aluminum alloy components of “A" or “B" class divisions, except structure which is considered as non-load-bearing, is to be such that the temperature of the structural core does not rise more than 200℃ above the ambient temperature at any time during the applicable fire exposure to the standard fire test.
(2) Special attention is to be given to the insulation of aluminum alloy components of columns, stanchions and other structural members required to support lifeboat and liferaft stowage, launching and embarkation areas, and “A" and “B" class divisions to ensure:

① that for such members supporting lifeboat and liferaft areas and “A" class divisions, the temperature rise limitation specified in above-mentioned (1) is to apply at the end of one hour;

② that for such members required to support “B" class divisions, the temperature rise limitation specified in above-mentioned (1) is to apply at the end of half an hour.

2.1.3 Crowns and casings of machinery spaces of category A are to be of steel construction.

2.2 Main vertical zones and horizontal zones

2.2.1 Passenger ships of class II
(1) The hull, superstructure and deckhouses in way of accommodation and service spaces are to be subdivided into main vertical zones by “A-0" class divisions. Steps and recesses are to be kept to a minimum, but where they are necessary they are also to be “A" class divisions. These divisions are to have insulation values in accordance with the tables in 2.4.3 of this Chapter.
(2) As far as practicable, the bulkheads forming the boundaries of the main vertical zones above the bulkhead deck are to be in line with watertight subdivision bulkheads situated immediately below the bulkhead deck. If the total area of the main vertical zone is not greater than 1600 m^2 on any deck, the maximum value of the length and width may be increased to 48 m. The length or width of a main vertical zone means the maximum distance between the furthermost points of the bulkheads bounding it.
(3) Such bulkheads are to extend from deck to deck and to the shell or other boundaries.
(4) Where a main vertical zone is subdivided by horizontal “A" class divisions into horizontal zones for the purpose of providing an appropriate barrier between a zone with sprinklers and a zone without sprinklers, the divisions are to extend between adjacent main vertical zone bulkheads and to the shell or exterior boundaries of the ship and are to be insulated in accordance with the fire insulation and integrity values given in Table 2.4.3b.
(5) On ships designed for special purposes, where the provision of main vertical zone bulkheads would defeat the purpose for which the ship is intended, equivalent means for controlling and limiting a fire are to be substituted and specifically approved.

2.3 Bulkheads within a main vertical zone or accommodation and service spaces and control stations

2.3.1 All corridor bulkheads where required to be “B" class divisions are to extend from deck to deck except:
(1) when continuous “B" class ceilings or linings are fitted on both sides of the bulkhead, the portion of the bulkhead behind the continuous ceiling or lining is to be of material which, in thickness and composition, is acceptable in the construction of “B" class divisions but which is to be required to meet “B" class integrity standards only in so far as is reasonable and practicable;
(2) in the case of a ship protected by an automatic sprinkler system complying with the provisions of 1.11 of this Chapter, the corridor bulkheads of “B" class materials may terminate at a ceiling in the corridor provided such a ceiling is of material which, in thickness and composition, is acceptable in the construction of “B" class divisions. Notwithstanding the requirements of 2.4 of this Chapter, such bulkheads and ceilings are to be required to meet “B" class integrity standards only in so far as is reasonable and practicable. All doors and frames in such bulkheads are to be of non-combustible materials and are to be so constructed and erected as to provide substantial fire resistance.

2.3.2 All bulkheads required to be “B" class divisions, except corridor bulkheads referred to in 2.3.1 of this Chapter, are to extend from deck to deck and to the shell or other boundaries unless the continuous “B" class ceilings or linings are fitted on both sides of the bulkheads, in which case the bulkhead may terminate at the continuous ceiling or lining.

2.4 Fire integrity of bulkheads and decks

2.4.1 In addition to complying with the specific provisions for fire integrity of bulkheads and decks mentioned elsewhere in this Chapter, the minimum fire integrity of bulkheads and decks is to be as prescribed in the following tables. Where the contents and use of a space are such that there is a doubt as to its classification for the purpose of this paragraph, it is to be treated as a space within the relevant category having the most stringent boundary requirements.

2.4.2 The following requirements are to govern application of the tables.

(1) For determining the appropriate fire integrity standards to be applied to boundaries between adjacent spaces, such spaces are classified according to their fire risk as shown in categories ① to ⑩ below. Smaller, enclosed rooms within a space that have less than 30% communicating openings to that space are considered separate spaces. The fire integrity of the boundary bulkheads and decks of such smaller rooms is to be as prescribed in tables. The title of each category is intended to be typical rather than restrictive. The number preceding each category refers to the applicable column or row in the tables.

① Control stations

Spaces containing emergency sources of power and lighting.
Wheelhouse and chartroom.
Spaces containing the ship's radio equipment.
Fire control stations.
Control room for propulsion machinery when located outside the propulsion machinery space.
Spaces containing centralized fire alarm equipment.
Spaces containing navigation equipment.
Spaces containing emergency battery rechargers or emergency charging and recharging panels.
All spaces containing emergency batteries (including backup power for radio installation or emergency batteries for the starting of the emergency generator).
Storage spaces for fire-extinguishing medium of fixed fire-extinguishing systems.

② Corridors

Passenger and crew corridors and lobbies.

③ Accommodation spaces

Spaces as defined in 1.2 of this Chapter excluding corridors.
Changing rooms.

④ Stairways

Interior stairways, lifts, totally enclosed emergency escape trunks, and escalators (other than those wholly contained within the machinery spaces) for passengers and crew and enclosures thereto.
In this connection, a stairway which is enclosed at only one level is to be regarded as part of the space from which it is not separated by a fire door.

⑤ Service spaces (low risk)

Lockers and store-rooms having areas less than 4 m^2 in which flammable liquids are not stored.
Drying rooms and laundries.
Food storage or refrigerating rooms using non-combustible materials as insulation layer.
Storage rooms having areas less than 4 m^2 for work clothes of crew when the clothes are soiled with oil.

⑥ Machinery spaces of category A

Spaces as defined in 1.2 of this Chapter.

⑦ Other machinery spaces

Electrical equipment rooms (auto-telephone exchange, air-conditioning duct spaces).
Spaces as defined in 1.2 of this Chapter excluding machinery spaces of category A.

⑧ Cargo spaces

All spaces used for cargo and trunkways and hatchways to such spaces.

⑨ Service spaces (high risk)

Galleys, pantries containing cooking appliances, paint and lamp rooms, lockers and

store-rooms having area of 4 m^2 or more, spaces for the storage of flammable liquids, saunas and workshops other than those forming part of the machinery spaces.
Food storage or refrigerating rooms using non-combustible materials as insulation layer.
Mail rooms.
Storage rooms having areas of 4 m^2 or more for work clothes of crew when the clothes are soiled with oil.
Storage rooms for oxygen or acetylene.

⑩ Open decks

Open deck spaces and enclosed promenades. To be considered in this category, enclosed promenades are to have no significant fire risk, meaning that furnishings are to be restricted to deck furniture. In addition, such spaces are to be naturally ventilated by permanent openings.
Air spaces (the space outside superstructures and deckhouses).

(2) In determining the applicable fire integrity standard of a boundary in accordance with Tables 2.4.4a and 2.4.4b between two spaces within a main vertical zone or horizontal zone which is not protected by an automatic sprinkler system complying with the provisions of 1.11 of this Chapter or between such zones neither of which is so protected, the higher of the two values given in the tables is to apply.

(3) In determining the applicable fire integrity standard of a boundary in accordance with Tables 2.4.4a and 2.4.4b between two spaces within a main vertical zone or horizontal zone which is protected by an automatic sprinkler system complying the provisions of 1.11 of this Chapter or between such zones both of which are so protected, the lesser of the two values given in the tables is to apply. Where a zone with sprinklers and a zone without sprinklers meet within accommodation and service spaces, the higher of the two values given in the tables is to apply to the division between the zones.

(4) Continuous "B" class ceilings or linings, in association with the relevant decks or bulkheads, may be accepted as contributing, wholly or in part, to the required insulation and integrity of a division.

2.4.3 The fire integrity of bulkheads and decks separating adjacent spaces for passenger ships of class II is to comply with the provisions of Table 2.4.3a and Table 2.4.3b respectively.

Fire integrity of bulkheads separating adjacent spaces **Table 2.4.3a**

Space	①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩
Control stations ①	A-0 [c]	A-0	A-60	A-0	A-15	A-60	A-15	A-60	A-60	*
Corridors ②		C [e]	B-0 [e]	A-0 [a] B-0 [e]	B-0 [e]	A-60	A-0	A-0	A-0	*
Accommodation spaces ③			C [e]	A-0 [a] B-0 [e]	B-0 [e]	A-60	A-0	A-0	A-0	*
Stairways ④				A-0 [a] B-0 [e]	A-0 [a] B-0 [e]	A-60	A-0	A-0	A-0	*
Service spaces(low risk) ⑤					C [e]	A-60	A-0	A-0	A-0	*
Machinery spaces of category A ⑥						*	A-0	A-0	A-60	*
Other machinery spaces ⑦							A-0 [b]	A-0	A-0	*
Cargo spaces ⑧								*	A-0	*
Service spaces(high risk) ⑨									A-0 [b]	*
Open decks ⑩										—

Fire integrity of decks separating adjacent spaces **Table 2.4.3b**

Space above→ Space below↓	①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩
Control stations ①	A-0	A-0	A-0	A-0	A-0	A-60	A-0	A-0	A-0	*
Corridors ②	A-0	*	*	A-0	*	A-60	A-0	A-0	A-0	*
Accommodation spaces ③	A-60	A-0	*	A-0	*	A-60	A-0	A-0	A-0	*
Stairways ④	A-0	A-0	A-0	*	A-0	A-60	A-0	A-0	A-0	*
Service spaces(low risk)	A-15	A-0	A-0	A-0	*	A-60	A-0	A-0	A-0	*

⑤										
Machinery spaces of category A ⑥	A-60	A-60	A-60	A-60	A-60	*	A-60[f]	A-30	A-60	*
Other machinery spaces ⑦	A-15	A-0	A-0	A-0	A-0	A-0	*	A-0	A-0	*
Cargo spaces ⑧	A-60	A-0	A-0	A-0	A-0	A-0	A-0	*	A-0	*
Service spaces(high risk) ⑨	A-60	A-0	A-0	A-0	A-0	A-60	A-0	A-0	A-0	*
Open decks ⑩	*	*	*	*	*	*	*	*	*	*

Notes: To be applied to both tables 2.4.3a and 2.4.3b as appropriate

a For clarification as to which applies, see 2.3 and 2.6 of the Chapter.

b Where spaces are of the same numerical category and superscript "b" appears, a bulkhead or deck of the rating shown in the tables is only required when the adjacent spaces are for a different purpose (e.g., in category ⑨). A galley next to a galley does not require a bulkhead, but a galley next to a paint room requires an "A-0" bulkhead.

c Bulkheads separating the wheelhouse and chartroom from each other may have a "B-0" rating.

e Where the division is the boundary of main vertical zone or horizontal zone, "B-0" and "C", where appearing in table 2.4.3a, is to be read as "A-0".

f Fire insulation need not be fitted if the machinery space in category ⑦ has little or no fire risk.

* Where an asterisk appears in the tables, the division is required to be of steel or other equivalent material, but is not required to be of "A" class standard. However, where a deck, except in a category ⑩ space, is penetrated for the passage of electric cables, pipes and vent ducts, such penetrations are to be made tight to prevent the passage of flame and smoke. Divisions between control stations (emergency generators) and open decks may have air intake openings without means for closure, unless a fixed gas fire-extinguishing system is fitted.

Where the division is the boundary of horizontal zone, an asterisk, where appearing in table 2.4.3a, except for categories ⑧ and ⑩, is to be read as "A-0".

— No special requirement for the material or integrity of the boundary.

2.4.4 The fire integrity of bulkheads and decks separating adjacent spaces for passenger ships of class III is to comply with the provisions of Table 2.4.4a and Table 2.4.4b respectively.

Fire integrity of bulkheads separating adjacent spaces Table 2.4.4a

Space	①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩
Control station ①	A-0[c]	A-0	A-15	A-0	A-15	A-30[p] A-15	A-15	A-30	A-30	*
Corridors ②		C	B-0	A-0[a] B-0	B-0	A-30[p] A-15	A-0	A-0	A-15 A-0[d]	*
Accommodation spaces ③			C	A-0[a] B-0	B-0	A-30[p] A-15	A-0	A-0	A-15 A-0[d]	*
Stairways ④				A-0[a]	A-0[a]	A-30[p] A-15	A-0	A-0	A-15 A-0[d]	*
Service spaces(low risk) ⑤					C	A-0	*	*	A-0	*
Machinery spaces of category A ⑥						*	A-0	A-0	A-30	*
Other machinery spaces ⑦							*	*	A-0	*
Cargo spaces ⑧								*	*	*
Service spaces(high risk) ⑨									*[k]	*
Open decks ⑩										—

Fire integrity of decks separating adjacent spaces Table 2.4.4b

Space above→ / Space below↓	①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩
Control stations ①	A-0	A-0	A-0	A-0	A-0	A-30[p] A-15	A-0	A-0	A-0	*
Corridors ②	A-0	*	*	A-0	*	A-30[p] A-15	A-0	A-0	A-0	*
Accommodation spaces ③	A-15	A-0	*	A-0	*	A-30[p] A-15	A-0	A-0	A-0	*

Stairways ④	A-0	A-0	A-0	*	A-0	A-30[p] A-15	A-0	A-0	A-0	*
Service spaces(low risk) ⑤	A-15	A-0	A-0	A-0	*	A-15	A-0	A-0	A-0	*
Machinery spaces of category A ⑥	A-30[p] A-15	A-30[p] A-15	A-30[p] A-15	A-30[p] A-15	A-15	*	A-0	A-15	A-30	*
Other machinery spaces ⑦	A-15	A-0	A-0	A-0	A-0	A-0	*	A-0	A-0	*
Cargo spaces ⑧	A-30	A-0	A-0	A-0	A-0	A-0	A-0	*	A-0	*
Service spaces(high risk) ⑨	A-30	A-15 A-0 [d]	A-15 A-0 [d]	A-15 A-0 [d]	A-0	A-15[P] A-0	A-0	A-0	*	*
Open decks ⑩	*	*	*	*	*	*	*	*	*	*

Notes: To be applied to both tables 2.4.4a and 2.4.4b as appropriate

a For clarification as to which applies, see 2.3 and 2.6 of the Chapter.

c Bulkheads separating the wheelhouse and chartroom from each other may have a "B-0" rating.

d Refer to 2.4.2(2) and (3) of the Chapter.

k A bulkhead or deck of the rating shown in the tables is only required when the adjacent spaces are for a different purpose. For example, a galley next to a galley does not require a bulkhead, but a galley next to a paint room requires a bulkhead of steel or other equivalent materials.

p Division rating of the internal-combustion machinery used for main propulsion where such machinery has in the aggregate a total power output of more than 375 kW.

* The division is required to be of steel or other equivalent material, but is not required to be of "A" class standard.

— No special requirement for the material or integrity of the boundary.

2.4.5 Windows facing life-saving appliances, embarkation and assembly stations, external stairs and open decks used for escape routes, and boundaries that will obstruct access to embarkation stations after being destroyed by fire, including doors, windows and sidescuttles, are to have fire integrity at least of "A-0" standard. For passenger ships carrying 100 passengers and upwards, fire integrity is to reach at least "A-30" standard and for passenger ships carrying 500 passengers and upwards, fire integrity is to reach at least "A-60" standard.

2.4.6 For evacuation stations and external escape routes (including survival craft stowage area, open deck spaces and enclosed promenades forming lifeboat and liferaft embarkation and lowering stations, internal and external assembly stations, external stairs and open decks used for escape routes, the ship's side to the waterline in the lightest seagoing condition, superstructure and deckhouse sides situated below and adjacent to the liferaft and evacuation slide embarkation areas), except that the boundaries of the adjacent spaces are open deck spaces, sanitary and similar spaces as well as tanks, voids and auxiliary machinery spaces having little or on fire risk are of "A-0" class integrity only, other boundaries of adjacent spaces are to be of at least "A-30" class integrity, and "A-60" when the ship carries 500 passengers and upwards. However, the ship's side to the waterline in the lightest seagoing condition, superstructure and deckhouse sides situated below and adjacent to the liferaft and evacuation slide embarkation areas may be reduced to "A-30". Where accommodation spaces or sanitary and similar spaces have fire risk, be it high or low, are located completely within the outer perimeter of the assembly station, the bulkheads of these spaces are allowed to be of "B-0" class integrity. Control positions for audio, video and light installations may be considered as part of the assembly station.

2.5 Means of escape

2.5.1 Unless expressly provided otherwise in this paragraph, at least two widely separated and ready means of escape are to be provided from all spaces or groups of spaces.

2.5.2 Stairways and ladders are to be arranged to provide ready means of escape to the lifeboat and liferaft embarkation deck from all passenger and crew spaces and from spaces in which the crew is normally employed, other than machinery spaces. In particular, the following provisions are to be complied with.

(1) Below the bulkhead deck, two means of escape, at least one of which is to be independent of watertight doors, are to be provided from each watertight compartment or similarly restricted space or group of spaces. Exceptionally, one of the means of escape for crew spaces that are entered only occasionally, if the required escape route is independent of watertight doors may be dispensed with. In this case, only means of escape can provide safe exit and the clear width of

stairways is not to be less than 800 mm.
(2) Above the bulkhead deck there are to be at least two means of escape from each main vertical zone or similarly restricted space or group of spaces at least one of which is to give access to a stairway forming a vertical escape.
(3) If a radiotelegraph station has no direct access to the open deck, two means of escape from or access to such station are to be provided, one of which may be a porthole or window of sufficient size or another equivalent means.
(4) A corridor, lobby or part of a corridor from which there is only one route of escape is to be prohibited. Dead-end corridors used in service areas which are necessary for the practical utility of the ship, such as fuel oil stations and athwartship supply corridors, are to be permitted, provided such dead-end corridors are separated from crew accommodation areas and are inaccessible from passenger accommodation areas. Also, a part of a corridor that has a depth not exceeding its width is considered a recess or local extension and is permitted.
(5) At least one of the means of escape required by (1) and (2) above is to consist of a readily accessible enclosed stairway, which is to provide continuous fire shelter from the level of its origin to the appropriate lifeboat and liferaft embarkation decks, or to the uppermost weather deck if the embarkation deck does not extend to the main vertical zone being considered. In the latter case, direct access to the embarkation deck by way of external open stairways and passageways is to be provided and is to have emergency lighting in accordance with the requirements of 3 of Chapter 2-1 of this PART and slip-free surfaces underfoot. The widths, number and continuity of escapes are to comply with the following requirements:

① Stairways are not to be less than 900 mm in clear width with handrails on both sides. The minimum clear width of stairways is to be increased by 10 mm for every one person provided for in excess of 90 persons. When the stairways are more than 900 mm in width, the maximum clear width between handrails is not to be more than 1,800 mm. The total number of persons to be evacuated by such stairways is to be assumed to be two thirds of the crew and the total number of passengers in the areas served by such stairways.

② All stairways sized for more than 90 persons are to be aligned fore and aft.

③ The dimensions of doorways, corridors and intermediate working platforms as component part of the escape route are to be determined using the same method as those of escapes.

④ Stairways are not to exceed 3.5 m in vertical rise without the provision of a working platform and are not to have an angle of inclination greater than 45.

⑤ With the exception of intermediate working platforms, working platforms at each deck level are to be not less than 2 m^2 in area and are to increase by 1 m^2 for every 10 persons provided for in excess of 20 persons, but need not exceed 16 m^2, except for those working platforms servicing public spaces having direct access onto the stairway enclosure.

(6) Protection of access from the stairway enclosures to the lifeboat and liferaft embarkation areas is to be provided either directly or through protected internal routes which have fire integrity and insulation values for stairway enclosures as determined by tables 2.4.3 to 2.4.4, as appropriate.
(7) Stairways serving only a space and a balcony in that space are not to be considered as forming one of the required means of escape.
(8) Each level within an atrium is to have two means of escape, one of which is to give direct access to an enclosed vertical means of escape meeting the requirements of (5). The dimension of the atrium is to take into account the total number of people at each level.
(9) Cabin and stateroom doors are not to require keys to unlock them from inside the room. Neither are there to be any doors along any designated escape route which require keys to unlock them when moving in the direction of escape.
(10) For passenger ships of class III carrying less than 100 passengers, the requirement for enclosed stairway, which is to provide continuous fire shelter, may not be complied with provided there are two means of escape.
2.5.3 Two means of escape are to be provided from each machinery space. In particular, the following provisions are to be complied with.
(1) Where the space is below the bulkhead deck the two means of escape are to consist of either:

① two sets of steel ladders, as widely separated as possible, leading to doors in the upper part of the space, separated and from which access is provided to the appropriate lifeboat and liferaft embarkation decks. One of these ladders is to be located within a protected

enclosure that satisfies category ④ of 2.4.3 and 2.4.4 of this Chapter, from the lower part of the machinery space of category A (the lowest level accessible to personnel) to a safe position outside the space. Self-closing fire doors of the same fire integrity standards are to be fitted in the enclosure. The ladder is to be fixed in such a way that heat is not transferred into the enclosure through non-insulated fixing points. The protected enclosure is to have minimum internal dimensions of at least 800 mm × 800 mm, and is to have emergency lighting provisions;

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

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

(3) In a passenger ship of less than 1000 gross tonnage, one of the means of escape may be dispensed with, due regard being paid to the width and disposition of the upper part of the space; and in a passenger ship of 1000 gross tonnage and above, one of the means of escape from any such space may be dispensed with so long as either a door or a steel ladder provides a safe escape route to the embarkation deck, due regard being paid to the nature and location of the space and whether persons are normally employed in that space.

(4) The central control room in machinery spaces is to have at least one means of escape to provide fire shelter to a safe position outside the machinery spaces.

(5) In the steering gear space, a second means of escape is to be provided when the emergency steering position is located in that space unless there is direct access to the open deck.

2.5.4 Stairways used as escapes in machinery spaces mentioned in 2.5.3 above are not to be less than 600 mm in clear width and are not to have an angle of inclination greater than 60. Where ladders are used as means of escape, standards recognized by CCS are to be complied with①.

2.5.5 In no case are lifts to be considered as forming one of the required means of escape.

2.5.6 The means of escape, including stairways and exits, are to be marked by lighting or photoluminescent strip indicators placed not more than 0.3 m above the deck at all points of the escape route, including angles and intersections②. The marking must enable passengers to identify the routes of escape and readily identify the escape exits. If electric illumination is used, it is to be supplied by the emergency source of power and it is to be so arranged that the failure of any single light or cut in a lighting strip will not result in the marking being ineffective. Additionally, escape route signs and fire equipment location markings are to be of photoluminescent material.

2.5.7 Emergency escape breathing devices (EEBD)

All passenger ships are to carry emergency escape breathing devices complying with the requirement of 2.2, Chapter 3 of the FSS Code within accommodation spaces and machinery spaces. The number and arrangement of EEBDs are to comply with the requirements of Table 2.5.7.

Requirements for the number and arrangement of EEBDs Table 2.5.7

Class of passenger ships	Machinery spaces of category A (attended)		Other machinery spaces (attended)	Accommodation spaces	Total number of devices	For training
	Containing internal combustion machinery used for main propulsion	Containing internal combustion machinery used for purposes other than main propulsion				

① Such as Chinese national standards Ship's steel inclined ladders GB4444-84, Ship's steel vertical ladders GB3892-83; Chinese industry standard Ship's steel inclined ladders CB/T81-1999, etc.

② Refer to IMO resolution A.752(18) the Guidelines for the evaluation, testing and application of low-location lighting on passenger Ships and publication ISO 15370:2001 Ships and marine technology—Low-location lighting on passenger ships.

Class II	(1) Machinery control room located within a machinery space: 1; workshop: 1 (not necessary if there is direct access to the means of escape); every deck or working platform adjacent to the means of escape (the means of escape forms the enclosed means of space except in the engine room bottom or another means of escape independent of watertight doors): 1. or (2) the number and location of EEBDs may also be determined according to the arrangement of the engine room and number of persons, but is to be at least 2 in number	every deck or working platform adjacent to the means of escape (the means of escape forms the enclosed means of space except in the engine room bottom or another means of escape independent of watertight doors): 1.	At least 1	At least 2; 4 more for every main vertical zone	2	1
Class III				At least 2		

2.6 Protection of stairways and lifts in accommodation spaces, service spaces and control stations

2.6.1 Stairways are to be within enclosures formed of "A" class divisions, with positive means of closure at all openings, except that:

(1) a stairway connecting only two decks need not be enclosed, provided the integrity of the deck is maintained by proper bulkheads or self-closing doors in one 'tween-deck space. When a stairway is closed in one 'tween-deck space, the stairway enclosure is to be protected in accordance with Table 2.4.3b or 2.4.4b of this Chapter for decks;

(2) stairways may be fitted in the open in a public space, provided they lie wholly within the public space;

(3) for passenger ships of class III carrying less than 100 passengers, stairways may be allowed to be within enclosures formed of "B" class divisions, with positive means of closure at all openings. However, for a stairway connecting only two decks, at least on one horizontal level the enclosure may be of "B-0" class divisions.

2.6.2 Stairway enclosures are to have direct access from the corridors and be of a sufficient area to prevent congestion, having in view the number of persons likely to use them in an emergency. Within the perimeter of such stairway enclosures, only public toilets, lockers of non-combustible material providing storage for non-hazardous safety equipment and open information counters are permitted. Only public spaces, corridors, lifts, public toilets, special category spaces, other escape stairways required by 2.5.2 of this Chapter and external areas are permitted to have direct access to these stairway enclosures.

2.6.3 All stairways are to be of steel or approved equivalent material.

2.6.4 Lift trunks are to be so fitted as to prevent the passage of smoke and flame from one 'tween-deck to another and are to be provided with means of closing so as to permit the control of draught and smoke.

2.7 Openings in "A" class divisions

2.7.1 For passenger ships of class II

(1) Except for hatches between cargo, special category, store, and baggage spaces, and between such spaces and the weather decks, openings are to be provided with permanently attached means of closing which are to be at least as effective for resisting fires as the divisions in which they are fitted.

(2) The construction of doors and door frames in "A" class divisions, with the means of securing

them when closed, is to provide resistance to fire as well as to the passage of smoke and flame equivalent to that of the bulkheads in which the doors are situated. Such doors and door frames are to be constructed of steel or other equivalent material. Watertight doors need not be insulated. Doors in machinery spaces boundaries of category A are to be reasonably gastight and be of a self-closing type. Hold-back hooks are not permitted. However, hold-back arrangements fitted with remote release devices of the fail-safe type may be utilized.

(3) It is to be possible for each door to be opened and closed from each side of the bulkhead by one person only.

(4) The requirements for "A" class integrity of the outer boundaries of a ship are not to apply to glass partitions, windows and sidescuttles, provided that there is no requirement for such boundaries to have "A" class integrity. The requirements for "A" class integrity of the outer boundaries of the ship are not to apply to exterior doors and stairway enclosure doors, except for those in superstructures and deckhouses facing life-saving appliances, embarkation and external assembly station areas, external stairs and open decks used for escape routes.

(5) Fire doors in main vertical zone bulkheads, galley boundaries and stairway enclosures other than power-operated watertight doors and those which are normally locked are to satisfy the following requirements:

① the doors are to be self-closing and be capable of closing with an angle of inclination of up to 3.5 °opposing closure;

② the approximate time of closure for hinged fire doors is to be no more than 40 s and no less than 10 s from the beginning of their movement with the ship in upright position. The approximate uniform rate of closure for sliding doors is to be of no more than 0.2 m/s and no less than 0.1 m/s with the ship in upright position;

③ the doors, except those for emergency escape trunks, are to be capable of remote release from the continuously manned central control station, either simultaneously or in groups, and are to be capable of release also individually from a position at both sides of the door. Release switches are to have an on-off function to prevent automatic resetting of the system;

④ hold-back hooks not subject to central control station release are prohibited;

⑤ a door closed remotely from the central control station is to be capable of being re-opened from both sides of the door by local control. After such local opening, the door is to automatically close again;

⑥ indication is to be provided at the fire door indicator panel in the continuously manned central control station whether each door is closed;

⑦ the release mechanism is to be so designed that the door will automatically close in the event of disruption of the control system or central power supply;

⑧ local power accumulators for power-operated doors are to be provided in the immediate vicinity of the doors to enable the doors to be operated at least ten times (fully opened and closed) after disruption of the control system or central power supply using the local controls;

⑨ disruption of the control system or central power supply at one door is not to impair the safe functioning of the other doors;

⑩ remote-released sliding or power-operated doors are to be equipped with an alarm that sounds at least 5 s but no more than 10 s, after the door is released from the central control station and before the door begins to move and continues sounding until the door is completely closed;

⑪ a door designed to re-open upon contacting an object in its path is to re-open not more than 1 m from the point of contact;

⑫ double-leaf doors equipped with a latch necessary for their fire integrity are to have a latch that is automatically activated by the operation of the doors when released by the system;

⑬ the components of the local control system are to be accessible for maintenance and adjusting;

⑭ power-operated doors are to be provided with a control system of an approved type which is to be able to operate in case of fire. This system is to satisfy the following requirements:

(a) the control system is to be able to operate the door at the temperature of at least 200℃ for at least 60 min, served by the power supply;

(b) the power supply for all other doors not subject to fire is not to be impaired;

(c) at temperatures exceeding 200℃, the control system is to be automatically isolated from the power supply and is to be capable of keeping the door closed up to at least 945℃.

(6) Except for watertight doors, weathertight doors (semi-watertight doors), doors leading to the open deck and doors which need to be reasonably gastight, all "A" class doors located in stairways, public spaces and main vertical zone bulkheads in escape routes are to be equipped with a self-closing hose port. The material, construction and fire resistance of the hose port are to be equivalent to the door into which it is fitted, and are to be a 150 mm square clear opening with the door closed and are to be inset into the lower edge of the door, opposite the door hinges or, in the case of sliding doors, nearest the opening.

2.7.2 For passenger ship of class III

(1) The requirements of 2.7.1(1) to (4) of this Chapter are to be complied with.

(2) Fire doors in main vertical zone bulkheads, galley boundaries and stairway enclosures other than power-operated watertight doors and those which are normally locked are to be self-closing and be capable of closing with an angle of inclination of up to 3.5°opposing closure. The time of closure for doors is to be capable of being controlled when necessary so as to prevent undue danger to personnel. All doors, are to be capable of remote release from the central control station, either simultaneously or in groups, and are to be capable of release also individually from a position at the door. The release mechanism is to be so designed that the door will automatically close in the event of disruption of the control system. However, where power-operated watertight doors are fitted, it may be deemed that the objective has already met. Hold-back hooks not subject to central control station release are prohibited. Double-leaf doors, when allowed to be fitted, are to have a latch that is automatically activated by the operation of the doors when released by the system.

(3) Doors in galley boundaries are to be of steel or approved equivalent material.

2.8 Openings in "B" class divisions

2.8.1 For passenger ships of class II

(1) Doors and door frames in "B" class divisions and means of securing them are to provide a method of closure which are to have resistance to fire equivalent to that of the divisions, except that ventilation openings may be permitted in the lower portion of such doors. Where such opening is in or under a door, the total net area of any such opening or openings is not to exceed 0.05 m^2. All ventilation openings are to be fitted with a grill made of non-combustible material. Doors in "B" class divisions are to be non-combustible.

(2) Openings in corridor bulkheads of "B" class materials are to be protected in accordance with the provisions of 2.3.1(2) of this Chapter if it is applicable.

(3) The requirements for "B" class integrity of the outer boundaries of a ship are not to apply to glass partitions, windows and sidescuttles. Similarly, the requirements for "B" class integrity are not to apply to exterior doors in superstructures and deckhouses. The use of combustible materials in doors separating cabins from the individual interior sanitary spaces such as showers may be permitted.

2.8.2 For passenger ships of class III

(1) Doors and door frames in corridor bulkheads of "B" class divisions and means of securing them are to provide a method of closure which are to have resistance to fire equivalent to that of the divisions.

(2) Doors in "B" class divisions are to be non-combustible. Openings in corridor bulkheads of "B" class materials are to be protected in accordance with the provisions of 2.3.1(2) of this Chapter if it is applicable.

(3) The requirements of 2.8.1(3) of this Chapter are to be complied with.

2.9 Windows and sidescuttles

2.9.1 Windows and sidescuttles in bulkheads within accommodation and service spaces and control stations are to be so constructed as to preserve the integrity requirements of the type of bulkheads in which they are fitted.

2.9.2 Notwithstanding the requirements of tables 2.4.3 and 2.4.4 of this Chapter, windows and sidescuttles in bulkheads separating accommodation and service spaces and control stations from weather are to be constructed with frames of steel or other suitable material. The glass is to be

retained by a metal glazing bead or angle.

2.9.3 Windows facing life-saving appliances, embarkation and assembly stations, external stairs and open decks used for escape routes, and windows situated below life raft and escape slide embarkation areas are to have fire integrity as required in 2.4.5 and 2.4.6 of this Chapter. Where automatic dedicated sprinkler heads are provided for windows, "A-0" windows may be accepted as equivalent. The sprinkler heads are to either be dedicated heads located above the windows; or conventional ceiling sprinkler heads arranged such that the window is protected by an average application rate of at least 5 *l*/min/m^2 and the additional window area is included in the calculation of the area of coverage; or water-mist nozzles that have been tested and approved in accordance with the guidelines of IMO①.

Windows located in the ship's side below the lifeboat embarkation area are to have fire integrity at least equal to "A-0" class.

2.10 Restricted use of combustible materials

2.10.1 Passenger ships of class II and passenger ships of class III carrying 100 passengers and upwards

(1) Insulating materials are to be non-combustible, except in cargo spaces, mail rooms, baggage rooms and refrigerated compartments of service spaces as well as accommodation spaces and service spaces in which the type of the internal division bulkheads are expressly provided as not limited. All ceilings, linings, grounds, draught stops and their insulation are to be of non-combustible materials.

(2) Vapour barriers and adhesives used in conjunction with insulation, as well as the insulation of pipe fittings, need not be of non-combustible materials, but they are to be kept to the minimum quantity practicable and their exposed surfaces are to have low flame-spread characteristics.

(3) Partial bulkheads or decks used to subdivide a space for utility or artistic treatment are to be of non-combustible materials. Linings, ceilings and partial bulkheads or decks used to screen or to separate adjacent cabin balconies are to be of non-combustible materials.

(4) "A", "B" or "C" class divisions in accommodation and service spaces and cabin balconies which are faced with combustible materials, facings, mouldings, decorations and veneers are to comply with the following requirements. However, traditional wooden benches and wooden linings on bulkheads and ceilings are permitted in saunas.

① Combustible materials used on the surfaces and linings are to have a calorific value not exceeding 45 MJ/m^2 of the area for thickness used. The requirements are not applicable to the surfaces of furniture fixed to linings or bulkheads.

② The total volume of combustible facings, mouldings, decorations and veneers in accommodation and service spaces is not to exceed a volume equivalent to 2.5 mm veneer on the combined area of the walls and ceiling linings. The requirements do not apply to cabin balconies. In the case of ships fitted with an automatic sprinkler system complying with the provisions of 1.11 of this Chapter, the above volume may include some combustible material used for erection of "C" class divisions.

③ The following surfaces are to have low flame-spread characteristics:

(a) exposed surfaces in corridors and stairway enclosures and of bulkhead and ceiling linings in accommodation and service spaces (except saunas) and control stations;

(b) surfaces and grounds in concealed or inaccessible spaces in accommodation and service spaces and control stations; and

(c) exposed surfaces of cabin balconies, except for natural hard wood decking systems.

(5) Furniture in stairway enclosures is to be limited to seating. It is to be fixed, limited to six seats on each deck in each stairway enclosure, be of restricted fire risk, and is not to restrict the passenger escape route. Additional seating in the main reception area within a stairway enclosure if it is fixed, non-combustible and does not restrict the passenger escape route may be permitted. Furniture is not to be permitted in passenger and crew corridors forming escape routes in cabin areas.

(6) Furniture and furnishings on cabin balconies are to comply with 1.2(19)①, ②, ③, ⑥ and ⑦ of this Chapter unless such balconies are protected by a fixed pressure water-spraying and

① Refer to the Revised Guidelines for approval of sprinkler systems equivalent to that referred to in SOLAS Regulation II-2/12 (Resolution A.800(19)).

fixed fire detection and fire alarm systems.
(7) Paints, varnishes and other finishes used on exposed interior surfaces and exposed surfaces of cabin balconies, excluding natural hard wood decking systems, are not to be capable of producing excessive quantities of smoke and toxic products, this being determined in accordance with the Fire Test Procedures Code.
(8) Primary deck coverings, if applied within accommodation and service spaces, control stations and cabin balconies are to be of approved material which will not give rise to smoke or toxic or explosive hazards at elevated temperatures.
2.10.2 Passenger ships of class III carrying less than 100 passengers
(1) As a minimum, the requirements of 2.10.1(1), (2), (3), (4), (7), (8) of this Chapter are to be complied with.
(2) Furniture in stairway enclosures is to be limited to seating. It is to be fixed and is not to restrict the passenger escape route. Furniture is not to be permitted in passenger and crew corridors forming escape routes in cabin areas.

2.11 Details of construction
2.11.1 Passenger ships of class II and III
(1) In accommodation and service spaces, control stations, corridors and stairways:
① Air spaces enclosed behind ceilings, paneling or linings are to be divided by close-fitting draught stops spaced not more than 14 m apart.
② In the vertical direction, such enclosed air spaces, including those behind linings of stairways, trunks, etc., are to be closed at each deck.
(2) The construction of ceilings and bulkheads is to be such that it will be possible, without impairing the efficiency of the fire protection, for the fire patrols to detect any smoke originating in concealed and inaccessible places, except where there is no risk of fire originating in such places.
2.11.2 Passenger ships of class III carrying less than 100 passengers are to comply with the requirements of 2.11.1(1) of this Chapter.
2.11.3 Non-load-bearing partial bulkheads which separate adjacent cabin balconies are to be capable of being opened by the crew from each side for the purpose of fighting fires.

2.12 Fixed fire detection and fire alarm systems and public address systems
2.12.1 Passenger ships of class II
(1) ① An automatic sprinkler, fire detection and fire alarm system of an approved type complying with 1.11 of this Chapter is to be installed in accommodation and service spaces, control stations, including corridors, stairways. Control stations, where water may cause damage to essential equipment, may be fitted with an approved dry pipe system or pre-action system.
② An approved fixed fire detection and fire alarm system complying with 1.12 of this Chapter is to be so 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.
③ 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 alarm system.
(2) An approved fixed fire detection and fire alarm system or a sample extraction smoke detection system required by 1.13 of this Chapter is to be provided in any cargo space. Passenger ships of class III carrying less than 100 passengers may be exempted from this requirement.
(3) Passenger ships are to be so equipped as to ensure that any initial fire alarm is immediately received by a responsible member of the crew.
(4) A special alarm, operated from the navigation bridge or fire control station, is to be fitted to summon the crew. This alarm may be part of the ship's general alarm system and is to be capable of being sounded independently of the alarm to the passenger spaces.
(5) A public address system or other effective means of communication is to be available throughout the accommodation and service spaces and control stations and open decks.
(6) An efficient patrol system is to be maintained so that an outbreak of fire may be promptly detected. Each member of the fire patrol is to be trained to be familiar with the arrangements of

the ship as well as the location and operation of any equipment he may be called upon to use. Each member of the fire patrol is to be provided with a two-way portable radiotelephone apparatus.
(7) A fixed fire detection and fire alarm system is to be installed on cabin balconies, when furniture and furnishings on such balconies are not as defined in 1.2(19)①, ②, ③, ⑥ and ⑦ of this Chapter.
2.12.2 For passenger ships of class III, a system complying with 2.12.1(1)① or ② is to be provided in accommodation and service spaces and control stations. However, for passenger ships of class III carrying less than 100 passengers, manually operated call points complying with 1.12 of this Chapter may be provided throughout accommodation and service spaces and control stations.

2.13 Fire-extinguishing arrangements in cargo spaces
2.13.1 Passenger ships of 1000 gross tonnage and upwards are to comply with the following requirements:
(1) except as provided for in (2) below, the cargo spaces are to be protected by a fixed carbon dioxide or inert gas fire-extinguishing system or by a fixed high-expansion foam fire-extinguishing system which gives equivalent protection;
(2) a ship engaged in the carriage of dangerous goods in any cargo spaces is to be provided with a fixed carbon dioxide or inert gas fire-extinguishing system complying with the provisions of 1.4 of this Chapter or with a fire-extinguishing system which has been confirmed to give equivalent protection for the cargoes carried.
2.13.2 For passenger ships of class III carrying less than 100 passengers, if the requirements of 2.13.1(1) of this Chapter are deemed unreasonable, and for passenger ships of less than 1000 gross tonnage, only water fire-extinguishing systems may be fitted.

2.14 Special requirements for ships engaged in the carriage of dangerous goods
2.14.1 If dangerous goods referred to in 1.2(26) of this Chapter are carried, relevant provisions of 3.10 of this Chapter are to be complied with.

3 Fire safety measures for cargo ships

3.1 Structure
3.1.1 All cargo ships are to comply with the following requirements.
(1) Unless provided otherwise by 3.1.1(4) of this Chapter, the hull, superstructure, structural bulkheads, decks and deckhouses are to be constructed of steel or other equivalent material.
(2) The insulation of aluminum alloy components of “A" or “B" class divisions, except structure which is considered as non-load-bearing, is to be such that the temperature of the structural core does not rise more than 200℃ above the ambient temperature at any time during the applicable exposure to the standard fire test.
(3) Special attention is to be given to the insulation of aluminum alloy components of columns, stanchions and other structural members required to support lifeboat and liferaft stowage, launching and embarkation areas, and “A" and “B" class divisions, to ensure:
① that for such members supporting lifeboat and liferaft areas and “A" class divisions, the temperature rise limitation specified in 3.1.1(2) of this Chapter is to apply at the end of 1 h;
② that for such members required to support “B" class divisions, the temperature rise limitation specified in 3.1.1(2) of this Chapter is to apply at the end of half an hour.
(4) Crowns and casings of machinery spaces of category A are to be of steel construction. Any openings are to be suitably arranged and protected to prevent the spread of fire.
3.1.2 Cargo ships of 2000 gross tonnage and upwards
(1) One of the following methods of protection is to be adopted in accommodation and service spaces:
① *Method IC* - The construction of internal divisional bulkheads of non-combustible “B” or “C”class divisions generally without the installation of an automatic sprinkler, fire detection and fire alarm system in the accommodation and service spaces, except as required by 3.8.1(1) of this Chapter; or
② *Method IIC* - The fitting of an automatic sprinkler, fire detection and fire alarm system as

required by 3.8.1(2) of this Chapter for the detection and extinction of fire in all spaces in which fire might be expected to originate, generally with no restriction on the type of internal divisional bulkheads; or

③ *Method IIIC* - The fitting of a fixed fire detection and fire alarm system as required by 3.8.1(3) of this Chapter in spaces in which a fire might be expected to originate, generally with no restriction on the type of internal divisional bulkheads, except that in no case is the area of any accommodation space or spaces bounded by an "A" or "B" class division to exceed 50 m^2. In general, this area is not to exceed 70 m^2 for public spaces.

(2) Bulkheads within accommodation and service spaces

① Bulkheads required to be "B" class divisions are to extend from deck to deck and to the shell or other boundaries. However, where a continuous "B" class ceiling or lining is fitted on both sides of the bulkhead, the bulkhead may terminate at the continuous ceiling or lining.

② *Method IC* - Bulkheads not required by this Chapter to be "A" or "B" class divisions are to be of at least "C" class construction.

③ *Method IIC* - There is to be no restriction on the construction of bulkheads not required by this Chapter to be "A" or "B" class divisions except in individual cases where "C" class bulkheads are required in accordance with table 3.2.3a.

④ *Method IIIC* - There is to be no restriction on the construction of bulkheads not required for cargo ships to be "A" or "B" class divisions except that the area of any accommodation space or spaces bounded by a continuous "A" or "B" class division are in no case to exceed 50 m^2, except in individual cases where "C" class bulkheads are required in accordance with table 3.2.3a. In general, this area is not to exceed 70 m^2 for public spaces.

3.1.3 Cargo ships of less than 2000 gross tonnage

One of the following methods of protection is to be adopted in accommodation and service spaces excluding void spaces, sanitary spaces:

(1) the area bounded by "A" or "B" class division is not to exceed 50 m^2. In general, this area is not to exceed 70 m^2 for public spaces; or

(2) when fitted with a fixed fire detection and fire alarm system complying with 1.12 of this Chapter, there is no limit for internal divisions.

3.2 Fire integrity of bulkheads and decks

3.2.1 In addition to complying with the specific provisions for fire integrity of bulkheads and decks mentioned elsewhere in this Chapter, the minimum fire integrity of bulkheads and decks is to be as prescribed in Tables 3.2.3a, 3.2.3b, 3.2.4a and 3.2.4b of this Chapter.

3.2.2 The following requirements are to govern application of Tables 3.2.3a, 3.2.3b, 3.2.4a and 3.2.4b.

(1) For determining the appropriate fire integrity standards to be applied to divisions between adjacent spaces, such spaces are classified according to their fire risk as shown in categories ① to ⑪ below. Where the contents and use of a space are such that there is a doubt as to its classification for the purpose of 3.2 of this Chapter, or where it is possible to assign two or more classifications to a space, it is to be treated as a space within the relevant category having the most stringent boundary requirements. Smaller, enclosed rooms within a space that have less than 30% communicating openings to that space are considered separate spaces. The fire integrity of the boundary bulkheads and decks of such smaller rooms is to be as prescribed in tables 3.2.3 and 3.2.4. The title of each category is intended to be typical rather than restrictive. The number preceding each category refers to the applicable column or row in the tables.

① Control stations

Spaces containing emergency sources of power and lighting.

Wheelhouse and chartroom.

Spaces containing the ship's radio equipment.

Fire control stations.

Control room for propulsion machinery when located outside the propulsion machinery space.

Spaces containing centralized fire alarm equipment.

Spaces containing navigation equipment.

Spaces containing emergency battery rechargers or emergency charging and recharging panels.
All spaces containing emergency batteries (including backup power for radio installation or emergency batteries for the starting of the emergency generator).
Storage spaces for fire-extinguishing medium of fixed fire-extinguishing systems.

② Corridors
Passenger and crew corridors and lobbies.

③ Accommodation spaces
Spaces as defined in 1.2 of this Chapter excluding corridors.
Changing rooms.

④ Stairways
Interior stairways, lifts, totally enclosed emergency escape trunks, and escalators (other than those wholly contained within the machinery spaces) for passengers and crew and enclosures thereto.
In this connection, a stairway which is enclosed at only one level is to be regarded as part of the space from which it is not separated by a fire door.

⑤ Service spaces (low risk)
Lockers and store-rooms having areas less than 4 m^2 in which flammable liquids are not stored.
Drying rooms and laundries.
Food storage or refrigerating rooms using non-combustible materials as insulation layer.
Storage rooms having areas less than 4 m^2 for work clothes of crew when the clothes are soiled with oil.

⑥ Machinery spaces of category A
Spaces as defined in 1.2 of this Chapter.

⑦ Other machinery spaces
Spaces as defined in 1.2 of this Chapter excluding machinery spaces of category A.

⑧ Cargo spaces
All spaces used for cargo (including cargo oil tanks) and trunk ways and hatchways to such spaces.

⑨ Service spaces (high risk)
Galleys, pantries containing cooking appliances, paint and lamp rooms, lockers and store-rooms having area of 4 m^2 or more, spaces for the storage of flammable liquids, saunas and workshops other than those forming part of the machinery spaces.
Food storage or refrigerating rooms using non-combustible materials as insulation layer.
Mail rooms.
Storage rooms having areas less than 4 m^2 for work clothes of crew when the clothes are soiled with oil.
Storage rooms for oxygen or acetylene.

⑩ Open decks
Open deck spaces and enclosed promenades. To be considered in this category, enclosed promenades are to have no significant fire risk, meaning that furnishings are to be restricted to deck furniture. In addition, such spaces are to be naturally ventilated by permanent openings.
Air spaces (the space outside superstructures and deckhouses).

⑪ *Ro-ro and vehicle spaces*
Ro-ro spaces as defined in 1.2 of this Chapter.
Vehicle spaces as defined in 1.2 of this Chapter.

(2) Continuous "B" class ceilings or linings, in association with the relevant decks or bulkheads, may be accepted as contributing, wholly or in part, to the required insulation and integrity of a division.

3.2.3 The fire integrity of bulkheads and decks separating adjacent spaces for cargo ships of 2000 gross tonnage and upwards is to comply with the provisions of Table 3.2.3a and Table 3.2.3b respectively.

Fire integrity of bulkheads separating adjacent spaces **Table 3.2.3a**

Space	①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩	⑪

Control stations ①	A-0[e]	A-0	A-60	A-0	A-15	A-60	A-15	A-60	A-60	*	A-60
Corridors ②		C	B-0	A-0[c] B-0	B-0	A-60	A-0	A-0	A-0	*	A-30
Accommodation spaces ③			C[a,b]	A-0[c] B-0	B-0	A-60	A-0	A-0	A-0	*	A-30
Stairways ④				A-0[c] B-0	A-0[c] B-0	A-60	A-0	A-0	A-0	*	A-30
Service spaces (low risk) ⑤					C	A-60	A-0	A-0	A-0	*	A-0
Machinery spaces of category A ⑥						*	A-0	A-0[g]	A-60	*	A-60[f]
Other machinery spaces ⑦							A-0[d]	A-0	A-0	*	A-0
Cargo spaces ⑧								*	A-0	*	A-0
Service spaces(high risk) ⑨									A-0[d]	*	A-30
Open decks ⑩										-	A-0
Ro-ro spaces and vehicle spaces ⑪											A-30

Fire integrity of decks separating adjacent spaces **Table 3.2.3b**

Space above→ / Space below↓	①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩	⑪
Control stations ①	A-0	A-0	A-0	A-0	A-0	A-60	A-0	A-0	A-0	*	A-60
Corridors ②	A-0	*	*	A-0	*	A-60	A-0	A-0	A-0	*	A-30
Accommodation spaces ③	A-60	A-0	*	A-0	*	A-60	A-0	A-0	A-0	*	A-30
Stairways ④	A-0	A-0	A-0	*	A-0	A-60	A-0	A-0	A-0	*	A-30
Service spaces(low risk) ⑤	A-15	A-0	A-0	A-0	*	A-60	A-0	A-0	A-0	*	A-0
Machinery spaces of category A ⑥	A-60	A-60	A-60	A-60	A-60	*	A-60[i]	A-30	A-60	*	A-60
Other machinery spaces ⑦	A-15	A-0	A-0	A-0	A-0	A-0	*	A-0	A-0	*	A-0
Cargo spaces (including open ro-ro spaces) ⑧	A-60	A-0	A-0	A-0	A-0	A-0	A-0	*	A-0	*	A-0
Service spaces(high risk) ⑨	A-60	A-0	A-0	A-0	A-0	A-60	A-0	A-0	A-0[d]	*	A-30
Open decks ⑩	*	*	*	*	*	*	*	*	*	-	A-0
Ro-ro spaces and vehicle spaces ⑪	A-60	A-30	A-30	A-30	A-0	A-60	A-0	A-0	A-30	A-0	A-30

Notes: To be applied to tables 3.2.3 and 3.2.4, as appropriate.

a No special requirements are imposed upon bulkheads in methods IIC and IIIC fire protection.

b In case of method IIIC, "B" class bulkheads of "B-0" rating are to be provided between spaces or groups of spaces or 50 m^2 and over in area.

c For clarification as to which applies, see 3.1.2(2) and 3.4 of this Chapter.

d Where spaces are of the same numerical category and superscript "d" appears a bulkhead or deck of the rating shown in the tables is only required when the adjacent spaces are for a different purpose (e.g., in category ⑨). A galley next to a galley does not require a bulkhead, but a galley next to a paint room requires an "A-0" bulkhead.

e Bulkheads separating the wheelhouse, chartroom and radio room from each other may have a "B-0" rating.

f An "A-0" rating may be used if no dangerous goods are intended to be carried or if such goods are stowed not less than 3 m horizontally from such a bulkhead.

g For cargo spaces in which dangerous goods are intended to be carried, 3.10 of this Chapter applies.

i Fire insulation need not be fitted in the machinery space in category ⑦ if it is confirmed to have little or no fire risk.

* Where an asterisk appears in the tables, the division is required to be of steel or other equivalent material but is not required to be of "A" class standard. However, where a deck, except an open deck, is penetrated for the passage of electric cables, pipes and vent ducts, such penetrations are to be made tight to prevent the passage of flame and smoke. Divisions between control stations (emergency generators) and open decks may have air intake openings without means for closure, unless a fixed gas fire-extinguishing system is fitted.

\- No special requirement for the material or integrity of the boundary.

3.2.4 The fire integrity of bulkheads and decks separating adjacent spaces for cargo ships of 500 gross tonnage and upwards but less than 2000 gross tonnage is to comply with the provisions of

Table 3.2.4a and Table 3.2.4b respectively.

Fire integrity of bulkheads separating adjacent spaces **Table 3.2.4a**

Space	①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩	⑪
Control stations ①	A-0[e]	A-0	A-30	A-0	A-0	A-30[j] A-15	A-0	A-30	A-30	*	A-30
Corridors ②		C	B-0	B-0[k] C	B-0	A-30[j] A-15	A-0	A-0	A-0	*	A-0
Accommodation spaces ③			—[l]	B-0[k] C	C	A-30[j] A-15	A-0	A-0	A-0	*	A-0
Stairways ④				B-0[k] C	B-0[k] C	A-30[j] A-15	A-0	A-0	A-0	*	A-0
Service spaces(low risk) ⑤					*	A-0	*	*	*	*	*[h]
Machinery spaces of category A ⑥						*	A-0	A-30[m] A-0[f]	A-30	*	A-30[m] A-0[f]
Other machinery spaces ⑦							*	A-0	A-0	*	A-0
Cargo spaces ⑧								*	A-0	*	A-0
Service spaces(high risk) ⑨									A-0[d]	*	A-30
Open decks ⑩										—	*
Ro-ro spaces and vehicle spaces ⑪											*[h]

Fire integrity of decks separating adjacent spaces **Table 3.2.4b**

Space above→ / Space below↓	①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩	⑪
Control stations ①	A-0	A-0	A-0	A-0	A-0	A-30[j] A-15	A-0	A-0	A-0	*	A-30
Corridors ②	A-0	*	*	A-0	*	A-30[j] A-15	A-0	A-0	A-0	*	A-0
Accommodation spaces ③	A-30	A-0	*	A-0	*	A-30[j] A-15	A-0	A-0	A-0	*	A-0
Stairways ④	A-0	A-0	A-0	*	*	A-30[j] A-15	A-0	A-0	A-0	*	A-0
Service spaces(low risk) ⑤	A-0	A-0	*	A-0	*	A-0	*	*[h]	*	*	A-0
Machinery spaces of category A ⑥	A-30[j] A-15	A-30[j] A-15	A-30[j] A-15	A-30[j] A-15	A-0	*	A-30[i]	A-30[m] A-0[f]	A-30[j] A-15	*	A-30[m] A-0[f]
Other machinery spaces ⑦	A-0	A-0	A-0	A-0	*	A-0	*	A-0	A-0	*	A-0
Cargo spaces (including open ro-ro spaces) ⑧	A-30	A-0	A-0	A-0	*	A-30[m] A-0[f]	*	*	A-0	*	A-0
Service spaces(high risk) ⑨	A-30	A-0	A-0	A-0	A-0	A-30[j] A-15	*	A-0	A-0[d]	*	A-0
Open decks ⑩	*	*	*	*	*	*	*	*	*	—	*
Ro-ro spaces and vehicle spaces ⑪	A-30	A-0	A-0	A-0	*	A-30[m] A-0[f]	A-0	A-0	A-0	*	*[h]

Notes: To be applied to tables 3.2.4a and 3.2.4b, as appropriate.

h Bulkheads and decks separating ro-ro spaces are to be capable of being closed reasonably gastight and such divisions are to have "A" class integrity in so far as reasonable and practicable, if it is confirmed to have little or no fire risk.

j Division rating of the internal-combustion machinery used for main propulsion where such machinery has in the aggregate a total power output of more than 375 kW.

k Stairways which penetrate more than a single deck are to be protected by at least "B-0" class divisions and self-closing doors.

l In case of method of 3.1.3(1) of this Chapter, the area bounded by "A" or "B" class division in accommodation spaces or groups of accommodation spaces is not to exceed 50 m^2.

m For cargo spaces and ro-ro cargo spaces in which dangerous goods are intended to be carried, the requirements of 3.10 of this Chapter are to be complied with, where A-60 class standard may be relaxed to A-15 class standard.

3.2.5 Cargo ships of less than 500 gross tonnage

(1) Corridor bulkheads and the doors therein are to be of steel or non-combustible material.

(2) The boundaries of machinery spaces of category A and galleys are to be of steel or equivalent

material, and the doors therein are to be of steel or non-combustible material.

3.3 Means of escape

3.3.1 Unless expressly provided otherwise in this paragraph, at least two widely separated and ready means of escape are to be provided from all spaces or groups of spaces.

3.3.2 Cargo ships of 2000 gross tonnage and upwards

(1) Stairways and ladders are to be so arranged as to provide, from all accommodation spaces and from spaces in which the crew is normally employed, other than machinery spaces, ready means of escape to the open deck and thence to the lifeboats and liferafts. The following general provisions are to be complied with.

① At all levels of accommodation there are to be provided at least two widely separated means of escape from each restricted space or group of spaces.

② (a) Below the lowest open deck the main means of escape is to be a stairway and the second escape may be a trunk or a stairway.

(b) Above the lowest open deck the means of escape are to be stairways or doors to an open deck or a combination thereof.

③ One of the means of escape, for crew spaces that are entered only occasionally, may be dispensed with if the required escape route is independent of watertight doors.

④ No dead-end corridors having a length of more than 7 m is to be accepted. A dead-end corridor is a corridor or part of a corridor from which there is only one escape route.

⑤ Stairways and corridors used as means of escape are to be not less than 700 mm in clear width and are to have a handrail on one side. Stairways and corridors with a clear width of 1,800 mm and over are to have handrails on both sides. ″Clear width″ is considered the distance between the handrail and the bulkhead on the other side or between the handrails. The angle of inclination of stairways should be, in general, 45, but not greater than 50, and in small spaces not more than 60. Doorways which give access to a stairway are to be of the same size as the stairway.

⑥ If a radiotelegraph station has no direct access to the open deck, two means of access to or egress from such station are to be provided, one of which may be a porthole or window of sufficient size or other means to provide an emergency escape.

(2) At least two means of escape are to be provided in ro-ro spaces where the crew are normally employed. The escape routes are to provide a safe escape to the lifeboat and liferaft embarkation decks or be accessible from the open deck and are to be located at the fore and aft ends of the space.

(3) Two means of escape are to be provided from each machinery space of category A. In particular, one of the following provisions are to be complied with:

① two sets of steel ladders, as widely separated as possible, leading to doors in the upper part of the space, similarly separated and from which access is provided to the open deck. One of these ladders is to be located within a protected enclosure that satisfies category ④ of 3.2.3 and 3.2.4 of this Chapter, from the lower part of the machinery space of category A (the lowest level accessible to personnel) it serves to a safe position outside the space. Self-closing fire doors of the same fire integrity standards are to be fitted in the enclosure. The ladder is to be fixed in such a way that heat is not transferred into the enclosure through non-insulated fixing points. The enclosure is to have minimum internal dimensions of at least 800 mm × 800 mm, and is to have emergency lighting provisions; or

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

(4) From machinery spaces other than those of category A, two escape routes to the open deck and thence to the lifeboats and liferafts embarkation decks are to be provided except that a single escape route may be accepted for spaces that are entered only occasionally and for spaces where the maximum travel distance to the door is 5 m or less.

(5) In the steering gear space, a second means of escape is to be provided when the emergency steering position is located in that space unless there is direct access to the open deck.

(6) Stairways used as escapes in machinery and steering gear spaces mentioned above are not to be less than 600 mm in clear width and are not to have an angle of inclination greater than 60. Where ladders are used as means of escape, standards recognized by CCS are to be complied with[①].

(7) In no case are lifts to be considered as forming one of the required means of escape.

3.3.3 Cargo ships of less than 2000 gross tonnage

(1) At all levels of accommodation, there is to be provided at least one means of escape to the open deck and thence to the lifeboats and liferafts from each restricted space or group of spaces. Stairways and corridors used as escapes are not to be less than 600 mm in clear width.

(2) From machinery spaces of category A, two escape routes to the open deck and thence to the lifeboats and liferafts embarkation decks are to be provided. One of the following provisions is to be complied with:

① two sets of steel ladders, as widely separated as possible, from the lowest level accessible to personnel to a safe position outside the space. If there is more than one working platform in machinery spaces of category A, at least one steel ladder is to be protected by continuous steel enclosure and fitted with one self-closing steel door. The enclosure is to have minimum internal dimensions of at least 600 mm × 600 mm, and is to have emergency lighting provisions; or

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

For cargo ships of less than 1000 gross tonnage, one of the means of escape from machinery spaces of category A may be dispensed with so long as either a door or a steel ladder provides a safe escape route to the embarkation deck.

(3) From machinery spaces other than those of category A, two escape routes to the open deck and thence to the lifeboats and liferafts embarkation decks are to be provided except that a single escape route may be accepted for spaces that are entered only occasionally and for spaces where the maximum travel distance to the door is 5 m or less.

(4) No dead-end corridors having a length of more than 7 m are to be accepted.

(5) In the steering gear space, a second means of escape is to be provided when the emergency steering position is located in that space unless there is direct access to the open deck.

(6) Stairways used as escapes in machinery and steering gear spaces mentioned above are not to be less than 600 mm in clear width. Where ladders are used as escapes, the standards recognized by CCS are to be complied with.

(7) In no case are lifts to be considered as forming one of the required means of escape.

3.3.4 Emergency escape breathing devices (EEBD)

(1) Cargo ships of 1000 gross tonnage and upwards are to carry emergency escape breathing devices complying with the requirement of 2.2, Chapter 3 of the FSS Code within accommodation spaces and machinery spaces. The number and arrangement of EEBDs are to comply with the requirements of Table 3.3.4. The number of EEBDs in unattended machinery spaces of category A is not to be less than two.

Requirements for the number and arrangement of EEBDs **Table 3.3.4**

Cargo ships	Machinery spaces of category A (attended)		Other machinery spaces (attended)	Accommodation spaces	Total number of devices	For training
	Containing internal combustion machinery used for main propulsion	Containing internal combustion machinery used for purposes other than main propulsion				

① Such as Chinese national standards Ship's steel inclined ladders GB4444-84, Ship's steel vertical ladders GB3892-83; Chinese industry standard Ship's steel inclined ladders CB/T81-1999, etc.

	(1) Machinery control room located within a machinery space: 1; workshop: 1 (not necessary if there is direct access to the means of escape); every deck or working platform adjacent to the means of escape (the means of escape forms the enclosed means of space except in the engine room bottom or another means of escape independent of watertight doors): 1. or (2) the number and location of EEBDs may also be determined according to the arrangement of the engine room and number of persons, but is to be at least 2 in number	every deck or working platform adjacent to the means of escape (the means of escape forms the enclosed means of space except in the engine room bottom or another means of escape independent of watertight doors): 1.	At least 1	2	1	1

3.4 Protection of stairways and lifts in accommodation spaces, service spaces and control stations

3.4.1 Cargo ships of 2000 gross tonnage and upwards

(1) Stairways which penetrate only a single deck are to be protected at least at one level by at least "B-0" class divisions and self-closing doors. Lifts which penetrate only a single deck are to be surrounded by "A-0" class divisions with steel doors at both levels. Stairways and lifts which penetrate more than a single deck are to be surrounded by at least "A-0" class divisions and be protected by self-closing doors at all levels.

(2) On ships having accommodation for 12 persons or less, where stairways penetrate more than a single deck and where there are at least two escape routes direct to the open deck at every accommodation level, consideration may be given to reducing the "A-0" requirements of above-mentioned 3.4.1 to "B-0".

(3) All stairways are to be of steel or approved equivalent material.

3.4.2 Cargo ships of less than 2000 gross tonnage

(1) Lift trunks and stairways which penetrate more than a single deck are to be surrounded by at least "B-0" class divisions and be protected by self-closing doors.

(2)All stairways are to be of steel frame construction.

3.5 Doors in fire-resisting divisions

3.5.1 Cargo ships of 2000 gross tonnage and upwards

(1) The fire resistance of doors are to be equivalent to that of the division in which they are fitted, this being determined in accordance with the Fire Test Procedures Code. Doors and door frames in "A" class divisions are to be constructed of steel. Doors in "B" class divisions are to be non-combustible. Doors fitted in boundary bulkheads of machinery spaces of category A are to be reasonably gastight and self-closing. In ships constructed according to method IC, the use of combustible materials in doors separating cabins from individual interior sanitary accommodation such as showers may be permitted.

(2) Doors required to be self-closing are not to be fitted with hold-back hooks. However, hold-back arrangements fitted with remote release devices of the fail-safe type may be utilized.

(3) In corridor bulkheads, ventilation openings may be permitted in and under the doors of cabins and public spaces. Ventilation openings are also permitted in "B" class doors leading to lavatories,

offices, pantries, lockers and store-rooms. Except as permitted below, the openings are to be provided only in the lower half of a door. Where such an opening is in or under a door, the total net area of any such opening or openings is not to exceed 0.05 m^2. Alternatively, a non-combustible air balance duct routed between the cabin and the corridor, and located below the sanitary unit, is permitted where the cross-sectional area of the duct does not exceed 0.05 m^2. Ventilation openings, except those under the door, are to be fitted with a grill made of non-combustible material.

(4) Watertight doors need not be insulated.

3.5.2 For cargo ships of less than 2000 gross tonnage, doors in fire-resisting divisions are to be of steel or non-combustible material. Doors fitted in boundary bulkheads of machinery spaces of category A are to be reasonably gastight and self-closing.

3.6 Restricted use of combustible materials

3.6.1 Exposed surfaces in corridors and stairway enclosures and of ceilings in accommodation and service spaces (except saunas) and control stations as well as surfaces and grounds in concealed or inaccessible spaces in accommodation and service spaces and control stations are to have low flame-spread characteristics.

3.6.2 Paints, varnishes and other finishes used on exposed interior surfaces are not to be capable of producing excessive quantities of smoke and toxic products.

3.6.3 Primary deck coverings, if applied within accommodation and service spaces and control stations, are to be of approved material which will not give rise to smoke or toxic or explosive hazards at elevated temperatures.

3.7 Details of construction

3.7.1 Cargo ships of 2000 gross tonnage and upwards

(1) Method IC--in accommodation and service spaces and control stations, all linings, grounds, draught stops and ceilings are to be of non-combustible material.

(2) Methods IIC and IIIC--in corridors and stairway enclosures serving accommodation and service spaces and control stations, linings, grounds, draught stops and ceilings are to be of non-combustible material.

(3) Methods IC, IIC and IIIC

① Insulating materials are to be non-combustible, except in cargo spaces, mail rooms, baggage rooms and refrigerated compartments of service spaces. Vapour barriers and adhesives used in conjunction with insulation, as well as the insulation of pipe fittings for cold service systems, need not be of non-combustible materials, but they are to be kept to the minimum quantity practicable and their exposed surfaces are to have low flame-spread characteristics.

② Non-combustible bulkheads, ceilings and linings fitted in accommodation and service spaces may be faced with combustible materials, facings, mouldings, decorations and veneers provided such spaces are bounded by non-combustible bulkheads, ceilings and linings in accordance with the provisions of ③, ④ below and 3.6 of this Chapter.

③ Combustible materials used on the surfaces and linings specified in ② above are to have a calorific value not exceeding 45 MJ/m^2 of the area for thickness used. The requirements are not applicable to the surfaces of furniture fixed to linings or bulkheads.

④ The total volume of combustible facings, mouldings, decorations and veneers in accommodation and service spaces is not to exceed a volume equivalent to 2.5 mm veneer on the combined area of the walls and ceiling linings. Furniture fixed to linings, bulkheads or decks need not be included in the calculation of the total volume of combustible materials; and in the case of ships fitted with an automatic sprinkler system complying with the provisions of 1.1 of this Chapter, the above volume may include some combustible material used for erection of "C" class divisions.

⑤ Air spaces enclosed behind ceilings, paneling or linings are to be divided by close-fitting draught stops spaced not more than 14 m apart. In the vertical direction, such enclosed air spaces, including those behind linings of stairways, trunks, etc., are to be closed at each deck.

3.7.2 Cargo ships of less than 2000 gross tonnage are to comply with the requirements of 3.7.1(3) of this Chapter insofar as practicable.

3.8 Fixed fire detection and fire alarm systems

3.8.1 Accommodation and service spaces and control stations of cargo ships of 2000 gross tonnage and upwards 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 3.1.2(1) of this Chapter.

(1) Method IC - A fixed fire detection and fire alarm system complying with the provisions of 1.12 of this Chapter is to be so installed and arranged as to provide smoke detection in all corridors, stairways and escape routes within accommodation spaces.

(2) Method IIC - An automatic sprinkler, fire detection and fire alarm system complying with the provisions of 1.11 of this Chapter is 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 complying with the provisions of 1.12 of this Chapter is to be so installed and arranged as to provide smoke detection in all corridors, stairways and escape routes within accommodation spaces.

(3) Method IIIC - A fixed fire detection and fire alarm system complying with the provisions of 1.12 of this Chapter 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 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.

3.8.2 Cargo ships of less than 2000 gross tonnage

(1) In case of method of 3.1.3(1) of this Chapter, manually operated call points complying with the provisions of 1.12 of this Chapter are to be installed in all the corridors, stairways within the accommodation spaces and service spaces.

(2) In case of method of 3.1.3(2) of this Chapter, a fixed fire detection and fire alarm system complying with the provisions of 1.12 of this Chapter is to be installed in accommodation spaces and service spaces, except void spaces, sanitary spaces.

3.9 Fire-protection arrangements in cargo spaces

3.9.1 General requirements

(1) Except for ro-ro and vehicle spaces, cargo spaces on cargo ships of 2,000 gross tonnage and upwards are to be protected by a fixed carbon dioxide or inert gas fire-extinguishing system complying with the provisions of 1.4 of this Chapter, or by a fire-extinguishing system which gives equivalent protection.

(2) Cargo spaces of any cargo ship if constructed, and solely intended, for the carriage of ore, coal, grain, unseasoned timber, non-combustible cargoes or cargoes which constitute a low fire risk may be exempted from the requirements of (1) above. Such exemptions may be granted only if the ship is fitted with steel hatch covers and effective means of closing all ventilators and other openings leading to the cargo spaces. When such exemptions are granted, an Exemption Certificate is to be issued, irrespective of the date of construction of the ship concerned, in accordance with 3, Chapter 1, and 4, Chapter 2, PART ONE of the Guidelines, and is to ensure that the list of cargoes the ship is permitted to carry is attached to the Exemption Certificate (reference may be made to the guidelines of IMO[①]; for details see the Appendix of this Chapter).

(3) Notwithstanding the provisions of (1) above, any ship engaged in the carriage of dangerous goods is to be provided with a fixed carbon dioxide or inert gas fire-extinguishing system complying with the provisions of 1.4 or with a fire-extinguishing system which gives equivalent protection for the cargoes carried.

3.9.2 Protection of ro-ro and vehicle spaces

(1) Ventilation systems of closed ro-ro and vehicle spaces

① Capacity of ventilation systems: there is to be provided an effective power ventilation system sufficient to give at least 6 air changes per hour. The number of air changes when vehicles are being loaded and unloaded is to be increased appropriately.

---

① Refer to the Lists of solid bulk cargoes for which a fixed gas fire-extinguishing system may be exempted or for which a fixed gas fire-extinguishing system is ineffective (MSC.1/Circ. 1395/Rev.1).

② Performance of ventilation systems

(a) Ventilation fans are normally to be run continuously whenever vehicles are on board. Where this is impracticable, they are to be operated for a limited period daily as weather permits and in any case for a reasonable period prior to discharge, after which period the ro-ro or vehicle space is to be proved gas-free. One or more portable combustible gas detecting instruments are to be carried for this purpose. The system is to be entirely separate from other ventilating systems. Ventilation ducts serving ro-ro or vehicle spaces are to be capable of being effectively sealed for each cargo space. The system is to be capable of being controlled from a position outside such spaces.

(b) The ventilation system is to be such as to prevent air stratification and the formation of air pockets.

③ Indication of ventilation systems: means are to be provided on the navigation bridge to indicate any loss of the required ventilating capacity, this being achieved by setting up an alarm which is initiated by the disconnection of the starting relay of the ventilation fans.

④ Closing appliances and ducts: arrangements are to be provided to permit a rapid shutdown and effective closure of the ventilation system from outside of the space in case of fire, taking into account the weather and sea conditions. Ventilation ducts, including dampers, within a common horizontal zone are to be made of steel.

⑤ Permanent openings

Permanent openings in the side plating, the ends or deckhand 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.

(2) Prevention of ignition of flammable gas in closed ro-ro and vehicle spaces

① Except as provided in ② below, electrical equipment and wiring are to be of a type suitable for use in an explosive petrol and air mixture.

② In case of other than special category spaces below the bulkhead deck, notwithstanding the provisions in ① above, above a height of 450 mm from the deck and from each platform for vehicles, if fitted, except platforms with openings of sufficient size permitting penetration of petrol gases downwards, electrical equipment of a type so enclosed and protected as to prevent the escape of sparks is to be permitted as an alternative, on condition that the ventilation system is so designed and operated as to provide continuous ventilation of the cargo spaces at the rate of at least ten air changes per hour whenever vehicles are on board.

③ Electrical equipment and wiring in exhaust ventilation ducts

Electrical equipment and wiring, if installed in an exhaust ventilation duct, are to be of a type approved for use in explosive petrol and air mixtures and the outlet from any exhaust duct is to be sited in a safe position, having regard to other possible sources of ignition.

④ Other ignition sources

Other equipment which may constitute a source of ignition of flammable vapours is not to be permitted.

(3) Detection and alarm

① Fixed fire detection and fire alarm systems

there is to be provided a fixed fire detection and fire alarm system complying with the provisions of 1.12 of this Chapter. 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 have satisfactory effects, 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 satisfying the expected objective.

② Sample extraction smoke detection systems

In closed ro-ro and vehicle spaces, a sample extraction smoke detection system complying with provisions of 1.13 of this Chapter may be used as an alternative for the fixed fire detection and fire alarm system required in ① above.

(4) Structural protection

The boundary bulkheads and decks of special category spaces and ro-ro spaces are to be insulated in accordance with the requirements of category ⑪, 3.2.3 or 3.2.4.

(5) Miscellaneous

① Scuppers and discharges

(a) Scuppers are not to be led to machinery or other spaces where sources of ignition may be present.

(b) The drainage system of the deck is to be so arranged that the water between the two sides or of one side does not interfere with each other and that the water in the space can be drained quickly and timely; special attention is to be paid to the design and arrangement of discharges (or suctions), i.e. due consideration is to be given to sufficient area of circulation and means to prevent blockage by sundries or of rapid dredging.

② Restricted use of combustible materials

The collision guard board on the side bulkhead of ro-ro spaces as well as slip-free coating on the deck are to be non-combustible materials which will not give rise to smoke or toxic or explosive hazards at elevated temperature.

③ Protection of lift trunks: if lifts used in the accommodation spaces and service spaces penetrate more than a single deck and open to the ro-ro spaces, the following requirements are to be complied with:

(a) in any circumstances, ventilation fans are to sustain ventilation at minimum positive pressure 25 Pa (wind velocity close to 3.5 m/s). Ventilation fans are normally to be run continuously and are to at least satisfy the number of air changes during the loading and unloading of vehicles.

(b) To prove that the ro-ro spaces have been freed of flammable gas, one portable flammable gas detector is to be provided.

(6) Fire extinction

① Fixed fire-extinguishing systems

(a) Vehicle spaces and ro-ro spaces which are capable of being sealed from a location outside of the cargo spaces are to be fitted with one of the following fixed gas fire-extinguishing systems:

ⓐ a fixed gas fire-extinguishing system complying with the provisions of 1.4 of this Chapter;

ⓑ a fixed high-expansion foam fire-extinguishing system complying with the provisions of 1.8 of this Chapter; or

ⓒ a fixed water-based fire-fighting system for ro-ro spaces and special category spaces complying with the provisions of 1.9 and 3.9.2(6)①(b)ⓐ to ⓕ of this Chapter.

(b) Vehicle spaces and ro-ro spaces not capable of being sealed and special category spaces are to be fitted with a fixed water-based fire-fighting system for ro-ro spaces and special category spaces complying with the provisions of 1.9 of this Chapter which is to protect all parts of any deck and vehicle platform in such spaces. Such a water-based fire-fighting system is to have:

ⓐ a pressure gauge on the valve manifold;

ⓑ clear marking on each manifold valve indicating the spaces served;

ⓒ instructions for maintenance and operation located in the valve room;

ⓓ a sufficient number of drainage valves to ensure complete drainage of the system;

ⓔ nozzles not less than 0.5 m above the roof of the vehicle;

ⓕ sufficient number of nozzle spares.

(c) The use of any other fixed fire-extinguishing system that has been shown, by a full-scale test in conditions simulating a flowing petrol fire in a vehicle space or a ro-ro space, to be not less effective in controlling fires likely to occur in such a space, may be permitted.

(d) When fixed pressure water-spraying fire-extinguishing systems are provided, in view of the serious loss of stability which could arise due to large quantities of water accumulating on the deck or decks during the operation of the water-spraying system, the following arrangements are to be provided:

ⓐ in the spaces above the bulkhead deck, scuppers are to be fitted so as to ensure that such water is rapidly discharged directly overboard and comply with the requirements

of IMO guidelines[①];

ⓑ in the spaces below the bulkhead deck, the drainage and pumping arrangements are to be such as to prevent the build-up of free surfaces. In such case, the drainage system is to be sized to remove no less than 125% of the combined capacity of both the water-spraying system pumps and the required number of fire hose nozzles, and comply with the requirements of IMO guidelines[①]. The drainage system valves are to be operable from outside the protected space at a position in the vicinity of the extinguishing system controls. Bilge wells are to be of sufficient holding capacity and are to be arranged at the side shell of the ship at a distance from each other of not more than 40 m in each watertight compartment. If this is not possible, the adverse effect upon stability of the added weight and free surface of water are to be taken into account. Such information is to be included in the stability information supplied to the master as required by 1.6.8, Chapter 2-1 of this PART.

(e) for vehicle and ro-ro spaces, where fixed pressure water-spraying systems are fitted, means are to be provided to prevent the blockage of drainage arrangements, and comply with the requirements of IMO guidelines[①].

② Portable fire extinguishers

(a) Portable fire extinguishers are to be provided at each deck level in each hold or compartment where vehicles are carried, spaced not more than 20 m apart. At least one portable fire extinguisher be located at each access to such a cargo space.

(b) In addition to the provision of (a) above, the following fire-extinguishing appliances are to be provided in vehicle and ro-ro spaces:

ⓐ at least three water-fog applicators;

ⓑ one portable foam applicator unit complying with the provisions of 1.5.5 of this Chapter, provided that at least two such units are available in the ship for use in such spaces.

(7) Ro-ro spaces on weather decks

Where ro-ro spaces onboard the ship are in the form of weather decks, fire-fighting of such spaces is to comply with the following requirements:

① Fire extinction

Such spaces need not be fitted with fixed pressure water-spraying fire-extinguishing systems but are to be fitted with water fire-extinguishing systems specified by 1.3 of this Chapter. The vehicle deck is to be provided with the following in addition to four nozzles:

(a) at least two spray nozzles complying with the provisions of 1.6.3 of this Chapter;

(b) at least two portable foam applicators complying with the provisions of 1.5.5 of this Chapter, provided that at least four such units are available in the ship for use in such spaces;

(c) at least four portable dry powder fire extinguishers or extinguishers of other types complying with the provisions of 1.5.1 of this Chapter.

② Miscellaneous

(a) Scuppers and discharges of such spaces are to comply with the requirements of 3.9.2(5)① and 3.9.2(6)①(e) of this Chapter;

(b) Drainage systems are to comply with the requirements of 3.9.2(6)①(d) of this Chapter.

(c) Restricted use of combustible materials in such spaces is to comply with the requirements of 3.9.2(5)② of this Chapter.

(d) Structural protection of such spaces is to comply with the requirements of 3.9.2(4) of this Chapter.

3.10 Special requirements for ships engaged in the carriage of dangerous goods

3.10.1 If dangerous goods referred to in 1.2(26) of this Chapter are carried, relevant provisions of 3.10.2 to 3.10.4 of this Chapter are to be complied with.

3.10.2 General requirements

(1) In addition to complying with the relevant requirements of each part of this Chapter, ship types

① Refer to the Guidelines for drainage systems in closed vehicle and ro-ro spaces and special category spaces (MSC.1/Circ.1320).

and cargo spaces, referred to in 3.10.2(2) of this Chapter, intended for the carriage of dangerous goods are to comply with the relevant requirements of 3.10 of this Chapter, as appropriate, except when carrying dangerous goods in limited quantities[①] and excepted quantities[②] unless such requirements have already been met by compliance with the requirements elsewhere in this chapter. The types of ships and modes of carriage of dangerous goods are referred to in (2) below and in table 3.10.2.

(2) The following ship types and cargo spaces are to govern the application of tables 3.10.2(1) and 3.10.2(2):

① ships and cargo spaces not specifically designed for the carriage of freight containers, but intended for the carriage of dangerous goods in packaged form, including goods in freight containers and portable tanks;

② purpose-built containerships and cargo spaces intended for the carriage of dangerous goods in freight containers and portable tanks;

③ ro-ro ships and ro-ro spaces intended for the carriage of dangerous goods;

④ ships and cargo spaces intended for the carnage of solid dangerous goods in bulk;

⑤ ships and cargo spaces intended for carriage of dangerous goods other than liquids and gases in bulk in ship borne barges.

3.10.3 Special requirements

Unless otherwise specified, the following requirements are to govern the application of tables 3.10.2(1), 3.10.2(2) and 3.10.2(3) to both "on-deck" and "under-deck" stowage of dangerous goods where the numbers of the followings paragraphs are indicated in the first column of the tables.

(1) Water supplies

① Arrangements are to be made to ensure immediate availability of a supply of water from the fire main at the required pressure either by permanent pressurization or by suitably placed remote arrangements for the fire pumps.

② The quantity of water delivered is to be capable of supplying four nozzles of a size and at pressures as specified in 1.3 of this Chapter, capable of being trained on any part of the cargo space when empty. This amount of water may be applied by equivalent means.

③ Means are to be provided for effectively cooling the designated under-deck cargo space by at least 5 *l*/min per square metre of the horizontal area of cargo spaces, either by a fixed arrangement of spraying nozzles or by flooding the cargo space with water. Hoses may be used for this purpose in small cargo spaces and in small areas of larger cargo spaces. However, the drainage and pumping arraignments are to be such as to prevent the build-up of free surfaces. The drainage system is to be sized to remove no less than 125% of the combined capacity of both the water spraying system pumps and the required number of fire hose nozzles. The drainage system valves are to be operable from outside the protected space at a position in the vicinity of the extinguishing system controls. Bilge wells are to be of sufficient holding capacity and are to be arranged at the side shell of the ship at a distance from each other of not more than 40 m in each watertight compartment. If this is not possible, the adverse effect upon stability of the added weight and free surface of water are to be taken into account.

④ Provision to flood a designated under-deck cargo space with suitable specified media may be substituted for the requirements in ③ above.

⑤ The total required capacity of the water supply is to satisfy ② and ③ above, if applicable, simultaneously calculated for the largest designated cargo space. The capacity requirements of ② above are to be met by the total capacity of the main fire pump(s), not including the capacity of the emergency fire pump, if fitted. If a drencher system is used to satisfy ③ above, the drencher pump is to also be taken into account in this total capacity calculation.

(2) Sources of ignition

Electrical equipment and wiring are not to be fitted in enclosed cargo spaces or vehicle spaces unless it is essential for operational purposes. However, if electrical equipment is fitted in such spaces, it is to be of a certified safe type for use in the dangerous environments to which it may be

① Refer to Chapter 3.4 of the International Maritime Dangerous Goods Code.

② Refer to Chapter 3.5 of the International Maritime Dangerous Goods Code.

exposed unless it is possible to completely isolate the electrical system (e.g. by removal of links in the system, other than fuses). Cable penetrations of the decks and bulkheads are to be sealed against the passage of gas or vapour. Through runs of cables and cables within the cargo spaces are to be protected against damage from impact. Any other equipment which may constitute a source of ignition of flammable vapour is not to be permitted.

(3) Detection system

Ro-ro spaces are to be fitted with a fixed fire detection and fire alarm system complying with the provisions of 1.12 of this Chapter. All other types of cargo spaces are to be fitted with either a fixed fire detection and fire alarm system complying with the provisions of 1.12 of this Chapter or a sample extraction smoke detection system complying with the provisions of 1.13 of this Chapter. If a sample extraction smoke detection system is fitted, particular attention is to be given to 1.13.1(4) of this Chapter in order to prevent the leakage of toxic fumes into occupied areas.

(4) Ventilation arrangements

① Adequate power ventilation is to be provided in enclosed cargo spaces. The arrangement is to be such as to provide for at least six air changes per hour in the cargo space, based on an empty cargo space, and for removal of vapours from the upper or lower parts of the cargo space, as appropriate.

② The fans are to be such as to avoid the possibility of ignition of flammable gas/air mixtures. Suitable wire mesh guards are to be fitted over inlet and outlet ventilation openings.

③ Natural ventilation is to be provided in enclosed cargo spaces intended for the carriage of solid dangerous goods in bulk, where there is no provision for mechanical ventilation.

(5) Bilge pumping

① Where it is intended to carry flammable or toxic liquids in enclosed cargo spaces, the bilge pumping system is to be designed to protect against inadvertent pumping of such liquids through machinery space piping or pumps. Where large quantities of such liquids are carried, consideration is to be given to the provision of additional means of draining those cargo spaces.

② If the bilge drainage system is additional to the system served by pumps in the machinery space, the capacity of the system is to be not less than 10 m^3/h per cargo space served. If the additional system is common, the capacity need not exceed 25 m^3/h. The additional bilge system need not be arranged with redundancy.

③ Whenever flammable or toxic liquids are carried, the bilge line into the machinery space is to be isolated either by fitting a blank flange or by a closed lockable valve.

④ Enclosed spaces outside machinery spaces containing bilge pumps serving cargo spaces intended for carriage of flammable or toxic liquids are to be fitted with separate mechanical ventilation giving at least six air changes per hour. If the space has access from another enclosed space, the door is to be self-closing.

⑤ If bilge drainage of cargo spaces is arranged by gravity drainage, the drainage is to be either led directly overboard or to a closed drain tank located outside the machinery spaces. The tank is to be provided with a vent pipe to a safe location on the open deck. Drainage from a cargo space into bilge wells in a lower space is only permitted if that space satisfies the same requirements as the cargo space above.

(6) Personnel protection

① Four sets of full protective clothing, resistant to chemical attack, are to be provided in addition to the fire-man's outfits required by 1.17 of this Chapter. The protective clothing is to cover all skin, so that no part of the body is unprotected and is to be selected taking into account the hazards associated with the chemicals being transported and the standards developed by IMO according to the class and physical state[①].

② At least two self-contained breathing apparatuses additional to those required by 1.17 of this Chapter are to be provided. Two spare charges suitable for use with the breathing apparatus are to be provided for each required apparatus. Ships that are equipped with suitably located means for fully recharging the air cylinders free from contamination need carry only one

① For solid bulk cargoes, the protective clothing should satisfy the equipment provisions specified in the respective schedules of the IMSBC Code for the individual substances. For packaged goods, the protective clothing should satisfy the equipment provisions specified in emergency procedures (EmS) of the Supplement to the IMDG Code for the individual substances.

spare charge for each required apparatus.

(7) Portable fire extinguishers

Portable fire extinguishers with a total capacity of at least 12 kg of dry powder or equivalent are to be provided for the cargo spaces. These extinguishers are to be in addition to any portable fire extinguishers required elsewhere in this chapter.

(8) Insulation of machinery space boundaries

Bulkheads forming boundaries between cargo spaces and machinery spaces of category A are to be insulated to "A-60" class standard, unless the dangerous goods are stowed at least 3 m horizontally away from such bulkheads. Other boundaries between such spaces are to be insulated to "A-60" class standard.

(9) Water-spray system

Each open ro-ro space having a deck above it and each space deemed to be a closed ro-ro space not capable of being sealed are to be fitted with an approved fixed pressure water-spraying system for manual operation which is to protect all parts of any deck and vehicle platform in the space, except that the use of any other fixed fire-extinguishing system that has been shown by full-scale test to be no less effective may be permitted. However, the drainage and pumping arrangements are to be such as to prevent the build-up of free surfaces. The drainage system is to be sized to remove no less than 125% of the combined capacity of both the water-spraying system pumps and the required number of fire hose nozzles. The drainage system valves are to be operable from outside the protected space at a position in the vicinity of the extinguishing system controls. Bilge wells are to be of sufficient holding capacity and are to be arranged at the side shell of the ship at a distance from each other of not more than 40 m in each watertight compartment. If this is not possible, the adverse effect upon stability of the added weight and free surface of water are to be taken into account. The information is to be included in the complete stability calculation specified in Appendix 1, PART ONE of the Guidelines.

(10) Separation of ro-ro spaces

① In ships having ro-ro spaces, a separation is to be provided between a closed ro-ro space and an adjacent open ro-ro space. The separation is to be such as to minimize the passage of dangerous vapors and liquids between such spaces. Alternatively, such separation need not be provided if the ro-ro space is considered to be a closed cargo space over its entire length and fully complies with the relevant special requirements of 3.10 of this Chapter.

② In ships having ro-ro spaces, a separation is to be provided between a closed ro-ro space and the adjacent weather deck. The separation is to be such as to minimize the passage of dangerous vapors and liquids between such spaces. Alternatively, a separation need not be provided if the arrangements of the closed ro-ro spaces are in accordance with those required for the dangerous goods carried on adjacent weather decks.

3.10.4 Document of compliance

If the construction and equipment of the ship comply with the requirements of 3.10 of this Chapter, the corresponding Certificate of Fitness for the Carriage of Dangerous Goods is to be issued. The Certificate of Fitness for the Carriage of Dangerous Goods is not required for the dangerous goods defined as class 6.2 and 7 of 1.2(26) of this Chapter and dangerous goods of limited quantities and excepted quantities except for solid dangerous goods in bulk.

3.10.5 Requirements for ships of less than 500 gross tonnage

(1) Ships of less than 500 gross tonnage engaged in the carriage of dangerous goods are to comply with the loading conditions according to the ship type and class of dangerous goods. Generally the following requirements are to be complied with as a minimum:

① water supply required by 3.10.3(1) of this Chapter, but fire pumps need not be started remotely;

② there is no potential source of fire in cargo spaces (power to all electrical installations is to be cut off during navigation);

③ natural ventilation is to be provided;

④ personnel protection required by 3.10.3(6) of this Chapter;

⑤ fire extinguishers required by 3.10.3(7) of this Chapter;

⑥ lightning-proof facilities (installing lightning arresters).

(2) The requirements above are to be recorded in the Document of Compliance mentioned in 3.10.4 of this Chapter.

Where X appears in table 3.10.2(1), it means this requirement is applicable to all classes of dangerous goods as given in the appropriate line of table 3.10.2(3), except as indicated by the notes.

Application of the requirements to different modes of carriage of dangerous goods in ships and cargo spaces **Table 3.10.2(1)**

3.10.2(2) / 3.10.3	Weather decks, including ①～⑤	① Not specially designed	② Container cargo spaces	③		④ Solid dangerous goods in bulk	⑤ Shipborne barges
				Closed ro-ro spaces[5]	Open ro-ro spaces		
(1)①	×	×	×	×	×	For application of requirements of 3.10 of this Chapter to different classes of dangerous goods, see table 3.10.2(2)	×
(1)②	×	×	×	×	×		—
(1)③	—	×	×	×	×		×
(1)④	—	×	×	×	×		×
(2)	—	×	×	×	×		×[4]
(3)	—	×	×	×	—		×[4]
(4)①	—	×	×[1]	×	—		×[4]
(4)②	—	×	×[1]	×	—		×[4]
(5)	—	×	×	×	—		—
(6)①	×	×	×	×	×		—
(6)②	×	×	×	×	×		—
(7)	×	×	—	—	×		—
(8)	×	×	×[2]	×	×		—
(9)	—	—	—	×[3]	×		—
(10)①	—	—	—	×	—		—
(10)②	—	—	—	×	—		—

Notes:

1 For classes 4 and 5.1 not applicable to closed freight containers.
For classes 2, 3, 6.1 and 8 when carried in closed freight containers, the ventilation rate may be reduced to not less than two air changes. For classes 4 and 5.1 liquids when carried in closed freight containers, the ventilation rate may be reduced to not less than two air changes per hour. For the purpose of this requirement a portable tank is a closed freight container.

2 Applicable to decks only.

3 Applies only to closed ro-ro spaces, not capable of being sealed.

4 In the special case where the barges are capable of containing flammable vapors or alternatively if they are capable of discharging flammable vapors to a safe space outside the barge carrier compartment by means of ventilation ducts connected to the barges, these requirements may be reduced or waived.

5 Special category spaces are to be treated as closed ro-ro spaces when dangerous goods are carried.

Application of the requirements to different classes of dangerous goods for ships and cargo spaces carrying solid dangerous goods in bulk **Table 3.10.2(2)**

Class / 3.10.3	4.1	4.2	4.3[6]	5.1	6.1	8	9
(1)①	×	×	—	×	—	—	×
(1)②	×	×	—	×	—	—	×
(2)	×	×[7]	×	×[8]	—	—	×[8]
(4)①	—	×[7]	×	—	—	—	—
(4)②	×[9]	×[7]	×	×[7, 9]	—	—	×[7, 9]
(4)③	×	×	×	×	×	×	×
(6)	×	×	×	×	×	×	×
(8)	×	×	×	×[7]	—	—	×[10]

Notes:

6 The hazards of substances in this class which may be carried in bulk are such that special consideration is to be given to the construction and equipment of the ship involved in addition to meeting the requirements enumerated in this table.

7 Only applicable to Seedcake containing solvent extractions, to Ammonium nitrate and to Ammonium nitrate fertilizers.

8 Only applicable to Ammonium nitrate and to Ammonium nitrate fertilizers. However, a degree of protection in accordance with standards contained in the International Electrotechnical Commission publication 60079, *Electrical apparatus for explosive gas atmospheres*, is sufficient.

9 Only suitable wire mesh guards are required.

10 The requirements of the International Maritime Solid Bulk Cargoes (IMSBC) Code are sufficient.

Application of the requirements to different class of dangerous goods except solid dangerous goods in bulk Table 3.10.2(3)

1.4S	2.1	2.2	2.3 Flammable[20]	2.3 Non-flammable	3 FP[15]<23℃	3 FP[15]≥23℃ ≤60℃	4.1	4.2	4.3 Liquids[21]	4.3 Solids	5.1	5.2[16]	6.1 Liquids FP[15]<23℃	6.1 Liquids FP[15]≥23℃ ≤60℃	6.1 Liquids	6.1 Solids	8 Liquids FP[15]<23℃	8 Liquids FP[15]≥23℃ ≤60℃	
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	X	-	X	-	X	-	-	-	X[18]	-	-	-	X	-	-	-	X	-	-
X	X	X	-	X	X	X	X	X	X	X	X	-	X	X	X	X	X	X	X
-	X	-	-	X	X	-	X[11]	X[11]	X	X	X[11]	-	X	X	-	X[11]	X	X	-
-	X	-	-	-	X	-	-	-	-	-	-	-	X	-	-	-	X	-	-
-	-	-	-	-	X	-	-	-	-	-	-	-	X	X	X	-	X	X[19]	X[19]
-	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
-	-	-	-	-	X	X	X	X	X	X	X	-	X	X	-	-	X	X	-
-	X	X	X	X	X	X	X	X	X	X	X[13]	X	X	X	-	-	X	X	-
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Notes:

11 When "mechanically-ventilated spaces" are required by the IMDG Code.

12 Stow 3 m horizontally away from the machinery space boundaries in all cases.

13 Refer to the IMDG Code.

14 As appropriate for the goods to be carried.

15 FP means flashpoint.

16 Under the provisions of the IMDG Code, stowage of class 5.2 dangerous goods under deck or in enclosed ro-ro spaces is prohibited.

17 Only applicable to dangerous goods evolving flammable vapour listed in the IMDG Code.

18 Only applicable to dangerous goods having a flashpoint less than 23℃ listed in the IMDG Code.

19 Only applicable to dangerous goods having a subsidiary risk class 6.1.

20 Under the provisions of the IMDG Code, stowage of class 2.3 having subsidiary risk class 2.1 under deck or in enclosed ro-ro spaces is prohibited.

21 Under the provisions of the IMDG Code, stowage of class 4.3 liquids having a flashpoint less than 23℃ under deck or in enclosed ro-ro spaces is prohibited.

4 Fire safety measures for tankers

4.1 Application

4.1.1 Unless expressly provided otherwise, requirements for tankers in 4 of this chapter are to apply to tankers carrying crude oil or petroleum products having a flashpoint not exceeding 60℃ (closed cup test), as determined by an approved flashpoint apparatus, and a Reid vapour pressure which is below the atmospheric pressure or other liquid products having a similar fire hazard.

4.1.2 Where liquid cargoes other than those referred to in 4.1.1 above or liquefied gases which introduce additional fire hazards are intended to be carried, additional safety measures are to be required, having due regard to the provisions of the International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (IBC Code), the International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (IGC Code), as appropriate.

(1) A liquid cargo with a flashpoint of less than 60℃ for which a regular foam fire-fighting system complying with 4.1.4 of this Chapter is not effective, is considered to be a cargo introducing additional fire hazards in this context. The following additional measures are required:

① the foam is to be of alcohol-resistant type;

② the type of foam concentrates for use in chemical tankers is to take into account IMO guidelines[①];

③ the capacity and application rates of the foam extinguishing system are to comply with chapter 11 of the IBC Code, except that lower application rates may be accepted based on performance tests. For tankers fitted with inert gas systems, a quantity of foam concentrate sufficient for 20 min of foam generation may be accepted.

(2) For the purpose of this paragraph, a liquid cargo with a vapour pressure greater than 1.013 bar absolute at 37.8℃ is considered to be a cargo introducing additional fire hazards. Ships carrying such substances are to comply with paragraph 15.14 of the IBC Code. When ships operate in restricted areas and at restricted times, the requirements for refrigeration systems in accordance with paragraph 15.14.3 of the Code above may be waived.

4.1.3 Liquid cargoes with a flashpoint exceeding 60℃ other than oil products or liquid cargoes subject to the requirements of the IBC Code are considered to constitute a low fire risk, not requiring the protection of a fixed foam extinguishing system.

4.1.4 Tankers carrying petroleum products with a flashpoint exceeding 60℃ (closed cup test), as determined by an approved flashpoint apparatus, are to comply with the requirements provided in 1.3.3(6) and 1.17.3(3) of this Chapter and the requirements for cargo ships other than tankers, except that, in lieu of the fixed fire-extinguishing system required in 3.9 of this Chapter, they are to be fitted with a fixed deck foam system which is to comply with the provisions of 4.13 of this Chapter.

4.1.5 4 of this Chapter applies to all combination carriers. Such ships are not to carry cargoes other than oil unless all cargo spaces are empty of oil and gas-freed or unless the arrangements provided in each case have been approved and comply with the relevant operational requirements for inert gas systems.

4.1.6 Chemical tankers and gas carriers are to comply with the requirements of 4 of this Chapter, except where alternative and supplementary arrangements are provided, having due regard to the provisions of the IBC Code and the IGC Code, as appropriate.

4.1.7 When chemical tankers and gas carriers carry goods mentioned in 4.1.1 of this Chapter, evaluation is to be carried out and submitted for approval.

4.2 Location and separation of spaces

4.2.1 Cargo pump-rooms, cargo tanks, slop tanks and cofferdams are to be positioned forward of machinery spaces. However, oil fuel bunker tanks need not be forward of machinery spaces. Cargo tanks and slop tanks are to be isolated from machinery spaces by cofferdams, cargo pump-rooms, oil bunker tanks or ballast tanks. Pump-rooms containing pumps and their accessories for ballasting those spaces situated adjacent to cargo tanks and slop tanks and pumps

① Guidelines for performance and testing criteria and surveys of expansion foam concentrates for fixed fire-extinguishing systems of chemical tankers.

for oil fuel transfer are to be considered as equivalent to a cargo pump-room within the context of 4.2 of this Chapter provided that such pump-rooms have the same safety standard as that required for cargo pump-rooms. Pump-rooms intended solely for ballast or oil fuel transfer, however, need not comply with the requirements of 4.15.1 of this Chapter. The lower portion of the pump-room may be recessed into machinery spaces of category A to accommodate pumps, provided that the deck head of the recess is in general not more than one third of the moulded depth above the keel, except that in the case of ships of not more than 25,000 tonnes deadweight, where it can be demonstrated that for reasons of access and satisfactory piping arrangements this is impracticable, a recess in excess of such height, but not exceeding one half of the molded depth above the keel, may be permitted.

4.2.2 Main cargo control stations, control stations, accommodation and service spaces (excluding isolated cargo handling gear lockers) are to be positioned aft of cargo tanks, slop tanks, and spaces which isolate cargo or slop tanks from machinery spaces, but not necessarily aft of the oil fuel bunker tanks and ballast tanks, and are to be arranged in such a way that a single failure of a deck or bulkhead is not to permit the entry of gas or fumes from the cargo tanks into main cargo control stations, control stations, or accommodation and service spaces. A recess provided in accordance with 4.2.1 above need not be taken into account when the position of these spaces is being determined.

4.2.3 Where deemed necessary, main cargo control stations, control stations, accommodation and service spaces may be permitted forward of the cargo tanks, slop tanks and spaces which isolate cargo and slop tanks from machinery spaces, but not necessarily forward of oil fuel bunker tanks or ballast tanks. Machinery spaces, other than those of category A, may be permitted forward of the cargo tanks and slop tanks provided they are isolated from the cargo tanks and slop tanks by cofferdams, cargo pump-rooms, oil fuel bunker tanks or ballast tanks, and have at least one portable fire extinguisher. In cases where they contain internal combustion machinery, one approved foam-type extinguisher of at least 45 *l* capacity or equivalent is to be arranged in addition to portable fire extinguishers. If operation of a semi-portable fire extinguisher is impracticable, this fire extinguisher may be replaced by two additional portable fire extinguishers. Main cargo control stations, control stations and accommodation and service spaces are to be arranged in such a way that a single failure of a deck or bulkhead is not to permit the entry of gas or fumes from the cargo tanks into such spaces. In addition, where deemed necessary for the safety or navigation of the ship, machinery spaces containing internal combustion machinery not being main propulsion machinery having an output greater than 375 kW may be permitted to be located forward of the cargo area provided the arrangements are in accordance with the provisions above.

4.2.4 In combination carriers only:

(1) The slop tanks are to be surrounded by cofferdams except where the boundaries of the slop tanks are part of the hull, main cargo deck, cargo pump-room bulkhead or oil fuel bunker tank. These cofferdams are not to be open to a double bottom, pipe tunnel, pump-room or other enclosed space, nor are they to be used for cargo or ballast and are not to be connected to piping systems serving oil cargo or ballast. Means are to be provided for filling the cofferdams with water and for draining them. Where the boundary of a slop tank is part of the cargo pump-room bulkhead, the pump-room is not to be open to the double bottom, pipe tunnel or other enclosed space; however, openings provided with gastight bolted covers may be permitted;

(2) Means are to be provided for isolating the piping connecting the pump-room with the slop tanks referred to in (1) above. The means of isolation are to consist of a valve followed by a spectacle flange or a spool piece with appropriate blank flanges. This arrangement is to be located adjacent to the slop tanks, but where this is unreasonable or impracticable, it may be located within the pump-room directly after the piping penetrates the bulkhead. A separate permanently installed pumping and piping arrangement incorporating a manifold, provided with a shut-off valve and a blank flange, is to be provided for discharging the contents of the slop tanks directly to the open deck for disposal to shore reception facilities when the ship is in the dry cargo mode. When the transfer system is used for slop transfer in the dry cargo mode, it is to have no connection to other systems. Separation from other systems by means of removal of spool pieces may be accepted;

(3) Hatches and tank cleaning openings to slop tanks are only to be permitted on the open deck and are to be fitted with closing arrangements. Except where they consist of bolted plates with

bolts at watertight spacing, these closing arrangements are to be provided with locking arrangements under the control of the responsible ship's officer;
(4) Where cargo wing tanks are provided, cargo oil lines below deck are to be installed inside these tanks. However, cargo oil lines may be permitted to be placed in special ducts provided these are capable of being adequately cleaned and ventilated. Where cargo wing tanks are not provided, cargo oil lines below deck are to be placed in special ducts.
4.2.5 Where the fitting of a navigation position above the cargo area is shown to be necessary, it is to be for navigation purposes only and it is to be separated from the cargo tank deck by means of an open space with a height of at least 2 m. The fire protection requirements for such a navigation position are to be those required for control stations, as specified in 4.4 of this Chapter and other provisions for tankers, as applicable.
4.2.6 Means are to be provided to keep deck spills away from the accommodation and service areas. This may be accomplished by provision of a permanent continuous coaming of a height of at least 300 mm, extending from side to side. Special consideration is to be given to the arrangements associated with stern loading.
4.2.7 Exterior boundaries of superstructures and deckhouses enclosing accommodation and including any overhanging decks which support such accommodation are to be constituted of steel and insulated to "A-60" standard for the whole of the portions which face the cargo area and on the outward sides for a distance of 3 m from the end boundary facing the cargo area. The distance of 3 m is to be measured horizontally and parallel to the middle line of the ship from the boundary which faces the cargo area at each deck level. In the case of the sides of those superstructures and deckhouses, such insulation is to be carried up to the underside of the deck of the navigation bridge.
For tankers of less than 500 gross tonnage, the boundaries mentioned above may be insulated to "A-30" standard.
4.2.8 Restriction on boundary openings
(1) Except as permitted in (2) below, access doors, air inlets and openings to accommodation spaces, service spaces, control stations and machinery spaces are not to face the cargo area. They are to be located on the transverse bulkhead not facing the cargo area or on the outboard side of the superstructure or deckhouse at a distance of at least 4% of the length of the ship, but not less than 3 m from the end of the superstructure or deckhouse facing the cargo area. This distance need not exceed 5 m.
(2) access doors in boundary bulkheads facing the cargo area or within the 5 m limits specified in (1) above, to main cargo control stations and to such service spaces used as provision rooms, store-rooms and lockers, provided they do not give access directly or indirectly to any other space containing or providing for accommodation, control stations or service spaces such as galleys, pantries or workshops, or similar spaces containing sources of vapour ignition, may be permitted. The boundary of such a space is to be insulated to "A-60" class standard, with the exception of the boundary facing the cargo area. Bolted plates for the removal of machinery may be fitted within the limits specified in (1) above. Wheelhouse doors and windows may be located within the limits specified in (1) above so long as they are designed to ensure that the wheelhouse can be made rapidly and efficiently gastight and vapourtight.
For tankers of less than 500 gross tonnage, the boundaries mentioned above may be insulated to "A-30" standard.
(3) Windows and sidescuttles facing the cargo area and on the sides of the superstructures and deckhouses within the limits specified in (1) above are to be of the fixed (non-opening) type. Such windows and sidescuttles, except wheelhouse windows, are to be constructed to "A-60" class standard except that "A-0" class standard is acceptable for windows and sidescuttles outside the 3m limit specified in 4.2.7 of this Chapter.
(4) Where there is permanent access from a pipe tunnel to the main pump-room, a watertight door complying with the requirements of Chapter 2-1 of this PART is to be fitted and, in addition, with the following:

① in addition to the bridge operation, the watertight door is to be capable of being manually closed from outside the main pump-room entrance;

② the watertight door is to be kept closed during normal operations of the ship except when access to the pipe tunnel is required. The watertight door is to also comply with the requirements of Chapter 2-1 of this PART.

4.3 Structure

4.3.1 Tankers of 500 gross tonnage and upwards are to comply with the requirements of 3.1.1 of this Chapter, and are only to use method IC defined by 3.1.2 of this Chapter.

4.3.2 For tankers of less than 500 gross tonnage:

(1) the requirements of 3.1.1(1) to (4) of this Chapter are to be complied with;

(2) the area of any accommodation space or spaces bounded by a continuous "A" or "B" class division is in no case to exceed 50 m^2.

4.4 Fire integrity of bulkheads and decks

4.4.1 In addition to complying with the specific provisions for fire integrity of bulkheads and decks of tankers mentioned elsewhere in this Chapter, the minimum fire integrity of bulkheads and decks is to be as prescribed in Tables 4.4.3a and 4.4.3b of this Chapter.

4.4.2 The following requirements are to govern application of Tables 4.4.3a and 4.4.3b.

(1) For determining the appropriate fire integrity standards to be applied to divisions between adjacent spaces, such spaces are classified according to their fire risk as shown in categories ① to ⑩ below. Where the contents and use of a space are such that there is a doubt as to its classification for the purpose of 4.4 of this Chapter, or where it is possible to assign two or more classifications to a space, it is to be treated as a space within the relevant category having the most stringent boundary requirements. Smaller, enclosed rooms within a space that have less than 30% communicating openings to that space are considered separate spaces. The fire integrity of the boundary bulkheads and decks of such smaller rooms is to be as prescribed in tables 4.4.3a and 4.4.3b. The title of each category is intended to be typical rather than restrictive. The number preceding each category refers to the applicable column or row in the tables.

① Control stations

Spaces containing emergency sources of power and lighting.

Wheelhouse and chartroom.

Spaces containing the ship's radio equipment.

Fire control stations.

Control room for propulsion machinery when located outside the propulsion machinery space.

Spaces containing centralized fire alarm equipment.

Spaces containing navigation equipment.

Spaces containing emergency battery rechargers or emergency charging and recharging panels.

All spaces containing emergency batteries (including backup power for radio installation or emergency batteries for the starting of the emergency generator).

Storage spaces for fire-extinguishing medium of fixed fire-extinguishing systems.

② Corridors

Passenger and crew corridors and lobbies.

③ Accommodation spaces

Spaces as defined in 1.2 of this Chapter excluding corridors.

Changing rooms.

④ Stairways

Interior stairways, lifts, totally enclosed emergency escape trunks, and escalators (other than those wholly contained within the machinery spaces) for passengers and crew and enclosures thereto.

In this connection, a stairway which is enclosed at only one level is to be regarded as part of the space from which it is not separated by a fire door.

⑤ Service spaces (low risk)

Lockers and store-rooms having areas less than 4 m^2 in which flammable liquids are not stored.

Drying rooms and laundries.

Food storage or refrigerating rooms using non-combustible materials as insulation layer.

Storage rooms having areas less than 4 m^2 for work clothes of crew when the clothes are soiled with oil.

⑥ Machinery spaces of category A
Spaces as defined in 1.2 of this Chapter.

⑦ Other machinery spaces
Electrical equipment rooms (auto-telephone exchange, air-conditioning duct spaces).
Spaces as defined in 1.2 of this Chapter excluding machinery spaces of category A.

⑧ Cargo pump-rooms
Spaces containing cargo pumps and entrances and trunks to such spaces.

⑨ Service spaces (high risk)
Galleys, pantries containing cooking appliances, paint and lamp rooms, lockers and store-rooms having area of 4 m^2 or more, spaces for the storage of flammable liquids, saunas and workshops other than those forming part of the machinery spaces.
Food storage or refrigerating rooms using non-combustible materials as insulation layer.
Mail rooms.
Storage rooms having areas less than 4 m^2 for work clothes of crew when the clothes are soiled with oil.
Storage rooms for oxygen or acetylene.

⑩ Open decks
Open deck spaces and enclosed promenades. To be considered in this category, enclosed promenades are to have no significant fire risk, meaning that furnishings are to be restricted to deck furniture. In addition, such spaces are to be naturally ventilated by permanent openings.
Air spaces (the space outside superstructures and deckhouses).

(2) Continuous "B" class ceilings or linings, in association with the relevant decks or bulkheads, may be accepted as contributing, wholly or in part, to the required insulation and integrity of a division.

(3) Permanent approved gastight lighting enclosures for illuminating cargo pump-rooms may be permitted in bulkheads and decks separating cargo pump-rooms and other spaces provided they are of adequate strength and the integrity and gastightness of the bulkhead or deck is maintained.

4.4.3 The fire integrity of bulkheads and decks separating adjacent spaces for tankers of 500 gross tonnage and upwards is to comply with the provisions of Table 4.4.3a and Table 4.4.3b respectively.

Fire integrity of bulkheads separating adjacent spaces **Table 4.4.3a**

Space	①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩
Control stations ①	A-0[c]	A-0	A-60	A-0	A-15	A-60	A-15	A-60	A-60	*
Corridors ②		C	B-0	B-0 A-0[a]	B-0	A-60	A-0	A-60	A-0	*
Accommodation spaces ③			C	B-0 A-0[a]	B-0	A-60	A-0	A-60	A-0	*
Stairways ④				B-0 A-0[a]	B-0 A-0[a]	A-60	A-0	A-60	A-0	*
Service spaces(low risk) ⑤					C	A-60	A-0	A-60	A-0	*
Machinery spaces of category A ⑥						*	A-0	A-0[d]	A-60	*
Other machinery spaces ⑦							A-0[b]	A-0	A-0	*
Cargo pump-rooms ⑧								*	A-60	*
Service spaces(high risk) ⑨									A-0[b]	*
Open decks ⑩										-

Fire integrity of decks separating adjacent spaces **Table 4.4.3b**

Space above→ / Space below↓	①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩
Control stations ①	A-0	A-0	A-0	A-0	A-0	A-60	A-0	-	A-0	*
Corridors ②	A-0	*	*	A-0	*	A-60	A-0	-	A-0	*
Accommodation spaces ③	A-60	A-0	*	A-0	*	A-60	A-0	-	A-0	*
Stairways ④	A-0	A-0	A-0	*	A-0	A-60	A-0	-	A-0	*
Service spaces(low risk) ⑤	A-15	A-0	A-0	A-0	*	A-60	A-0	-	A-0	*
Machinery spaces of category	A-60	A-60	A-60	A-60	A-60	*	A-60[e]	A-0	A-60	*

A	⑥										
Other machinery spaces	⑦	A-15	A-0	A-0	A-0	A-0	A-0	*	A-0	A-0	*
Cargo pump-rooms	⑧	-	-	-	-	-	A-0[d]	A-0	*	-	*
Service spaces(high risk)	⑨	A-60	A-0	A-0	A-0	A-0	A-60	A-0	-	A-0[b]	*
Open decks	⑩	*	*	*	*	*	*	*	*	*	-

Notes: To be applied to tables 4.4.3a and 4.4.3b as appropriate.

a For clarification as to which applies, see 3.1.1(2) and 3.4 of this Chapter.

b Where spaces are of the same numerical category and superscript "b" appears, a bulkhead or deck of the rating shown in the tables is only required when the adjacent spaces are for a different purpose (e.g., in category ⑨). A galley next to a galley does not require a bulkhead but a galley next to a paint room requires and "A-0" bulkhead.

c Bulkheads separating the wheelhouse, chartroom and radio room from each other may have a "B-0" rating.

d Bulkheads and decks between cargo pump-rooms and machinery spaces of category A may be penetrated by cargo pump shaft glands and similar gland penetrations, provided that gastight seals with efficient lubrication or other means of ensuring the permanence of the gas seal are fitted in way of the bulkheads or deck.

e Fire insulation need not be fitted in the machinery space in category ⑦ if it is confirmed to have little or no fire risk.

* Where an asterisk appears in the table, the division is required to be of steel or other equivalent material, but is not required to be of "A" class standard. However, where a deck, except an open deck, is penetrated for the passage of electric cables, pipes and vent ducts, such penetrations are to be made tight to prevent the passage of flame and smoke. Divisions between control stations (emergency generators) and open decks may have air intake openings without means for closure, unless a fixed gas fire-extinguishing system is fitted.

\- No special requirement for the material or integrity of the boundary.

4.4.4 Tankers of less than 500 gross tonnage

(1) Corridor bulkheads and the doors therein are to be of steel or non-combustible material.

(2) The boundaries of machinery spaces of category A and galleys are to be of steel or equivalent material, and the doors therein are to be of steel or non-combustible material.

4.5 Means of escape

4.5.1 Tankers of 500 gross tonnage and upwards are to comply with the provisions of 3.3.2(1), (3), (4), (5), (6) and 3.3.4 of this Chapter.

4.5.2 Tankers of less than 500 gross tonnage are to comply with the provisions of 3.3.3 of this Chapter.

4.6 Protection of stairways and lifts in accommodation spaces, service spaces and control stations

4.6.1 Tankers of 500 gross tonnage and upwards are to comply with the provisions of 3.4.1 of this Chapter.

4.6.2 Tankers of less than 500 gross tonnage are to comply with the provisions of 3.4.2 of this Chapter.

4.7 Doors in fire-resisting divisions

4.7.1 Tankers of 500 gross tonnage and upwards are to comply with the provisions of 3.5.1 of this Chapter.

4.7.2 Tankers of less than 500 gross tonnage are to comply with the provisions of 3.5.2 of this Chapter.

4.8 Restricted use of combustible materials

4.8.1 All tankers are to comply with the provisions of 3.6 of this Chapter.

4.9 Details of construction

4.9.1 Tankers of 500 gross tonnage and upwards are to comply with the provisions of 3.7.1(1) and (3) of this Chapter.

4.9.2 Tankers of less than 500 gross tonnage are to comply with the provisions of 3.7.2 of this Chapter.

4.9.3 Skylights to cargo pump-rooms are to be of steel, are not to contain any glass and are to be capable of being closed from outside the pump-room.

4.10 Fixed fire detection and fire alarm systems

4.10.1 For tankers of 500 gross tonnage and upwards, a fixed fire detection and fire alarm system complying with the provisions of 1.12 of this Chapter is to be so installed and arranged as to provide smoke detection in all corridors, stairways and escape routes within accommodation spaces.
4.10.2 For tankers of less than 500 gross tonnage, manually operated call points complying with the provisions of 1.12 of this Chapter are to be installed throughout the accommodation spaces and service spaces.

4.11 Venting, purging, gas-freeing and ventilation

4.11.1 Venting

(1) The venting system of cargo tanks is to be entirely distinct from the air pipes of the other compartments of the ship. The arrangements and position of openings in the cargo tank deck from which emission of flammable vapours can occur are to be such as to minimize the possibility of flammable vapours being admitted to enclosed spaces containing a source of ignition, or collecting in the vicinity of deck machinery and equipment which may constitute an ignition hazard. In accordance with this general principle the criteria in (2) to (12) will apply.

(2) The venting arrangements are to be so designed and operated as to ensure that neither pressure nor vacuum in cargo tanks is to exceed design parameters and be such as to provide for:

① the flow of the small volumes of vapour, air or inert gas mixtures caused by thermal variations in a cargo tank in all cases through pressure/vacuum valves;

② the passage of large volumes of vapour, air or inert gas mixtures during cargo loading and ballasting, or during discharging;

③ a secondary means of allowing full flow relief of vapors, air or inert gas mixtures, to prevent over-pressure or under-pressure in the event of failure of the arrangements in ② above. Alternatively, pressure sensors may be fitted in each tank protected by the arrangement required in ② above, with a monitoring system in the ship's cargo control room or the position from which cargo operations are normally carried out. Such monitoring equipment is also to provide an alarm facility which is activated by detection of over-pressure or under-pressure conditions within a tank.

(3)① The venting arrangements in each cargo tank may be independent or combined with other cargo tanks and may be incorporated into the inert gas piping.

② Where the arrangements are combined with other cargo tanks, either stop valves or other acceptable means are to be provided to isolate each cargo tank. Where stop valves are fitted, they are to be provided with locking arrangements which are to be under the control of the responsible ship's officer. There is to be a clear visual indication of the operational status of the valves or other acceptable means. Where tanks have been isolated, it is to be ensured that relevant isolating valves are opened before cargo loading or ballasting or discharging of those tanks is commenced. Any isolation must continue to permit the flow caused by thermal variations in a cargo tank in accordance with (2)① above.

(4) If cargo loading and ballasting or discharging of a cargo tank or cargo tank group which is isolated from a common venting system is intended, that cargo tank or cargo tank group is to be fitted with a means for over-pressure or under-pressure protection as required in (2)③ above.

(5) The venting arrangements are to be connected to the top of each cargo tank and are to be self-draining to the cargo tanks under all normal conditions of trim and list of the ship. Where it may not be possible to provide self-draining lines, permanent arrangements are to be provided to drain the vent lines to a cargo tank.

(6) The venting system is to be provided with devices to prevent the passage of flame into the cargo tanks. The design, testing and locating of these devices are to comply with the established requirements or the accepted standards. Ullage openings are not to be used for pressure equalization. They are to be provided with self-closing and tightly sealing covers. Flame arresters and screens are not permitted in these openings.

(7) Provision is to be made to guard against liquid rising in the venting system to a height which would exceed the design head of cargo tanks. This is to be accomplished by high-level alarms or overflow control systems or other equivalent means, together with gauging devices and cargo tank filling procedures. For the purposes of this paragraph, spill valves are not considered equivalent to an overflow system.

(8) Openings for pressure release required by (2)① are to:

① have as great a height as is practicable above the cargo tank deck to obtain maximum dispersal of flammable vapours but in no case less than 2 m above the cargo tank deck;

② be arranged at the further distance practicable but not less than 5 m from the nearest air intakes and openings to enclosed spaces containing a source of ignition and from deck machinery and equipment which may constitute an ignition hazard. Anchor windlass and chain locker openings constitute an ignition hazard.

(9) Pressure/vacuum valves required by (2)① may be provided with a bypass arrangement when they are located in a vent main or masthead riser. Where such an arrangement is provided there are to be suitable indicators to show whether the bypass is open or closed.

(10) Vent outlets for cargo loading, discharging and ballasting required by (2)② are to:

① permit the free flow of vapour mixtures; or permit the throttling of the discharge of the vapour mixtures to achieve a velocity of not less than 30 m/s;

② be so arranged that the vapour mixture is discharged vertically upwards;

③ where the method is by free flow of vapour mixtures, be such that the outlet is not to be less than 6 m above the cargo tank deck or fore and aft gangway if situated within 4 m of the gangway and located not less than 10 m measured horizontally from the nearest air intakes and openings to enclosed spaces containing a source of ignition and from deck machinery and equipment which may constitute an ignition hazard;

④ where the method is by high-velocity discharge, be located at a height not less than 2 m above the cargo tank deck and not less than 10 m measured horizontally from the nearest air intakes and openings to enclosed spaces containing a source of ignition and from deck machinery, which may include anchor windlass and chain locker openings, and equipment which may constitute an ignition hazard. These outlets are to be provided with high-velocity devices of an approved type;

⑤ be designed on the basis of the maximum designed loading rate multiplied by a factor of at least 1.25 to take account of gas evolution, in order to prevent the pressure in any cargo tank from exceeding the design pressure. The master are to be provided with information regarding the maximum permissible loading rate for each cargo tank and in the case of combined venting systems, for each group of cargo tanks.

(11) The arrangements for the venting of vapours displaced from the cargo tanks during loading and ballasting are to comply with the provisions of 4.11.1 of this Chapter and are to consist of either one or more mast risers, or a number of high-velocity vents. The inert gas supply main may be used for such venting.

(12) In combination carriers, the arrangement to isolate slop tanks containing oil or oil residues from other cargo tanks is to consist of blank flanges which will remain in position at all times when cargoes other than liquid cargoes referred to in 4.1.1 of this Chapter are carried.

4.11.2 Tank purging and/or gas-freeing

(1) Arrangements for purging and/or gas-freeing are to be such as to minimize the hazards due to the dispersal of flammable vapours in the atmosphere and to flammable mixtures in a cargo tank.

(2) Procedures for cargo tank purging and/or gas-freeing are to be as follows.

① When the ship is provided with an inert gas system, the cargo tanks are to first be purged in accordance with the provisions of 4.11.2(1) and (3) of this Chapter until the concentration of hydrocarbon vapours in the cargo tanks has been reduced to less than 2% by volume. Thereafter, gas-freeing may take place at the cargo tank deck level.

② When the ship is not provided with an inert gas system, the operation is to be such that the flammable vapour is discharged initially through:

(a) the vent outlets as specified in 4.11.1(9) of this Chapter;

(b) outlets at least 2 m above the cargo tank deck level with a vertical efflux velocity of at least 30 m/s maintained during the gas-freeing operation;

(c) outlets at least 2 m above the cargo tank deck level with a vertical efflux velocity of at least 20 m/s and which are protected by suitable devices to prevent the passage of flame.

③ The above outlets are to be located not less than 10 m, measured horizontally, from the nearest air intakes and openings to enclosed spaces containing a source of ignition and from deck machinery, which may include anchor windlass and chain locker openings, and equipment which may constitute an ignition hazard.

④ When the flammable vapour concentration at the outlet has been reduced to 30% of the lower flammable limit, gas-freeing may be continued at cargo tank deck level.

(3) The arrangements for inerting, purging or gas-freeing of empty tanks as required in 4.14.1(3) of this Chapter are to comply with the relevant provisions of 4 of this Chapter and are to be such that the accumulation of hydrocarbon vapours in pockets formed by the internal structural members in a tank is minimized and that:

① on individual cargo tanks, the gas outlet pipe, if fitted, is to be positioned as far as practicable from the inert gas/air inlet and in accordance with 4.11.1 of this Chapter. The inlet of such outlet pipes may be located either at deck level or at not more than 1 m above the bottom of the tank;

② the cross-sectional area of such gas outlet pipe referred to in ① above is to be such that an exit velocity of at least 20 m/s can be maintained when any three tanks are being simultaneously supplied with inert gas. Their outlets are to extend not less than 2 m above deck level;

③ each gas outlet referred to in ① above is to be fitted with suitable blanking arrangements.

4.11.3 Ventilation

(1) Cargo pump-rooms are to be mechanically ventilated and discharges from the exhaust fans are to be led to a safe place on the open deck. The ventilation of these rooms is to have sufficient capacity to minimize the possibility of accumulation of flammable vapours. The number of air changes is to be at least 20 per hour, based upon the gross volume of the space. The air ducts are to be arranged so that all of the space is effectively ventilated. The ventilation is to be of the suction type using fans of the non-sparking type.

(2) The arrangement of ventilation inlets and outlets and other deckhouse and superstructure boundary space openings is to be such as to complement the provisions of 4.11.1 of this Chapter. Such vents, especially for machinery spaces, are to be situated as far aft as practicable. Due consideration in this regard is to be given when the ship is equipped to load or discharge at the stern. Sources of ignition such as electrical equipment are to be so arranged as to avoid an explosion hazard.

(3) In combination carriers, cargo spaces and any enclosed spaces adjacent to cargo spaces are to be capable of being mechanically ventilated. The mechanical ventilation may be provided by portable fans. An approved fixed gas warning system capable of monitoring flammable vapours is to be provided in cargo pump-rooms, pipe ducts and cofferdams, as referred to in paragraph 4.2.4 of this Chapter, adjacent to slop tanks. Suitable arrangements are to be made to facilitate measurement of flammable vapours in all other spaces within the cargo area. Such measurements are to be made possible from the open deck or easily accessible positions.

4.11.4 Inerting, ventilation and gas measurement

(1) Double hull and double bottom spaces are to be fitted with suitable connections for the supply of air.

(2) Tankers required to be fitted with inert gas systems are to comply with the following provisions:

① double hull spaces are to be fitted with suitable connections for the supply of inert gas;

② where hull spaces are connected to a permanently fitted inert gas distribution system, means are to be provided to prevent hydrocarbon gases from the cargo tanks entering the double hull spaces through the system;

③ where such spaces are not permanently connected to an inert gas distribution system, appropriate means are to be provided to allow connection to the inert gas main.

(3)① Suitable portable instruments for measuring oxygen and flammable vapour concentrations are to be provided. In selecting these instruments, due attention is to be given to their use in combination with the fixed gas sampling line systems referred to in 4.11.4(3)② of this Chapter.

② Where the atmosphere in double hull spaces cannot be reliably measured using flexible gas sampling hoses, such spaces are to be fitted with permanent gas sampling lines. The configuration of gas sampling lines is to be adapted to the design of such spaces.

③ The materials of construction and the dimensions of gas sampling lines are to be such as to prevent restriction. Where plastic materials are used, they are to be electrically conductive.

4.11.5 Combustible gas detecting instrument

Tankers are to be equipped with at least one portable instrument for measuring flammable vapour concentrations, together with a sufficient set of spares. Suitable means are to be provided for the calibration of such instruments.

4.11.6 Safety measures in cargo tanks

One or more pressure/vacuum-breaking devices are to be provided to prevent the cargo tanks from being subject to:

(1) a positive pressure, in excess of the test pressure of the cargo tank, if the cargo were to be loaded at the maximum rated capacity and all other outlets are left shut;

(2) a negative pressure in excess of 700 mm water gauge if the cargo were to be discharged at the maximum rated capacity of the cargo pumps and the inert gas blowers were to fail.

Such devices are to be installed on the inert gas main unless they are installed in the venting system required by 4.11.1 of this Chapter or on individual cargo tanks. The location and design of the devices are to be in accordance with 4.11.1 of this Chapter.

4.12 Cargo tank protection

4.12.1 For tankers of 20,000 tonnes deadweight and upwards the protection of the cargo tanks deck area and cargo tanks are to be achieved by a fixed deck foam system and a fixed inert gas system in accordance with the requirements of 4.13 and 4.14 of this Chapter, except that, in lieu of the above installations, after due consideration having been given to the ship's arrangement and equipment, other combination of fixed installations may be accepted if they afford protection equivalent to the above. The requirements for alternative fixed installations are to comply with the requirements in 4.12.2 and 4.12.3 below. However, information such as relevant calculation, testing or operation experience is to be provided.

4.12.2 To be considered equivalent, the system proposed in lieu of the deck foam system is to:

(1) be capable of extinguishing spill fires and also preclude ignition of spilled oil not yet ignited;

(2) be capable of combating fires in ruptured tanks.

4.12.3 To be considered equivalent, the system proposed in lieu of the fixed inert gas system is to:

(1) be capable of preventing dangerous accumulations of explosive mixtures in intact cargo tanks during normal service throughout the ballast voyage and necessary in-tank operations;

(2) be so designed as to minimize the risk of ignition from the generation of static electricity by the system itself.

4.12.4 All tankers operating with a cargo tank cleaning procedure using crude oil washing are to be fitted with an inert gas system complying with the requirements of 4.14 of this Chapter and with fixed tank washing machines.

4.12.5 All tankers fitted with a fixed inert gas system are to be provided with a closed ullage system.

4.12.6 Tanker of less than 20 000 tonnes deadweight are to be provided with a deck foam system complying with the requirements of 4.13 of this Chapter. Tankers of less than 4000 tons deadweight may be provided with a foam applicator complying with the requirements of 4.13.3 of this Chapter. Tankers of less than 500 gross tonnage may be provided with a portable foam applicator.

4.13 Fixed deck foam systems

4.13.1 General requirements

(1) The arrangements for providing foam are to be capable of delivering foam to the entire cargo tanks deck area as well as into any cargo tank the deck of which has been ruptured.

(2) The deck foam system is to be capable of simple and rapid operation.

(3) Operation of a deck foam system at its required output is to permit the simultaneous use of the minimum required number of jets of water at the required pressure from the fire main. Where the deck foam system is supplied by a common line from the fire main, additional foam concentrate is to be provided for operation of two nozzles for the same period of time required for the foam system. The simultaneous use of the minimum required jets of water is to be possible on deck over the full length of the ship, in the accommodation, service spaces, control stations and machinery spaces①.

① Refer to the recommendations of the International Electrotechnical Commission, in particular publication 60079 Electrical apparatus for explosive gas atmospheres.

4.13.2 Component requirements

(1) Foam solution and foam concentrate

① For tankers carrying:

(a) crude oil or petroleum products having a flashpoint not exceeding 60℃ (closed cup), as determined by an approved flashpoint apparatus, and a Reid vapour pressure which is below atmospheric pressure or other liquid products having a similar fire hazard, including cargoes in chapter 18 of the IBC Code, having a flashpoint not exceeding 60℃ (closed cup) for which a regular foam fire-fighting system is effective (refer to 4.1.1 and 4.13 of this Chapter); or

(b) petroleum products with a flashpoint exceeding 60℃ (closed cup), as determined by an approved flashpoint apparatus (refer to 4.1.4 of this Chapter); or

(c) products of chapter 17 of the IBC Code, with a flashpoint exceeding 60℃ (closed cup) determined by an approved flashpoint apparatus (refer to paragraph 11.1.3 of the IBC Code and 4.1.4 of this Chapter),

② the rate of supply of foam solution is to be not less than the greatest of the following:

(a) 0.6 *l*/min per square metre of cargo tanks deck area, where cargo tanks deck area means the maximum breadth of the ship multiplied by the total longitudinal extent of the cargo tank spaces;

(b) 6 *l*/min per square metre of the horizontal sectional area of the single tank having the largest such area; or

(c) 3 *l*/min per square metre of the area protected by the largest monitor, such area being entirely forward of the monitor, but in no case should the output of any monitor be less than 1,250 *l*/min.

③ For tankers carrying chemicals in bulk listed in chapter 17 of the IBC Code, having a flashpoint not exceeding 60℃ (closed cup), the rate of supply of foam solution is to be as required by the IBC Code.

④ Sufficient foam concentrate is to be supplied to ensure at least 20 min of foam generation in tankers fitted with an inert gas installation or 30 min of foam generation in tankers not fitted with an inert gas installation or not required to use an inert gas system.

⑤ The foam concentrate supplied on board is to be approved for the cargoes intended to be carried[①]. Type B foam concentrates are to be supplied for the protection of crude oil, petroleum products and non-polar solvent cargoes. Type A foam concentrates are to be supplied for polar solvent cargoes, as listed in the table of chapter 17 of the IBC Code. Only one type of foam concentrate is to be supplied, and it is to be effective for the maximum possible number of cargoes intended to be carried. For cargoes for which foam is not effective or is incompatible, additional arrangements are to be provided.

⑥ Liquid cargoes with a flashpoint not exceeding 60℃ for which a regular foam fire-fighting system is not effective are to comply with the provisions of 4.1.2(1) of this Chapter.

(2) Monitors and foam applicators

① Foam from the fixed foam system is to be supplied by means of monitors and foam applicators. Prototype tests of the monitors and foam applicators are to be performed to ensure the foam expansion and drainage time of the foam produced does not differ more than ± 10 per cent of that determined in 4.13.2(1)⑤ of this Chapter. When medium expansion ratio foam (between 21 to 1 and 200 to 1 expansion ratio) is employed, the application rate of the foam and the capacity of a monitor installation are to be agreed. At least 50 per cent of the foam solution supply rate required is to be delivered from each monitor. On tankers of less than 4,000 tonnes deadweight installation of monitors may not be required but only applicators. However, in such a case the capacity of each applicator is to be at least 25 per cent of the foam solution supply rate required.

② The capacity of any applicator is to be not less than 400 *l*/min and the applicator throw in still air conditions is to be not less than 15 m.

4.13.3 Installation requirements

(1) Main control station

① Refer to IMO Guidelines for performance and testing criteria and surveys of foam concentrates for fixed fire-extinguishing systems (MSC.1/Circ.1312).

The main control station for the system is to be suitably located outside the cargo area, adjacent to the accommodation spaces and readily accessible and operable in the event of fire in the areas protected.

(2) Monitors

① The number and position of monitors are to be such as to comply with the provisions of 4.13.1(1) of this Chapter.

② The distance from the monitor to the farthest extremity of the protected area forward of that monitor is not to be more than 75 per cent of the monitor throw in still air conditions.

③ A monitor and hose connection for a foam applicator are to be situated both port and starboard at the front of the poop or accommodation spaces facing the cargo tanks deck. The monitors and hose connections are to be aft of any cargo tanks, but may be located in the cargo area above pump-rooms, cofferdams, ballast tanks and void spaces adjacent to cargo tanks if capable of protecting the deck below and aft of each other. On tankers of less than 4,000 tonnes deadweight a hose connection for a foam applicator is to be situated both port and starboard at the front of the poop or accommodation spaces facing the cargo tanks deck.

(3) Applicators

① At least four foam applicators are to be provided on all tankers. The number and disposition of foam main outlets are to be such that foam from at least two applicators can be directed on to any part of the cargo tanks deck area.

② Applicators are to be provided to ensure flexibility of action during fire-fighting operations and to cover areas screened from the monitors.

(4) Isolation valves

Valves are to be provided in the foam main, and in the fire main when this is an integral part of the deck foam system, immediately forward of any monitor position to isolate damaged sections of those mains.

4.14 Inert gas systems

4.14.1 General requirements

(1) Throughout this paragraph the term cargo tank includes also slop tanks.

(2) The inert gas system is to be designed, constructed and tested in accordance with the following requirements. It is to be so designed and operated as to render and maintain the atmosphere of the cargo tanks non-flammable at all times, except when such tanks are required to be gas-free. In the event that the inert gas system is unable to meet the operational requirement set out above and it has been assessed that it is impracticable to effect a repair, then cargo discharge, deballasting and necessary tank cleaning is only to be resumed when the “emergency conditions" laid down in IMO Guidelines[①] on inert gas systems are complied with.

(3) The system is to be capable of:

① inerting empty cargo tanks by reducing the oxygen content of the atmosphere in each tank to a level at which combustion cannot be supported;

② maintaining the atmosphere in any part of any cargo tank with an oxygen content not exceeding 8% by volume and at a positive pressure at all times in port and at sea except when it is necessary for such a tank to be gas-free;

③ eliminating the need for air to enter a tank during normal operations except when it is necessary for such a tank to be gas-free;

④ purging empty cargo tanks of a hydrocarbon gas, so that subsequent gas-freeing operations will at no time create a flammable atmosphere within the tank.

4.14.2 Component requirements

(1) Supply of inert gas

① The inert gas supply may be treated flue gas from main or auxiliary boilers. Systems using flue gases from one or more separate gas generators or other sources or any combination thereof may be accepted, provided that an equivalent standard of safety is achieved. Such systems are, as far as practicable, to comply with the requirements of this chapter. Systems

① Clarification of inert gas system requirements under SOLAS 1974, as amended (MSC/Circ.485) and Revised Guidelines for inert gas system (MSC/Circ.353), as amended by MSC/Circ.387.

using stored carbon dioxide are not to be permitted unless it is confirmed that the risk of ignition from generation of static electricity by the system itself is minimized.

② The system is to be capable of delivering inert gas to the cargo tanks at a rate of at least 125% of the maximum rate of discharge capacity of the ship expressed as a volume.

③ The system is to be capable of delivering inert gas with an oxygen content of not more than 5 % by volume in the inert gas supply main to the cargo tanks at any required rate of flow.

④ Two fuel oil pumps are to be fitted to the inert gas generator. Only one fuel oil pump may be permitted on condition that sufficient spares for the fuel oil pump and its prime mover are carried on board to enable any failure of the fuel oil pump and its prime mover to be rectified by the ship's crew.

(2) Scrubbers

① A flue gas scrubber is to be fitted which will effectively cool the volume of gas specified in 4.14.2(1)② and ③ of this Chapter and remove solids and sulphur combustion products. The cooling water arrangements are to be such that an adequate supply of water will always be available without interfering with any essential services on the ship. Provision is to also be made for an alternative supply of cooling water.

② Filters or equivalent devices are to be fitted to minimize the amount of water carried over to the inert gas blowers.

③ The scrubber is to be located aft of all cargo tanks, cargo pump-rooms and cofferdams separating these spaces from machinery spaces of category A.

(3) Blowers

① At least two blowers are to be fitted and be capable of delivering to the cargo tanks at least the volume of gas required by 4.14.2(1)② and ③ of this Chapter. For systems with gas generators only one blower may be permitted if that system is capable of delivering the total volume of gas required by 4.14.2(1)② and ③ of this Chapter to the protected cargo tanks, provided that sufficient spares for the blower and its prime mover are carried on board to enable any failure of the blower and its prime mover to be rectified by the ship's crew.

② The inert gas system is to be so designed that the maximum pressure which it can exert on any cargo tank will not exceed the test pressure of any cargo tank. Suitable shutoff arrangements are to be provided on the suction and discharge connections of each blower. Arrangements are to be provided to enable the functioning of the inert gas plant to be stabilized before commencing cargo discharge. If the blowers are to be used for gas-freeing, their air inlets are to be provided with blanking arrangements.

③ The blowers are to be located aft of all cargo tanks, cargo pump-rooms and cofferdams separating these spaces from machinery spaces of category A.

(4) Water seals

① The water seal referred to in 4.14.3(1)④(a) of this Chapter is to be capable of being supplied by two separate pumps, each of which is to be capable of maintaining an adequate supply at all times.

② The arrangement of the seal and its associated fittings is to be such that it will prevent backflow of hydrocarbon vapours and will ensure the proper functioning of the seal under operating conditions.

③ Provision is to be made to ensure that the water seal is protected against freezing, in such a way that the integrity of seal is not impaired by overheating.

④ A water loop or other approved arrangement is also to be fitted to each associated water supply and drain pipe and each venting or pressure-sensing pipe leading to gas-safe spaces. Means are to be provided to prevent such loops from being emptied by vacuum.

⑤ The deck water seal and loop arrangements are to be capable of preventing return of hydrocarbon vapours at a pressure equal to the test pressure of the cargo tanks.

⑥ In respect of 4.14.4(3)①(g) of this Chapter, the maintenance of an adequate reserve of water at all times and the integrity of the arrangements to permit the automatic formation of the water seal when the gas flow ceases are to be guaranteed. The audible and visual alarm on the low level of water in the water seal is to operate when the inert gas is not being supplied.

4.14.3 Installation requirements

(1) Safety measures in the system

① Flue gas isolating valves

Flue gas isolating valves are to be fitted in the inert gas supply mains between the boiler uptakes and the flue gas scrubber. These valves are to be provided with indicators to show whether they are open or shut, and precautions are to be taken to maintain them gas-tight and keep the seatings clear of soot. Arrangements are to be made to ensure that boiler soot blowers cannot be operated when the corresponding flue gas valve is open.

② Prevention of flue gas leakage

(a) Special consideration is to be given to the design and location of scrubber and blowers with relevant piping and fittings in order to prevent flue gas leakages into en closed spaces.

(b) To permit safe maintenance, an additional water seal or other effective means of preventing flue gas leakage are to be fitted between the flue gas isolating valves and scrubber or incorporated in the gas entry to the scrubber.

③ Gas regulation valves

(a) A gas regulating valve is to be fitted in the inert gas supply main. This valve is to be automatically controlled to close as required in 4.14.3(1)⑤ of this Chapter. It is also to be capable of automatically regulating the flow of inert gas to the cargo tanks unless means are provided to automatically control the speed of the inert gas blowers required in 4.14.2(3) of this Chapter.

(b) The valve referred to in (a) above is to be located at the forward bulkhead of the forward most gas-safe space (a gas-safe space is a space in which the entry of hydrocarbon gases would produce hazards with regard to flammability or toxicity) through which the inert gas supply main passes.

④ Non-return devices of flue gas

(a) At least two non-return devices, one of which is to be a water seal, are to be fitted in the inert gas supply main, in order to prevent the return of hydrocarbon vapour to the machinery space uptakes or to any gas-safe spaces under all normal conditions of trim, list and motion of the ship. They are to be located between the automatic valve required by 4.14.3(1)③(a) of this Chapter and the aftermost connection to any cargo tank or cargo pipeline.

(b) The devices referred to in (a) above are to be located in the cargo area on deck.

(c) The second device is to be a non-return valve or equivalent capable of preventing the return of vapours or liquids and fitted forward of the deck water seal required in (a) above. It is to be provided with positive means of closure. As an alternative to positive means of closure, an additional valve having such means of closure may be provided forward of the non-return valve to isolate the deck water seal from the inert gas main to the cargo tanks.

(d) As an additional safeguard against the possible leakage of hydrocarbon liquids or vapours back from the deck main, means are to be provided to permit this section of the line between the valve having positive means of closure referred to in (c) above and the valve referred to in 4.14.3(1)③ of this Chapter to be vented in a safe manner when the first of these valves is closed.

⑤ Automatic shutdown

(a) Automatic shutdown of the inert gas blowers and gas regulating valve is to be arranged on predetermined limits being reached in respect of 4.14.4(3)①(a), (b) and (c) of this Chapter.

(b) Automatic shutdown of the gas regulating valve is to be arranged in respect of 4.14.4(3) ①(d) of this Chapter.

⑥ Oxygen rich gas

In respect of 4.14.4(3)①(e) of this Chapter, when the oxygen content of the inert gas exceeds 8% by volume, immediate action is to be taken to improve the gas quality. Unless the quality of the gas improves, all cargo tank operations are to be suspended so as to avoid air being drawn into the tanks and the isolation valve referred to in 4.14.3(1)④(c) of this Chapter is to be closed.

(2) Inert gas lines

① The inert gas main may be divided into two or more branches forward of the non-return devices required by 4.14.2(4) and 4.14.3(1)④of this Chapter.

② The inert gas supply main is to be fitted with branch piping leading to each cargo tank. Branch piping for inert gas is to be fitted with either stop valves or equivalent means of control for isolating each tank. Where stop valves are fitted, they are to be provided with locking arrangements, which are to be under the control of a responsible ship's officer. The control system operated is to provide unambiguous information of the operational status of such valves.

③ In combination carriers, the arrangement to isolate the slop tanks containing oil or oil residues from other tanks is to consist of blank flanges which will remain in position at all times when cargoes other than oil are being carried except as provided for in the relevant section of the Guidelines on inert gas systems developed by IMO.

④ Means are to be provided to protect cargo tanks against the effect of overpressure or vacuum caused by thermal variations when the cargo tanks are isolated from the inert gas mains.

⑤ Piping systems are to be so designed as to prevent the accumulation of cargo or water in the pipelines under all normal conditions.

⑥ Arrangements are to be provided to enable the inert gas main to be connected to an external supply of inert gas. The arrangements are to consist of a 250 mm nominal pipe size bolted flange, isolated from the inert gas main by a valve and located forward of the non-return valve referred to in 4.14.3(1)④(c). The design of the flange should conform to the appropriate class in the standards adopted for the design of other external connections in the ship's cargo piping system.

⑦ If a connection is fitted between the inert gas supply main and the cargo piping system, arrangements are to be made to ensure an effective isolation having regard to the large pressure difference which may exist between the systems. This is to consist of two shutoff valves with an arrangement to vent the space between the valves in a safe manner or an arrangement consisting of a spool-piece with associated blanks.

⑧ The valve separating the inert gas supply main from the cargo main and which is on the cargo main side is to be a non-return valve with a positive means of closure.

4.14.4 Operation and control requirements

(1) Indication devices

Means are to be provided for continuously indicating the temperature and pressure of the inert gas at the discharge side of the gas blowers, whenever the gas blowers are operating.

(2) Indicating and recording devices

① Instrumentation is to be fitted for continuously indicating and permanently recording, when inert gas is being supplied:

(a) the pressure of the inert gas supply mains forward of the non-return devices required by 4.14.3(1)④(a); and

(b) the oxygen content of the inert gas in the inert gas supply mains on the discharge side of the gas blowers.

② The devices referred to in ① above are to be placed in the cargo control room where provided. But where no cargo control room is provided, they are to be placed in a position easily accessible to the officer in charge of cargo operations.

③ In addition, meters are to be fitted:

(a) in the navigating bridge to indicate at all times the pressure referred to in 4.14.4(2)①(a) of this Chapter and the pressure in the slop tanks of combination carriers, whenever those tanks are isolated from the inert gas supply main;

(b) in the machinery control room or in the machinery space to indicate the oxygen content referred to in 4.14.4(2)①(b) of this Chapter.

④ Portable instruments for measuring oxygen and flammable vapour concentration are to be provided. In addition, suitable arrangement is to be made on each cargo tank such that the condition of the tank atmosphere can be determined using these portable instruments.

⑤ Suitable means are to be provided for the zero and span calibration of both fixed and

portable gas concentration measurement instruments, referred to in 4.14.4(2) of this Chapter.

(3) Audible and visual alarms

① For inert gas systems of both the flue, gas type and the inert gas generator type, audible and visual alarms are to be provided to indicate:

(a) low water pressure or low water flow rate to the flue gas scrubber as referred to in 4.14.2(2)① of this Chapter;

(b) high water level in the flue gas scrubber as referred to in 4.14.2(2)① of this Chapter;

(c) high gas temperature as referred to in 4.14.4(1) of this Chapter;

(d) failure of the inert gas blowers referred to in 4.14.4(3) of this Chapter;

(e) oxygen content in excess of 8% by volume as referred to in4.14.4(2)①(b) of this Chapter;

(f) failure of the power supply to the automatic control system for the gas regulating valve and to the indicating devices as referred to in 4.14.3(1)③ and 4.14.4(2)① of this Chapter;

(g) low water level in the water seal as referred to in 4.14.3(1)④(a) of this Chapter;

(h) gas pressure less than 100 mm water gauge as referred to in 4.14.4(2)①(a) of this Chapter. The alarm arrangement is to be such as to ensure that the pressure in slop tanks in combination carriers can be monitored at all times;

(i) high gas pressure as referred to in 4.14.4(2)①(a) of this Chapter.

② For inert gas systems of the inert gas generator type, additional audible and visual alarms are to be provided to indicate:

(a) insufficient fuel oil supply;

(b) failure of the power supply to the generator;

(c) failure of the power supply to the automatic control system for the generator.

③ The alarms required in 4.14.4(3)①(e), (f) and (h) of this Chapter are to be fitted in the machinery space and cargo control room, where provided, but in each case in such a position that they are immediately received by responsible members of the crew.

④ An audible alarm system independent of that required in 4.14.4(3)①(h) of this Chapter or automatic shutdown of cargo pumps is to be provided to operate on predetermined limits of low pressure in the inert gas main being reached.

(4) Instruction manuals

Detailed instruction manuals are to be provided on board, covering the operations, safety and maintenance requirements and occupational health hazards relevant to the inert gas system and its application to the cargo tank system The manuals are to include guidance on procedures to be followed in the event of a fault or failure of the inert gas system.

4.14.5 Tests

(1) The pressure pipelines of inert gas systems are to be hydraulically tested in the workshop with a pressure of 1.5 times the design pressure and subject to a tightness test with a pressure of 1.25 times the design pressure after installation on board.

(2) On completion of installation of inert gas systems including alarm and safety equipment, an operation test is to be carried out under working condition.

4.15 Protection of cargo pump-rooms

4.15.1 Each cargo pump-room is to be provided with one of the following fixed fire-extinguishing systems operated from a readily accessible position outside the pump-room. Cargo pump-rooms are to be provided with a system suitable for machinery spaces of category A.

(1) A carbon dioxide system complying with the provisions of 1.4 of this Chapter and with the following:

① the alarms are to comply with 1.4.1(6) of this Chapter;

② a notice is to be exhibited at the controls stating that due to the electrostatic ignition hazard, the system is to be used only for fire extinguishing and not for inerting purposes.

(2) A high-expansion foam system complying with the provisions of 1.8 of this Chapter, provided that the foam concentrate supply is suitable for extinguishing fires involving the cargoes carried.

(3) A pressure water-spraying system complying with the provisions of 1.9 of this Chapter.

4.15.2 Where the fire-extinguishing medium used in the cargo pump-room system is also used in systems serving other spaces, the quantity of medium provided or its delivery rate need not be

more than the maximum required for the largest compartment.

4.15.3 Cargo tankers of 500 gross tonnage and upwards are to provide following means of protection for cargo pump-rooms. Pump rooms intended solely for ballast or oil fuel transfer, however, need not comply with these requirements.

(1) Cargo pumps, ballast pumps and stripping pumps, as well as pumps for slop tanks, pumps for COW or similar pumps, installed in cargo pump rooms and driven by shafts passing through cargo pump room bulkheads are to be fitted with temperature sensing devices for bulkhead shaft glands, bearings and pump casings. These device are to be capable of automatically effecting a continuous audible and visual alarm in the cargo control room or the pump control station.

(2) Lighting in cargo pump rooms, except emergency lighting, is to be interlocked with ventilation such that the ventilation is to be in operation when switching on the lighting. Failure of the ventilation system is not to cause the lighting to go out.

(3) A system for continuously monitoring the concentration of hydrocarbon gases is to be fitted. Sampling points or detector heads are to be located in suitable positions in order that potentially dangerous leakages are readily detected. When the hydrocarbon gas concentration reaches a preset level, which is not to be higher than 10% of the lower flammable limit, a continuous audible and visual alarm signal is to be automatically effected in the cargo pump room, engine control room, cargo control room and navigation bridge to alert personnel to the potential hazard.

(4) All cargo pump rooms are to be provided with bilge level monitoring devices together with appropriately located alarms. Bilge high-level alarms are acceptable as an alternative means for the level monitoring devices.

4.16 Additional requirements for cargo oil tanks and cofferdams covered by forecastles

4.16.1 To prevent accumulation of oil vapour, forecastles are not allowed to be provided with enclosed spaces above cargo oil tanks and cofferdams and close to each other. Otherwise, such tankers are only allowed to carry petroleum products having a flashpoint exceeding 60℃.

4.16.2 If forecastles are located in enclosed spaces above cargo oil tanks and cofferdams and are separated from each other by some open spaces, the following requirements are to be complied with:

(1) all electrical installations in the forecastle are to be explosion-proof;

(2) the enclosed spaces of the forecastle are to be provided with means of ventilation;

(3) all objects in the enclosed spaces are to be fixed in position;

(4) flammable and explosive objects, such as paints, are not to be stored in the enclosed spaces;

(5) repair operation is not to be carried out in the enclosed spaces;

(6) the doors of the enclosed spaces are not allowed to be open when the cargo oil is loaded and unloaded;

(7) the concentration of flammable gas is to be measured before entering the enclosed spaces.

5 Fire safety measures for special purpose ships

5.1 For special purpose ships carrying not more than 60 persons, the fire safety measures are to comply with the relevant requirements for cargo ships with the same gross tonnage in the corresponding service area.

5.2 For special purpose ships carrying 60 or more persons, the fire safety measures are to comply with the relevant requirements for passenger ships of the corresponding category in the corresponding service area. However, the requirements of Reg.II-2/21, 22 and 23 of SOLAS do not apply to special purpose ships.

Fire Safety Measures of Special Purpose Ships **Table 5.1**

Number of persons onboard	Service area	Applicable ship type	Fire safety measures
Less than 60	Any service area	Cargo ships of same gross tonnage	Cargo ships of this Chapter
60~240	Unrestricted, service categeory 1	Passenger ships of class I	Passenger ships carrying not more than 36 persons of Chapter II-2 of SOLAS
	Service categeory 2	Passenger ships of class II	Passenger ships of class II of this Chapter

	Service categeory 2, service categeory 3	Passenger ships of class III	Passenger ships of class III of this Chapter
More than 240	Unrestricted, service categeory 1	Passenger ships of class I	Passenger ships carrying more than 36 persons of Chapter II-2 of SOLAS
	Service categeory 2	Passenger ships of class II of less than 500 persons	Passenger ships of class II of this Chapter
		Passenger ships of class II of 500 persons and upwards	Passenger ships carrying more than 36 persons of Chapter II-2 of SOLAS
	Service categeory 2, service categeory 3	Passenger ships of class III of less than 500 persons	Passenger ships of class III of this Chapter
		Passenger ships of class III of 500 persons and upwards but less than 1000 persons	Passenger ships of class II of this Chapter
		Passenger ships of class III of 1000 persons and upwards	Passenger ships carrying more than 36 persons of Chapter 2-2, PART FOUR of the Guidelines

6 Fire safety measures for non-power-driven ships

6.1 General requirements

6.1.1 6 of this Chapter applies to non-power-driven ships provided with machinery spaces of category A but does not apply to dock pontoons in 7 of this Chapter.

6.1.2 Manned non-power-driven ships required by this Chapter are non-power-driven ships provided with accommodation spaces for the crew to have rest.

6.2 Additional requirements for manned non-power-driven ships

6.2.1 Fire integrity of bulkheads and decks are to comply with the following requirements.

(1) Corridor bulkheads and the doors therein are to be of steel or non-combustible material.

(2) The boundaries of machinery spaces of category A and galleys are to be of steel and the doors therein are to be of steel or non-combustible material.

6.2.2 Means of escape are to comply with the following requirements.

(1) Each space normally employed by crew is to be provided with at least one means of escape to the open deck and thence to lifeboats and liferafts, or to a safe place ashore.

(2) Stairways and ladders consisting of means of escape are to be of non-combustible material.

(3) Where machinery spaces of category A are fitted with internal-combustion machinery having in the aggregate a total power output of not less than 375 kW or oil-fired boilers having an evaporating capacity not less than 250 kg/h, at least two sets of steel ladders, as widely separated as possible, from the lowest level accessible to personnel to the open deck, are to be provided. One escape may be allowed for small spaces. If there is more than one working platform in machinery spaces of category A, at least one steel ladder is to be protected by continuous steel enclosure.

(4) For machinery spaces of category A not normally employed by the crew, or fitted with internal-combustion machinery having in the aggregate a total power output of less than 375 kW or oil-fired boilers having an evaporating capacity less than 250 kg/h, only one safe access to the open deck may be provided.

6.2.3 Regardless of tonnage, the fire-fighting systems and provision of fire-fighting appliances are to comply with the following requirements.

(1) The ship is to be provided with at least one fixed independent power-driven fire pump and one hand-operated fire pump as well as sea water suctions and fire hoses. For machinery spaces of category A fitted with internal-combustion machinery having in the aggregate a total power output not less than 750 kW and/or oil-fired steam boilers having an evaporating capacity not less than 250 kg/h and/or oil-fired hot water boilers having a thermal power not less than 175 kW, the capacity of the fixed fire pump is to be at least 25 m^3/h and the pressure at the fire hydrant is to be at least 0.25 MPa. For machinery spaces fitted with internal-combustion machinery having in the aggregate a total power output not less than 375 kW but less than 750 kW, regardless of whether the oil-fired boilers are fitted in the same spaces, the capacity of the fixed fire pump is to be at least 15 m^3/h and the pressure at the fire hydrant is to at least sustain a water jet with a throw of 12 m. In addition to the fixed fire pump required above, the capacity of the hand-operated fire pump

required is to be at least 3 m^3/h and the pressure at the pump discharge is to at least sustain a water jet with a throw of 12 m.
For machinery spaces fitted with internal-combustion machinery having in the aggregate a total power output less than 375 kW and/or oil-fired steam boilers having an evaporating capacity less than 250 kg/h and/or oil-fired hot water boilers having a thermal power less than 175 kW, only one hand-operated fire pump may be fitted, the capacity of which is to be at least 3 m^3/h and the pressure at the pump discharge is to at least sustain a water jet with a throw of 12 m.
(2) Where the machinery spaces onboard are fitted with internal-combustion machinery having in the aggregate a total power output not less than 750 kW, or oil-fired steam boilers having an evaporating capacity not less than 250 kg/h and/or oil-fired hot water boilers having a thermal power not less than 175 kW, fixed fire-extinguishing systems and fire-fighting appliances are to be provided in accordance with 1.6.1 to 1.6.3 of this Chapter. For internal-combustion machinery having in the aggregate a total power output not less than 375 kW but less than 750 kW, water fire-extinguishing systems and fire-fighting appliances are to be provided in accordance with 1.6.6 of this Chapter. For internal-combustion machinery having in the aggregate a total power output less than 375 kW and/or oil-fired steam boilers having an evaporating capacity less than 250 kg/h and/or oil-fired hot water boilers having a thermal power less than 175 kW, only fire-fighting appliances for oil fire may be provided.
(3) For spaces with high fire risk within accommodation spaces, such as galleys, at least one portable fire extinguisher is to be provided at each deck level.
(4) At least two emergency escape breathing devices are to be provided in machinery spaces of category A and galleys within accommodation spaces.

6.3 Additional requirements for non-manned non-power-driven ships with personnel in operation

6.3.1 Fire-fighting appliances are to be specially considered according to the actual conditions such as the ship size, functions and number of personnel in operation as well as the distribution of combustible materials in machinery spaces of category A and decks. Necessary water fire-extinguishing systems and portable fire extinguishers are to be provided.

6.4 Non-power-driven ships carrying dangerous goods

6.4.1 Where ships are intended for carrying dangerous goods, necessary fire-fighting systems and appliances are to be provided as referred to in the requirements of 3.10 of this Chapter.

7 Special fire safety measures for dock pontoons

7.1 General requirement

7.1.1 Manned dock pontoons referred to in 7 of this Chapter are dock pontoons provided with accommodation spaces for the crew to have rest.

7.2 Manned dock pontoons

7.2.1 Fire integrity of bulkheads and decks is to comply with the following requirements.
(1) Corridor bulkheads and the doors therein are to be of steel or non-combustible material.
(2) The boundaries of machinery spaces of category A and galleys are to be of steel and the doors therein are to be of steel or non-combustible material.
7.2.2 Means of escape are to comply with the following requirements.
(1) Each space normally employed by crew is to be provided with at least one means of escape to the open deck and thence to lifeboats and liferafts, or to a safe place ashore.
(2) Stairways and ladders consisting of means of escape are to be of non-combustible material.
(3) Where machinery spaces of category A are fitted with internal-combustion machinery having in the aggregate a total power output of not less than 375 kW or oil-fired boilers having an evaporating capacity not less than 250 kg/h, at least two sets of steel ladders, as widely separated as possible, from the lowest level accessible to personnel to the open deck, are to be provided. If there is more than one working platform in machinery spaces of category A, at least one steel ladder is to be protected by continuous steel enclosure.
(4) For machinery spaces of category A not normally employed by the crew, or fitted with

internal-combustion machinery having in the aggregate a total power output of less than 375 kW or oil-fired boilers having an evaporating capacity less than 250 kg/h, only one safe access to the open deck may be provided.

7.2.3 The arrangement of fire pumps is to comply with the following requirements.

For machinery spaces of category A fitted with internal-combustion machinery having in the aggregate a total power output not less than 750 kW and/or oil-fired steam boilers having an evaporating capacity not less than 250 kg/h and/or oil-fired hot water boilers having a thermal power not less than 175 kW, the water inflow rate of the fire mains is to be at least 25 m^3/h and the pressure at the fire hydrant is to be at least 0.25 MPa. For machinery spaces fitted with internal-combustion machinery having in the aggregate a total power output not less than 375 kW but less than 750 kW, regardless of whether the oil-fired boilers are fitted in the same spaces, the water inflow rate of the fire mains is to be at least 15 m^3/h and the pressure at the fire hydrant is to at least sustain a water jet with a throw of 12 m.

A hand-operated fire pump is to also be provided onboard, the capacity of which is to be at least 3 m^3/h and the pressure at the pump discharge is to at least sustain a water jet with a throw of 12 m.

For machinery spaces fitted with internal-combustion machinery having in the aggregate a total power output less than 375 kW and/or oil-fired steam boilers having an evaporating capacity less than 250 kg/h and/or oil-fired hot water boilers having a thermal power less than 175 kW, only one hand-operated fire pump may be fitted, the capacity of which is to be at least 3 m^3/h and the pressure at the pump discharge is to at least sustain a water jet with a throw of 12 m.

7.2.4 The fire-fighting appliances in the machinery spaces are to comply with the following requirements.

Where the machinery spaces onboard are fitted with internal-combustion machinery having in the aggregate a total power output not less than 750 kW, or oil-fired steam boilers having an evaporating capacity not less than 250 kg/h and/or oil-fired hot water boilers having a thermal power not less than 175 kW, fixed fire-extinguishing systems and fire-fighting appliances are to be provided in accordance with 1.6.1 to 1.6.3 of this Chapter. For internal-combustion machinery having in the aggregate a total power output not less than 375 kW but less than 750 kW, water fire-extinguishing systems and fire-fighting appliances are to be provided in accordance with 1.6.6 of this Chapter. For internal-combustion machinery having in the aggregate a total power output less than 375 kW and/or oil-fired steam boilers having an evaporating capacity less than 250 kg/h and/or oil-fired hot water boilers having a thermal power less than 175 kW, only fire-fighting appliances for oil fire may be provided.

7.2.5 For spaces with high fire risk within accommodation spaces, such as galleys, at least one portable fire extinguisher is to be provided at each deck level.

7.2.6 At least two emergency escape breathing devices are to be provided in machinery spaces of category A and galleys within accommodation spaces.

7.2.7 Where the number of persons other than the crew onboard exceeds 100, at least two means of escape, as widely separated as possible, to the open deck and thence to a safe place ashore are to be provided, one of which is to be protected by continuous steel enclosure.

7.2.8 Where the pontoon is provided with accommodation spaces for persons other than the crew, one system required in 2.12.1(1)① or ② of this Chapter is to be fitted in the spaces. However, where the number of persons other than the crew onboard is not more than 100, manually operated call points complying with the requirements of 1.12 of this Chapter are to be installed throughout the accommodation spaces.

7.3 Non-manned deck pontoons with personnel in operation

Fire-fighting appliances are to be specially considered according to the actual conditions such as the ship size, functions and number of persons in operation as well as the distribution of combustible materials in machinery spaces of category A and decks. Necessary water fire-extinguishing systems and portable fire extinguishers are to be provided.

7.4 Deck pontoons storing dangerous goods

Where ships are stored with dangerous goods, necessary fire-fighting systems and appliances are to be provided as referred to in the requirements of 3.10 of this Chapter.

7.5 Use of LPG ranges

7.5.1 It is not allowed to use ranges using liquid fuels (e.g. kerosene) in atmospheric pressure and liquefied/solid petroleum/alcohol as fuels onboard the ship. If ranges using LPG as fuel are fitted, the following requirements are to be met.

(1) The doors and windows of the galley are to open outwards and to the open deck. Natural ventilation or mechanical ventilation is to be provided to ensure the air flowing between upper and lower spaces inside the galley and purge the smoke and the gas liable to escape to a safe place.

(2) Ranges, gas cylinders, angle valves and pressure reduction valves, etc. are to be approved products and satisfy their intended usage.

(3) The arrangements for the storage, distribution and utilization of the gaseous fuel are to be such that, having regard to the hazards of fire and explosion which the use of such fuel may entail, the safety of the ship and the persons on board is preserved.

(4) Ranges and gas cylinders are to be fixed securely and means are to be provided to prevent them from shifting. Gas cylinders are to be of steel and stored on the open deck or in well ventilated spaces with access only to the open deck. Fixed hoops are to be capable of being released easily and quickly. Cylinders are to be provided with wood blocks under the bottom to avoid impact.

(5) The supply of gaseous fuel is to be capable of being cut off from a readily accessible position outside the space in the event of a fire occurring in the space.

(6) Pipelines for delivering gaseous fuel from gas cylinders to the stoves or water heaters are to be of steel or other approved materials before the pressure reduction valve and may be flexible hoses after the pressure reduction valve. All joints (connections) of pipelines are to be provided with means to ensure gastightness. Safety appliances for automatic shutoff are to be provided so that they will automatically shut off gaseous fuel supply when the flame in the stoves goes out.

(7) Where open-flame ranges using LPG as fuel are fitted onboard the ship, materials used within the extent specified by Figure 7.5.1 are to comply with the following requirements:

① curtains and other suspended textile materials are not to be fitted within I and II;

② materials fitted within I are to be glass, ceramics, aluminium, black metals or similar materials having fire protection properties;

③ materials fitted within II, if the surface temperature exceeds 80℃, are to be glass, ceramics, metals or similar materials having fire protection properties.

(8) Where uptakes are fitted above ranges, the uptakes are to be separated from the adjacent structure to avoid overheating or damage of adjacent materials or ship structures.

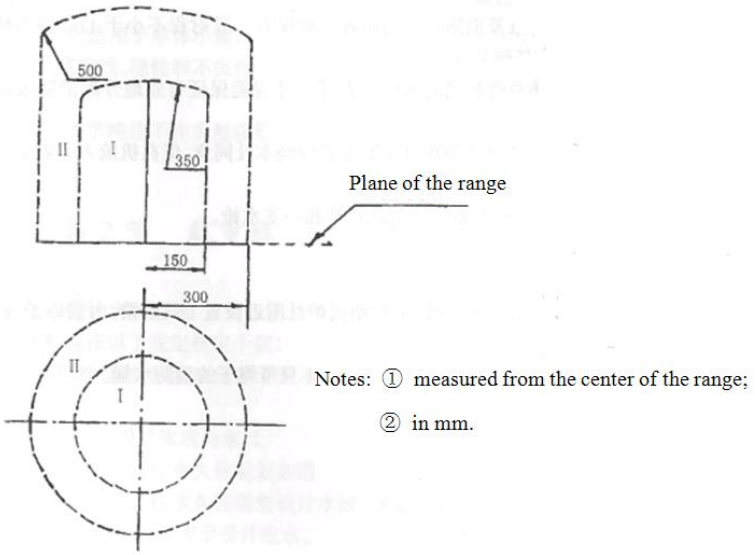


Figure 7.5.1 Areas for specified materials

8 Special fire safety measures for oil recovery ships

8.1 General requirement

8.1.1 The fire-fighting of oil recovery ships is to comply with the requirements for cargo ships of same gross tonnage as well as the special requirements of 8 of this Chapter.

8.1.2 Relevant definitions in 8 of this Chapter are as follows.

(1) Oil recovery ship means a steel ship specially or also engaged in the recovery of oil floating on the sea.
(2) Gas-hazardous zone means an area in which flammable or explosive gas or vapor is liable to accumulate to a dangerous concentration. For the purpose of this Chapter, the gas-hazardous zones may be divided into the following categories:

① hazardous zone of Category 0 means an area in which the mixture of flammable or explosive gas or vapor with air exists continuously or for long time, including recovered oil tanks and the interiors of piping systems and containers of the containment system for recovered oil;

② hazardous zone of Category 1 means an area in which the mixture of flammable or explosive gas or vapor with air may occur during normal operation, including:

(a) cofferdams or other spaces adjacent to any recovered oil tank (except for 8.2.1(6));

(b) enclosed or semi-enclosed spaces in which pipe flanges, valves, hoses, pumps and other equipment for handling of recovered oil are located;

(c) spaces including semi-enclosed spaces on open deck within a 3 m radius of the separator, the hoses and valves used for oil recovery, the openings of recovered oil tanks and the openings of spaces within the hazardous zones of Category 1 such as pump rooms or cofferdams;

(d) space on open deck above recovered oil tanks, extending 3 m respectively fore and aft of this area to a height of 2.4 m;

(e) any enclosed space outside a recovered oil tank, through which recovered oil piping passes or in which such piping terminates, may be excluded, provided that ventilation is fitted as specified in 8.2.4(4);

(f) enclosed or semi-enclosed spaces which can be entered directly from hazardous zones of Category 1 (without air lock) or which have openings into hazardous zones of Category 1 may be excluded, provided that ventilation is fitted as specified in 8.2.4(4).

③ safe areas are the areas outside the above-mentioned gas-dangerous zones.

8.2 Oil recovery ships for floating oil with a flash point not exceeding 60℃ (closed-cup test)

8.2.1 Recovered oil tanks are to be arranged according to the following requirements.
(1) Any tanks, which are also intended for other purposes and will not be utilized during oil recovery operations, are to be arranged so that recovered oil cannot be transferred to them inadvertently.
(2) Tanks intended for the storage of recovered oil are to be located forward or aft of the accommodation and machinery spaces.
(3) Except where permitted by (6) below, tanks intended for the storage of recovered oil are to be separated from accommodation and machinery spaces by cofferdams. Oil fuel tanks, settling tanks, tanks for ballast water or anti-pollution liquid, closed spaces where oil recovery handling equipment is stored and pump rooms may be considered as a cofferdam.
(4) Cofferdams are to be at least one frame spacing in length (600 mm minimum) and are to cover the whole area of the boundary under consideration.
(5) The height of tanks for recovered oil is not to be less than 1.5 m. Internal obstructions in the tanks are to be avoided to ensure a full flow of recovered oil. Adequate drainage openings are to be provided to ensure free flow of residues to assist in cleaning and gas freeing on completion of recovery operations. Any coating in the walls of tanks for recovered oil is to be of an oil and dispersion resistant type.
(6) Where cofferdams are impractical to arrange, any tank adjacent to the machinery spaces or pipe tunnel may be accepted for storage of recovered oil, provided that bulkheads of the tank are:

① accessible for inspection;

② carried continuously through abutting plate panels, except that full penetration welding may be used at the top of the tank.

(7) All openings (sounding pipes, hatches for the deployment of portable pumps and hoses) to tanks for recovered oil are to be located on open deck to prevent accumulation of oil vapour.
(8) Tanks for recovered oil are to have suitable access from open deck for cleaning and gas-freeing, or small dedicated hatches for cleaning.
8.2.2 Access and other openings are to comply with the following requirements.

(1) Ventilation openings to safe spaces such as accommodation, service and machinery spaces, control stations and navigation bridge are to be located outside gas-dangerous zones.
(2) In general, access doors or openings other than ventilation openings are not permitted between safe spaces (such as accommodation, service and machinery spaces, control stations and navigation bridge) and gas-hazardous zones.

① Access doors may be accepted between such spaces and gas-hazardous zones of Category 1, provided that the following conditions are met:
   (a) an air lock is to consist of two steel doors substantially gastight which should be spaced not less than 1.5 m apart (watertight doors may be considered as gastight doors);
   (b) safe spaces are under positive pressure mechanical ventilation in relation to the gas-hazardous zones;
   (c) the doors are to be self-closing and without any holding back arrangements;
   (d) signs are provided to warn that the doors are to be kept closed during oil recovery operations.

② Any opening other than access openings and ventilation openings may be accepted between such safe spaces and gas-hazardous zones of Category 1, provided that the following conditions are met:
   (a) the closing appliance are to be confirmed as gastight;
   (b) signs are provided to warn that they are to be kept closed during oil recovery operations or cleaning and gas-freeing operations of recovered oil tanks, and means are provided to prevent unauthorized opening.

(3) Oil handling spaces on deck are to be provided with a coaming around all pumps, transfer flanges and other connections. Each coaming is to have a height sufficient to prevent recovered oil from entering accommodation, machinery, control and service spaces or passing overboard. The coaming is to have a height of at least 150 mm. Where drains are provided for the coaming, closing devices for these drains are to be permanently attached.

8.2.3 The provision of structural fire protection and extinction appliances is to comply with the following requirements.
(1) For vessels with tanks for recovered oil forward of superstructures, exterior boundaries of superstructures and deckhouses enclosing accommodation, including any overhanging decks which support such accommodation, are to be insulated to A-60 standard for all parts which face deck areas where there are arrangements for collection, handling and transfer of recovered oil as well as tanks for recovered oil and for 3 m aft or forward thereof. The requirement is also applicable for access doors in such boundaries.
(2) The requirement in (1) above is also applicable for vessels with tanks aft of superstructures, provided that exterior boundaries of superstructures and deckhouses enclosing accommodation, including any overhanging decks which support such accommodation, are situated within 10 m of the nearest tank for recovered oil.
(3) Portholes or windows in the exterior boundaries which are required to be insulated to A-60 standard, as referred to in (1) above, are to be of fixed (non-opening) type and are to be insulated to A-60 standard, except for those in the navigation bridge.
(4) As an alternative to compliance with (1) and (2) above, a fixed water spraying system may be used to protect all boundaries, portholes or windows which may, in this case, be insulated to A-0 standard. The system is to be capable of delivering water at a rate of 10 *l*/min per m^2 at least and is to be readily available.
(5) Working deck areas used for oil recovery operations, where there are arrangements for the collection, handling and transfer of recovered oil, are to be provided with the following fire-extinguishing equipment:

① two dry powder fire-extinguishers, each at least 50 kg capacity. The fire-extinguishers are to be located near the working deck and are to be fitted with discharge hoses having a length sufficient to reach the arrangements for the collection, handling and transfer of recovered oil;

② a large fire-extinguishing foam installation fitted with at least one portable foam applicator. The foam installation is to be so arranged that it is capable of applying foam to any part of the working deck. The capacity of any applicator is to be not less than 400 *l*/min of foam solution and the applicator throw in still air conditions is to be not less than 15 m. Sufficient foam concentrate is to be provided for at least 0.4 *l*/m^2 of the working deck area with a

minimum quantity of 200 *l*. The foam expansion ratio is generally not to exceed 12 to 1.

(6) Each recovery oil pump-room is to be provided with a fixed fire-extinguishing system suitable for machinery spaces of category A. The system controls are to be operated from a readily accessible position outside the pump-room. Where a carbon dioxide system is used, the quantity of carbon dioxide is to be sufficient to give a minimum volume of free gas equal to 45% of the gross volume of the tanks for recovered oil. A notice is to be exhibited at the controls stating that, due to the electrostatic ignition hazard, the system is to be used only for fire extinguishing and not for inerting purposes.

(7) Oil recovery ships are to carry at least four fire-man's outfits.

8.2.4 Mechanical ventilation is to comply with the following requirements.

(1) The design, type and structure of mechanical ventilation systems may be dealt with in accordance with the relevant requirements for oil tankers.

(2) Spaces with access to hazardous zones of Category 1 are to be kept under positive pressure mechanical ventilation during oil recovery operations, with the air intake located inside a safe area.

(3) Spaces in hazardous zones of Categories 0 and 1 that are not frequently used during oil recovery operations are not to be ventilated, provided that the equipment therein is provided with the required explosion protection. For safety reasons, spaces in hazardous zones of Categories 0 and 1 that must be accessible at all times are to be equipped with a ventilation system of the extraction type, ensuring at least 8 air changes per hour.

(4) Hazardous zones of Category 1 may be accepted as safe areas, provided that the following special ventilation requirements are complied with and positive pressure mechanical ventilation is maintained:

① the ventilation airflow is to be at least 20 air changes per hour;

② the arrangement of ventilation inlet and outlet openings in a space is to be such that the entire space is efficiently ventilated, taking special consideration to locations where gas may be released or may accumulate;

③ the air intake is to be located in a safe area.

(5) For the spaces required to be under positive pressure ventilation, audible and visual alarms are to be initiated at the navigation bridge or other suitable positions in case of loss of positive pressure ventilation.

8.2.5 Gas detection and alarm systems are to comply with the following requirements.

(1) For the purpose of explosion protection, the ship is to be equipped with a permanently installed gas detection system, which will actuate an audible and visual alarm at the navigation bridge, open deck or other suitable positions when a concentration of hydrocarbon gas or similar products equal to 30% of the lower explosion limit (LEL) is exceeded.

Detection points may be arranged according to specific circumstances, generally close to ventilation air intakes, in air locks and on the main deck (at least one at the fore end and one at the aft end of the ship).

(2) In addition to the above gas detection system, at least one portable instrument is to be available on board for gas detection.

8.2.6 Venting arrangements of tanks for recovered oil are to comply with the following requirements.

(1) Every tank for recovered oil is to be fitted with a vent pipe or other equivalent venting arrangement. The vent pipes are to be sized for 125% of the maximum loading rate to prevent the pressure in any recovered oil tank from exceeding the design pressure; however, the diameter of each vent pipe is to be not less than 60 mm. Venting outlets are to be led to open deck. Gas from the outlets is to be discharged directly upwards.

(2) The outlets are to have a minimum height of 2.4 m above deck and be located at a minimum horizontal distance of 5 m away from openings to accommodation and other gas-safe spaces, ventilation intakes for accommodation and machinery spaces and non-certified safe electrical equipment.

(3) The end of vent pipes is to be fitted with a corrosion resistant flameproof wire gauze capable of being easily renewed.

(4) For multi-purpose oil recovery ships, portable vent pipes intended for use during oil recovery operations only, may be accepted.

8.3 Oil recovery ships for oil with a flash point exceeding 60℃ (closed-cup test)

8.3.1 The fire-fighting of oil recovery ships for oil with a flash point exceeding 60℃ is to comply with the relevant requirements for cargo ships as well as the following special requirements:

(1) working deck areas are to be provided with fire-fighting appliances in accordance with 8.2.3(5) in lieu of the fixed fire-extinguishing system required for cargo spaces of cargo ships;

(2) all openings to tanks for recovered oil are to comply with the requirement of 8.2.1(7);

(3) coaming and drains are to be provided in accordance with 8.2.2.3;

(4) fire-man's outfits are to be provided in accordance with 8.2.3(7);

(5) at least one portable instrument is to be available on board for gas detection.

9 Special fire safety measures for floating docks

9.1 General requirements

9.1.1 9 of this Chapter applies to floating docks operating at those settled locations where there is no available professional fire service. However, where such fire service can be provided in the operating area, consideration may be given by CCS to effectiveness of the fire service under the equivalent conditions as required in 9 of this Chapter.

9.1.2 9 of this Chapter applies to the minimum fire protection, detection and extinction for floating docks, excluding the equipment for fire-fighting that may occur on docked ships.

9.1.3 The performance standards of the relevant systems, equipment and material and testing methods are to comply with the relevant provisions of 1 of this Chapter.

9.2 Structural fire protection

9.2.1 The pontoons, wing walls, super structures, bulkheads, decks, deckhouses and gangways are to be of steel or other material which has structural and fire integrity properties equivalent to steel.

9.2.2 Pipes conveying oil or combustible liquids are to be of approved material having regard to the fire-risk. Materials readily rendered ineffective by heat are not to be used for overboard scuppers, sanitary discharges and other outlets which are close to the waterline and where the failure of the material in the event of fire would give rise to dangers of flooding.

9.2.3 All internal bulkheads, ceilings and linings are to be constructed of non-combustible materials. Corridor bulkheads are to be constructed of steel or to 'B' Class standards.

9.2.4 All exposed surfaces in corridors and stairway enclosures and surfaces in concealed or inaccessible spaces are to have low flame-spread characteristics. Bulkheads, ceilings and linings may have combustible veneer, provided that such veneer is not to exceed 2.0 mm in thickness within any such space except corridors, stairway enclosures and control stations, where it is not to exceed 1.5 mm.

9.2.5 Paints, varnishes and other finishes used on exposed interior surfaces are not to be capable of producing excessive quantities of smoke and toxic products during a fire.

9.2.6 Bulkheads of galley, paint stores, lamp rooms and other compartments containing materials which would constitute a fire hazard are to be of steel or equivalent material.

9.2.7 Deck coverings within accommodation spaces on the decks forming the crown of machinery spaces are to be of approved materials which will not readily ignite, or give rise to toxic or explosive hazards at elevated temperatures.

9.3 Fixed fire-extinguishing and fire detection systems

9.3.1 Water fire-extinguishing systems

(1) The capacity of fire pumps is to be determined in accordance with the quantity of water required for the operation of the water fire-extinguishing system of the cargo ship whose displacement corresponds to the largest lifting capacity of the floating dock.

(2) The fire pumps and associated piping and fire main are to be so designed that a minimum pressure can be maintained sufficient to produce two jets of water of 12 m through nozzles specified in the Rules with the quantity of water specified in (1) above through any adjacent hydrants. The minimum pressure required is to be obtained from fire hydrants at the top deck when the floating dock is in its fully risen position.

(3) The diameter of the fire main is to be based on the required capacity of the fire pump or pumps, and the diameters of the water service pipes is to be sufficient to ensure an adequate supply of water for the simultaneous operation of at least two fire hoses using any of the hydrants. In general, the diameter of the fire main is not to be less than that required by the following formula and may be rounded off to the acceptable nearest standard size:

$$d = \frac{L_D}{1.2} + 25 \qquad \text{mm}$$

where: d —— internal diameter of the fire main, in mm. The diameter of the fire main need not exceed 125 mm but in no case is it to be less than 50 mm;

L_D —— length of the floating dock, in m.

(4) The wash deck line may be used as a fire main provided that the requirements of 9.3 of this Chapter are satisfied.

(5) In floating docks of less than 1000 t design lift, is to be provided with one fixed power pump and one hand operated pump. For floating docks of 1000 t design lift and over, at least two independently driven fixed power pumps are to be provided, preferably one pump being placed in each wing.

(6) In floating docks of 2000 t design lift and over, if a fire in any one compartment could put all the pumps out of action, there is to be an alternative means of providing water for fire-fighting. This alternative means is to be a fixed emergency pump independently driven by a diesel engine, or other approved means. This emergency pump is to be capable of supplying two jets of water of not less than 12 m. The pump is to be located in a readily accessible position which is not likely to be rendered in accessible position which is not likely to be rendered inaccessible by a fire in the compartment containing the main fire pumps. The pump is to be provided with its own sea suction. A valve is to be provided for isolating the main fire pumps. This isolating valve is to be situated in a readily accessible position outside that compartment. However, if shore-based fire-fighting appliances are readily available, consideration may be given to dispensing with the emergency pump.

(7) In the machinery spaces containing a total power of 735 kW and over, two hydrants are to be provided, and in the machinery spaces where the total power is less than 735 kW, one hydrant will be accepted. If it is difficult to arrange those hydrants in the machinery spaces, such hydrants may be arranged near the accesses outside the machinery spaces subject to confirmation.

(8) The number of fire-hoses to be provided, each completed with couplings and nozzles, is to be one for each 32 m in length of each wing of the dock and one spare, but in no case less than a total of six (three on each wing) for floating docks of 1,000 t design lift and over, and not less than a total of four for floating docks less than 1,000 t design lift. These numbers do not include any hoses required in any engine or boiler room. If necessary, the number of hoses is to be increased to ensure that hoses insufficient number are available and accessible at all times.

9.3.2 Fixed fire-extinguishing systems

(1) For the machinery spaces containing diesel engines or gas turbines with a total power of 735 kW and over, or for spaces where oil-fired boilers with steam pressure exceeding 0.35 MPa are situated, or in spaces containing oil fuel units or settling tanks, any one of the following types of fixed fire-extinguishing systems is to be provided:

① a pressurized water-spraying system;

② a fire-smothering gas system;

③ a foam system supplemented, if necessary, by a fixed or mobile pressurized water of foam spraying system to fight fire above floor plates.

The fixed fire-extinguishing systems of the above type ② is to be installed in all spaces where the flash point of the oil fuel is less than 60℃ (closed cup test). If the engine and boiler rooms are not entirely separate, or if fuel oil can drain from the boiler room into the engine room into the engine room bilges, the combined engine and boiler rooms are to be considered as one compartment.

(2) For flammable liquid lockers of a deck area of 4 m^2 and more, and flammable liquid lockers which give access to accommodation spaces, one of the fixed arrangements as specified below are to be provided:

① a CO_2 system, designed for 40% of the gross volume of the space;

② a dry powder system, designed for at least 0.5 kg powder/m^3;

③ a pressure water-spraying or an automatic sprinkler system, designed for 5 l/m^2 min. The pressure water spraying system may be connected to the ship's fire main.

Systems or arrangements other than those mentioned in ①, ②, ③ above may be accepted that relevant technical and test data are provided.

9.3.3 Fire detection systems

(1) Where it is proposed to apply a remote centralized control system for the essential machinery of 735 kW and over, and it is intended that the engine and/or boiler rooms will be periodically unattended, an approved fire detection system is to be provided in these spaces.

(2) The alarm system is to initiate audible and visible alarm signals at the central control room. Where it is intended that the engine and/or boiler rooms will not be continuously manned, the alarm system is to initiate audible and visible signals at the station from which the machinery is controlled.

9.4 Fire-fighting appliances

9.4.1 The extinguishers

(1) The central control rooms, accommodation and service spaces are to be provided with a sufficient number of portable fire-extinguishers to ensure that at least one extinguisher will be readily available for use in every compartment of the crew spaces.

(2) For galleys, and for spaces containing domestic boilers, one portable fire-extinguisher suitable for dealing with oil fires or fires in electric cooking equipment is to be provided.

At least one CO_2 portable fire extinguisher sized to provide a minimum volume of free gas equal to 40% of the gross volume of the space is to be provided in the paint locker the deck area of which is less than 4 m^2. The extinguisher may be discharged through a port on the wall of the locker without having to enter into the protected space. The required portable fire extinguisher is to be stowed adjacent to the port.

(3) There are to be at least two approved portable foam fire extinguishers, or other approved medium suitable for extinguishing oil fires, in each firing space of each boiler room and each space in which a part of the oil fuel installation is situated. In addition, there is to be at least one extinguisher of the same description with a capacity of 9 *l* for each burner, provided that the total capacity of the additional extinguishers need not exceed 45 *l* of any one boiler room.

(4) In each firing space there is to be a receptacle containing at least 0.28 m^3 of sand, sawdust impregnated with soda, or other approved dry material and a scoop for distributing this material. Alternatively, an approved portable extinguisher may be substituted therein.

(5) For all machinery spaces containing diesel engines or gas turbines with a total power of not less than 375 kW, a foam extinguisher with at least 45 *l* capacity or the equivalent is to be provided in every engine space. In addition, one approved portable foam extinguisher for each 735 kW of the engine power output or part thereof is to be provided.

The total number of portable extinguishers so supplied is not to be less than two but need not exceed six.

(6) For machinery spaces containing diesel engines or gas turbines with a total power of less than 375 kW, a foam extinguisher with 45 *l* capacity need not be provided in every engine space and only two foam extinguishers or the equivalent are to be provided.

9.4.2 Alternative to the extinguisher

For similar situations, the following equivalent extinguishers may be taken as the alternative:

Foam extinguisher	Carbon dioxide
135 L	40 kg
45 L	23 kg
9 L	6 kg

9.4.3 Emergency escape breathing device

(1) At least two emergency escape breathing devices are to be carried in accommodation and service spaces. The devices are to be situated near the stairway ready for use.

(2) At least one emergency escape breathing device is to be carried on each deck or near the stairways in machinery spaces. The total number of emergency escape breathing devices so supplied in machinery spaces is not to be less than two.

Appendix
MSC.1/Circ.1395/Rev.1
(9 July 2013)

LISTS OF SOLID BULK CARGOES FOR WHICH A FIXED GAS FIRE-EXTINGUISHING SYSTEM MAY BE EXEMPTED OR FOR WHICH A FIXED GAS FIRE-EXTINGUISHING SYSTEM IS INEFFECTIVE

1 The Maritime Safety Committee, at its sixty-fourth session (5 to 9 December 1994), agreed that there was a need to provide Administrations with guidelines regarding the provisions of SOLAS regulation II-2/10 concerning exemptions from the requirements for fire-extinguishing systems.

2 Consequently, the Committee approved MSC/Circ.671 whereby it agreed to:

.1 a list of solid bulk cargoes, for which a fixed gas fire-extinguishing system may be exempted (table 1) and recommended Member Governments to take into account the information contained in table 1 when granting exemptions under the provisions of SOLAS regulation II-2/10.7.1.4; and

.2 a list of solid bulk cargoes for which a fixed gas fire-extinguishing system is ineffective (table 2), and recommended that cargo spaces in a ship engaged in the carriage of cargoes listed in table 2 be provided with a fire-extinguishing system which provides equivalent protection. The Committee also agreed that Administrations should take account of the provisions of SOLAS regulation II-2/19.3.1 when determining suitable requirements for an equivalent fire-extinguishing system.

3 The Maritime Safety Committee, at its seventy-ninth session (1 to 10 December 2004), reviewed the above-mentioned tables and approved MSC.1/Circ.1146. The Committee decided that the annexed tables should be periodically reviewed and invited Member Governments to provide the Organization, when granting exemptions to ships for the carriage of cargoes not included in table 1, with data on the non-combustibility or fire risk properties of such cargoes. Member Governments were also requested to provide the Organization, when equivalent fire-extinguishing systems are required for the agreed carriage of cargoes not included in table 2, with data on the inefficiency of fixed gas fire-extinguishing systems for such cargoes.

4 The Maritime Safety Committee, at its eighty-ninth session (11 to 20 May 2011), noting the mandatory status of the IMSBC Code, reviewed the aforementioned lists of solid bulk cargoes to align certain names in the lists with those in the recent version of the IMDG Code and approved MSC/Circ.1395 on Lists of solid bulk cargoes for which a fixed gas fire-extinguishing system may be exempted or for which a fixed gas fire-extinguishing system is ineffective, superseding MSC.1/Circ.1146.

5 The Maritime Safety Committee, at its ninety-second session (12 to 21 June 2013), considering the proposal by the Sub-Committee on Dangerous Goods, Solid Cargoes and Containers, at its seventeenth session, approved a revision to MSC.1/Circ.1395, as set out in tables 1 and 2 of the annex.

6 The purpose of this circular is to provide guidance to Administrations. It should not, however, be considered as precluding Administrations from their right to grant exemptions for cargoes not included in table 1 or to impose any conditions when granting such exemptions under the provisions of SOLAS regulation II-2/10.7.1.4.

7 This circular supersedes MSC.1/Circ.1395.

Annex

TABLE 1
LIST OF SOLID BULK CARGOES FOR WHICH A FIXED GAS FIRE-EXTINGUISHING SYSTEM MAY BE EXEMPTED

1 Cargoes including, but not limited to, those listed in regulation II-2/10:

Ore
Coal (COAL and BROWN COAL BRIQUETTES)
Grain
Unseasoned timber

2 Cargoes listed in the International Maritime Solid Bulk Cargoes (IMSBC) Code, which are not combustible or constitute a low fire-risk, as follows:

.1 all cargoes not categorized into Group B in the IMSBC Code; and

.2 the following cargoes categorized into Group B in the IMSBC Code:

ALUMINA HYDRATE
ALUMINIUM SMELTING BY-PRODUCTS, UN 3170
(Both the names ALUMINIUM SMELTING BY-PRODUCTS or ALUMINIUM REMELTING BY-PRODUCTS are in use as proper shipping name)
ALUMINIUM FERROSILICON POWDER, UN 1395
ALUMINIUM SILICON POWDER, UNCOATED, UN 1398
CALCINED PYRITES (Pyritic ash)
CLINKER ASH, WET
COAL TAR PITCH
DIRECT REDUCED IRON (A) Briquettes, hot moulded
FERROPHOSPHORUS (including briquettes)
FERROSILICON, with more than 30% but less than 90% silicon, UN 1408
FERROSILICON, with 25% to 30% silicon, or 90% or more silicon
FLUORSPAR (calcium fluoride)
GRANULATED NICKEL MATTE (LESS THAN 2% MOISTURE CONTENT)
LIME (UNSLAKED)
LOGS
MAGNESIA (UNSLAKED)
PEAT MOSS
PETROLEUM COKE①
PITCH PRILL
PULP WOOD
RADIOACTIVE MATERIAL, LOW SPECIFIC ACTIVITY MATERIAL (LSA-1), UN 2912 (non-fissile or fissile – excepted)
RADIOACTIVE MATERIAL, SURFACE CONTAMINATED OBJECT(S) (SCO-I or SCO-II), UN 2913 (non-fissile or fissile – excepted)
ROUNDWOOD
SAW LOGS
SILICOMANGANESE
SULPHUR, UN 1350
TIMBER
VANADIUM ORE
WOODCHIPS, with moisture content of 15% or more
ZINC ASHES, UN 1435

.3 Cargoes assigned to the following generic Group B shipping schedules when they do not exhibit any self-heating, flammability, or water-reactive flammability hazards in accordance with the MHB tests and classification criteria contained in the Code:

METAL SULPHIDE CONCENTRATES

① When loaded and transported under the provisions of the IMSBC Code.

3 Solid bulk cargoes which are not listed in the IMSBC Code, provided that:

.1 they are assessed in accordance with section 1.3 of the Code;

.2 they do not present hazards of Group B as defined in the Code; and

.3 a certificate has been provided by the competent authority of the port of loading to the master in accordance with 1.3.2 of the Code.

TABLE 2
LIST OF SOLID BULK CARGOES FOR WHICH A FIXED GAS FIRE-EXTINGUISHING SYSTEM IS INEFFECTIVE AND FOR WHICH A FIRE-EXTINGUISHING SYSTEM GIVING EQUIVALENT PROTECTION SHALL BE AVAILABLE

The following cargoes categorized into Group B of the IMSBC Code:

ALUMINIUM NITRATE, UN 1438

AMMONIUM NITRATE, UN 1942 (with not more than 0.2% total combustible material, including any organic substance, calculated as carbon to the exclusion of any other added substance)

AMMONIUM NITRATE BASED FERTILIZER, UN 2067

AMMONIUM NITRATE BASED FERTILIZER, UN 2071

BARIUM NITRATE, UN 1446

CALCIUM NITRATE, UN 1454

LEAD NITRATE, UN 1469

MAGNESIUM NITRATE, UN 1474

POTASSIUM NITRATE, UN 1486

SODIUM NITRATE, UN 1498

SODIUM NITRATE AND POTASSIUM NITRATE, MIXTURE, UN 1499

Chapter 3 LIFE-SAVING APPLIANCES

1 General provisions

1.1 Application

1.1.1 The life-saving appliances and arrangements are to be manufactured in accordance with the relevant requirements of 6 of this Chapter and they may be used onboard only after a satisfactory examination is carried out and the related certificate is obtained.

1.1.2 The life-saving appliances onboard as required in this Chapter may be substituted by others provided that they are to be tested and subject to approval.

1.1.3 When life-saving appliances or arrangements on such ships are replaced or such ships undergo repairs, alterations or modifications of a major character which involve replacement of, or any addition to, their existing life-saving appliances or arrangements, such life-saving appliances or arrangements, in so far as is reasonable and practicable, comply with the requirements of this chapter. However, if a survival craft other than an inflatable liferaft is replaced without replacing its launching appliance, or vice versa, the survival craft or launching appliance may be of the same type as that replaced.

1.1.4 For ships limited by their dimensions and arrangements, where it is impracticable to implement the requirements of this Chapter, other equivalent measures may be taken subject to agreement.

1.2 Definitions

1.2.1 For the purpose of this Chapter, unless expressly provided otherwise:

(1) *Embarkation ladder* is the ladder provided at survival craft embarkation stations to permit safe access to survival craft after launching.

(2) *Float-free launching* is that method of launching survival craft whereby the craft is automatically released from a sinking ship and is ready for use.

(3) *Inflatable appliance* is an appliance which depends upon non-rigid, gas-filled chambers for buoyancy and which is normally kept uninflated until ready for use.

(4) *Rescue boat* is a boat designed to rescue persons in distress and to marshal survival craft.

(5) *Survival craft* is a craft capable of sustaining the lives of persons in distress from the time of abandoning the ship.

(6) *Length(L)*, for the purpose of this Chapter, is 96% of the total length on a waterline at 85% of the least moulded depth measured from the top of the keel, or the length from the fore-side of the stem to the axis of the rudder stock on that waterline, if that be greater. In ships designed with a rake of keel the waterline on which this is measured is to be parallel to the designed waterline.

(7) *Certificated person* is a person who holds a valid certificate of proficiency in survival craft.

(8) *Marine evacuation system* is an appliance for the rapid transfer of persons from the embarkation deck of a ship to a floating survival craft.

(9) *Lightest seagoing condition* is the loading condition with the ship on even keel, without cargo, with 10% stores and fuel remaining and in the case of a passenger ship with the full number of passengers and crew and their luggage.

(10) *Launching appliance or arrangement* is a means of transferring a survival craft or rescue boat from its stowed position safely to the water.

(11) *Free-fall launching* is that method of launching a survival craft whereby the craft with its complement of persons and equipment on board is released and allowed to fall into the sea without any restraining apparatus.

2 Provision of life-saving appliances

2.1 Provisions for survival craft and rescue boat

2.1.1 General requirements

(1) The survival craft and marine evacuation system, if fitted, provided in accordance with 2 of this Chapter are to be distributed on both sides of the ship evenly along ship length insofar as practicable.

(2) A lifeboat may be accepted as a rescue boat provided that it and its launching and recovery arrangements also comply with the requirements for a rescue boat. The rated capacity of the

lifeboat may also be included in the capacity of the lifeboat required by this regulation.
(3) For passenger ships, all survival craft required to provide for abandonment by the total number of persons on board are to be capable of being launched with their full complement of persons and equipment within a period of 30 min from the time the abandon ship signal is given after all persons have been assembled, with lifejackets donned.
(4) For ships other than passenger ships, all survival craft required to provide for abandonment by the total number of persons on board, excluding liferafts boarded from a position on deck less than 4.5 m above the waterline in the lightest seagoing condition and which have a mass of not more than 185 kg, are to be capable of being launched with their full complement of persons and equipment within a period of 10 min from the time the abandon ship signal is given.
(5) For passenger ships of service category 2 and below constantly engaged on voyages in warm climate①, throw-overboard liferafts may be replaced by open reversible liferafts.
(6) Unless provided otherwise in this Chapter, the provision of survival craft of motor ships other than passenger ships is to be in accordance with the requirements of 2.1.3 of this Chapter for other cargo ships.
(7) Unless provided otherwise in this Chapter, the provision of survival craft of manned and unmanned non-power-driven ships is to be in accordance with the applicable requirements of 2.3 of this Chapter for other ships.

2.1.2 Passenger ships

(1) The percentage of aggregate capacity for survival craft and rescue boats carried on each passenger ship to the total number of persons on board is not to be less than those specified in Table 2.1.2.
(2) For passenger ships of class I and passenger ships of class II of 85 m in length and upwards, in addition to the provisions of Table 2.1.2, the ratio of the total number of lifeboats and rescue boats (if provided) to the number of liferafts is not to be less than 1:9.
(3) For passenger ships of class II carrying 500 or more persons, the provision of the life-saving appliances is to comply with the relevant provisions for passenger ships of class I.
(4) For passenger ships of class III carrying 500 or more persons, the provision of the life-saving appliances is to comply with the relevant provisions for passenger ships of class II.
(5) For passenger ships of class III carrying 1000 or more persons, the provision of the life-saving appliances is to comply with the relevant provisions for passenger ships of class I.

Provision of Life-saving Appliances for Passenger Ships (%) **Table 2.1.2**

Ship class / ship length L		Lifeboat	Inflatable liferaft②	Aggregate capacity of the ship	Rescue boat③
I	—	30①	95	125	1
II	$L \geq 85$ m	110①		110	1
III	< 85m	—	110	110	1

① At least one partially or totally enclosed lifeboat is to be provided on each side of the ship.
② Launching appliances are to be provided in accordance with the requirements of 2.4.1 taking into account the height of the embarkation position to the waterline when the ship is in its lightest seagoing condition.
③ Passenger ships of class III with $L \leq 45$ m may be exempted.

(6) Marine evacuation system or systems complying with 6.13.1 and their complement inflatable liferafts may replace the davit-launched liferafts of equal capacity in Table 2.1.2.

2.1.3 Cargo ships

(1) Unless provided otherwise, the life-saving appliances of cargo ships are to be provided in accordance with this regulation.
(2) For cargo ships of unrestricted service, survival craft are to be provided according to the following requirements:

① All oil tankers, chemical tankers, gas carriers and other cargo ships with $L \geq 85$ m are to be provided at least in accordance with Table 2.1.3(2)①.

① Refer to MSC/Circ.1046, Guidelines for the assessment of thermal protection.

Provision of life-saving appliances for oil tankers/chemical tankers/gas carriers/other cargo ships with $L \geq 85$ m(%) Table 2.1.3(2)①

Totally enclosed lifeboat	**Inflatable liferaft ***	**Rescue boat**	**Additional liferaft (stowage spacing> 100 m)**	**Aggregate capacity(%)**
100 on each side	100 (transferable from side to side)	1 (not included in the aggregate capacity)	1 or 2 (see(5)) (not included in the aggregate capacity)	300
	100 on each side (not transferable)			400
or				
Free-fall lifeboat	**Inflatable liferaft ****	**Rescue boat**	**Additional liferaft (stowage spacing > 100 m)**	**Aggregate capacity(%)**
100	100 on each side	1 (not included in the aggregate capacity)	1 or 2 (see(5)) (not included in the aggregate capacity)	300

***** Launching appliances are to be provided in accordance with the requirements of 2.4.1 taking into account the height of the embarkation position to the waterline when the ship is in its lightest seagoing condition.

****** At least one inflatable liferaft is to be provided on each side of the ship and of such capacity as will accommodate the total number of persons on board and the liferaft on at least one side of the ship is to be served by launching appliances.

② Chemical tankers and gas carriers carrying cargoes emitting toxic vapours or gases[①] are to carry lifeboats with a self-contained air support system.

③ Oil tankers, chemical tankers and gas carriers carrying cargoes having a flashpoint not exceeding 60℃ (closed-cup test) are to carry fire-protected lifeboats.

④ Cargo ships with $L < 85$ m other than oil tankers, chemical tankers and gas carriers are to be provided at least in accordance with Table 2.1.3(2)④.

Provision of life-saving appliances for cargo ships with $L < 85$ m (%) Table 2.1.3(2)④

Inflatable liferaft *	**Rescue boat**	**Aggregate capacity(%)**
100 on each side (transferable from side to side)	1	200
150 on each side (not transferable)		300

* When any liferaft is lost or unusable, the percentage of usable liferafts on each side is to be 100%, and launching appliances are to be provided in accordance with the requirements of 2.4.1 taking into account the height of the embarkation position to the waterline when the ship is in its lightest seagoing condition.

(3) For cargo ships of service category 1, survival craft are to be provided according to the following requirements:

① Oil tankers, chemical tankers, gas carriers with $L > 60$ m and other cargo ships with $L \geq 85$ m are to be provided at least in accordance with 2.1.3(2)① to ③ above for ships of unrestricted service.

② Cargo ships with 60 m $< L <$ 85 m other than oil tankers, chemical tankers and gas carriers are to be provided at least in accordance with Table 2.1.3(2)④ above.

③ Cargo ships with $L \leq 60$ m, including oil tankers, chemical tankers and gas carriers, are to be provided in accordance with Table 2.1.3(3)③ below unless provided otherwise by ④ to ⑥ below.

Provision of life-saving appliances for cargo ships with $L \leq 60$ m (%) Table 2.1.3(3)③

Inflatable liferaft *	**Aggregate capacity(%)**
100 on each side (transferable from side to side)	200
150 on each side (not transferable)	300

***** Launching appliances are to be provided in accordance with the requirements of 2.4.1 taking into account the height of the embarkation position to the waterline when the ship is in its lightest seagoing condition.

① Refer to the products for which emergency escape respiratory protection is required in chapter 17 of the International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (IBC Code), and in chapter 19 of the International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (IGC Code).

④ Chemical tankers and gas carriers with $L \leq 60$ m carrying cargoes emitting toxic vapours or gases[①] are to carry lifeboats on each side with a self-contained air support system and of such aggregate capacity as will accommodate the total number of persons on board. In addition, the ship is to be provided with one rescue boat and inflatable liferafts of such aggregate capacity as will accommodate 50% of the total number of persons on board.

⑤ Oil tankers, chemical tankers and gas carriers with $L \leq 60$ m carrying cargoes having a flashpoint not exceeding 60℃ (closed-cup test) are to carry fire-protected lifeboats on each side and of such aggregate capacity as will accommodate the total number of persons on board. In addition, the ship is to be provided with one rescue boat and inflatable liferafts of such aggregate capacity as will accommodate 50% of the total number of persons on board.

⑥ The survival craft required in ④ and ⑤ above may be replaced by the following:

(a) at least one free-fall lifeboat (for ships specified in ④, lifeboats are to be with a self-contained air support system; for ships specified in ⑤, lifeboats are to be fire-protected) capable of being free-fall launched over the stern of the ship and of such aggregate capacity as will accommodate the total number of persons on board;

(b) at least one inflatable liferaft on each side of the ship and of such aggregate capacity as will accommodate the total number of persons on board. The liferafts on at least one side of the ship are to be served by launching appliances;

(c) a rescue boat.

(4) For cargo ships of service categories 2 and 3, survival craft are to be provided according to the following requirements:

① Unless provided otherwise in ② to ④ below, for cargo ships and oil tankers, chemical tankers and gas carriers carrying cargoes having a flashpoint exceeding 60℃ (closed-cup test), the percentage of aggregate capacity for survival craft carried to the total number of persons on board is not to be less than that specified in Table 2.1.3(4).

Provision of life-saving appliances for cargo ships (%) Table 2.1.3(4)

Inflatable liferaft *	Aggregate capacity(%)
100 on each side	200

***** Launching appliances are to be provided in accordance with the requirements of 2.4.1 taking into account the height of the embarkation position to the waterline when the ship is in its lightest seagoing condition.

② Oil tankers, chemical tankers and gas carriers carrying cargoes having a flashpoint not exceeding 60℃ (closed-cup test) are to carry fire-protected lifeboats on each side and of such aggregate capacity as will accommodate the total number of persons on board. In addition, the ship is to be provided with one rescue boat and inflatable liferafts of such aggregate capacity as will accommodate 50% of the total number of persons on board.

③ Chemical tankers and gas carriers carrying cargoes emitting toxic vapours or gases[①] are to carry lifeboats with a self-contained air support system on each side and of such aggregate capacity as will accommodate the total number of persons on board. In addition, the ship is to be provided with one rescue boat and inflatable liferafts of such aggregate capacity as will accommodate 50% of the total number of persons on board.

④ The survival craft required in ② and ③ above may be replaced by the following:

(a) at least one free-fall lifeboat (for ships specified in ②, lifeboats are to be fire-protected; for ships specified in ③, lifeboats are to be with a self-contained air support system) capable of being free-fall launched over the stern of the ship and of such aggregate capacity as will accommodate the total number of persons on board;

(b) at least one inflatable liferaft on each side of the ship and of such aggregate capacity as will accommodate the total number of persons on board. The liferafts on at least one side of the ship are to be served by launching appliances;

(c) a rescue boat.

(5) For all cargo ships, where the horizontal distance from the extreme end of the stem or stern of

① Refer to the products for which emergency escape respiratory protection is required in chapter 17 of the International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (IBC Code), and in chapter 19 of the International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (IGC Code).

the ship to the nearest end of the closest survival craft is more than 100 m, in addition to the liferafts required above, a liferaft stowed as far forward or aft, or one as far forward and another as far aft, as is reasonable and practicable. Such liferaft or liferafts may be securely fastened so as to permit manual release and may not necessarily be of the type which can be launched from an approved launching device. Where the liferafts are stowed, the following are to be provided:

① at least two lifejackets and at least two immersion suits;

② sufficient illumination for the stowed position and the area of water into which liferafts are to be launched. Where portable lighting is used, brackets are to be provided so as to be positioned on both sides of the ship; and

③ where liferafts boarded from a position on deck more than 4.5 m above the waterline in the lightest seagoing condition, at least one embarkation ladder or other equivalent embarkation appliances.

2.1.4 Other ships

(1) Manned non-power-driven ships

① The ship is to be provided with inflatable liferafts of such aggregate capacity as will accommodate at least 100% of the total number of persons on board. Ships carrying cargoes having a flashpoint not exceeding 60℃ (closed-cup test) are to be provided with inflatable liferafts of such aggregate capacity as will accommodate at least 150% of the total number of persons on board. When any liferaft is unusable, the rest inflatable liferafts are to be able to accommodate at least 100% of the total number of persons on board.

② One immersion suit is to be provided for each person except for ships provided with davits for launching liferafts or marine evacuation systems.

(2) Special purpose ships

① Special purpose ships carrying more than 60 persons are to be provided with life-saving appliances in accordance with 2.1.2 on the requirements for passenger ships. In such cases, the corresponding class of passenger ships is to be assigned in accordance with the provisions of 3, Chapter 1 of this PART.

② Notwithstanding the provision of ① above, sail training ships carrying more than 60 persons are to be provided with life-saving appliances as follows regardless whether they are power-driven and of their tonnage:

(a) each side is to be provided with liferafts of such aggregate capacity as will accommodate 100% of the total number of persons on board. Where liferafts cannot be launched on either side of the ship, each side is to be provided with liferafts of such aggregate capacity as will accommodate 150% of the total number of persons on board;

(b) one immersion suit is to be provided for every person except for ships provided with davits for launching liferafts or ships engaged solely on voyages in warm climate;

(c) a rescue boat.

③ Special purpose ships carrying not more than 60 persons are to be provided with life-saving appliances in accordance with paragraph 2.1.3 on the requirements for cargo ships other than oil tankers, chemical tankers, gas carriers in corresponding navigational areas. Where such ships comply with the subdivision requirements for special purpose ships carrying more than 60 persons, paragraph 2.1.2 on the requirements for passenger ships may be complied with. In such cases, the corresponding class of passenger ships is to be assigned in accordance with the provisions of 3, Chapter 1 of this PART.

(3) Working ships

① Power-driven working ships are to be provided with life-saving appliances in accordance with (2) of this regulation. However, where the number of the crew in working conditions exceeds the rated capacity of the ship, additional necessary personal life-saving appliances and other applicable life-saving appliances specified by 2.5 of this Chapter are to be provided.

② Manned non-power-driven working ships, such as floating cranes, floating pile drivers, dredgers, hopper barges, etc., are to be provided with life-saving appliances in accordance with (1) of this regulation.

(4) Non-power-driven ships unmanned in navigational condition but manned in working condition

Life-saving appliances are to be specially considered according to the actual conditions such as the ship size, functions and number of persons in operation. Necessary personal life-saving appliances

and other applicable life-saving appliances specified by 2.5 of this Chapter are to be provided.
(5) Pontoons
For dock pontoons, lifebuoys of appropriate number, with or without self-igniting smoke signals, may be provided according to the provisions for cargo ships in Table 2.2.2(3). In addition, one lifejacket is to be provided for each person on duty.
(6) Cargo ships carrying not more than 12 passengers
Life-saving appliances are to be provided in accordance with the requirements of 2.1.3 of this Chapter for cargo ships other than oil tankers, chemical tankers and gas carriers (in such cases, when calculating the aggregate capacity of the liferafts, the number of these persons is to be included).
(7) Floating docks
Lifebuoys of appropriate number are to be provided on both sides of the weather deck in accordance with the requirements of Table 2.2.2(3) for cargo ships.

2.2 Provision of personal life-saving appliances

2.2.1 For the purpose of this section, passenger ships include ro-ro passenger ships and vehicle and passenger ferries and cargo ships include all ships other than passenger ships.
2.2.2 Lifebuoys
(1) Passenger ships of class I are to be provided in accordance with Table 2.2.2(1):

Table 2.2.2(1)

Ship length (m)	Minimum number of lifebuoys (pcs.)
Less than 60	8
60 and upwards but less than 120	12
120 and upwards but less than 180	18
180 and upwards but less than 240	21

(2) Cargo ships of unrestricted service or service category 1 are to be provided in accordance with Table 2.2.2(2):

Table 2.2.2(2)

Ship length (m)	Minimum number of lifebuoys (pcs.)
Less than 100	8
100 and upwards but less than 150	10
150 and upwards but less than 200	12
200 and upwards	14

(3) Cargo ships and passenger ships other than those specified in (1) and (2) above are to be provided in accordance with Table 2.2.2(3):

Table 2.2.2(3)

Class/Type of ship	ship length (m)	Total number of lifebuoys (pcs.)	With self-igniting lights	
			Total number (pcs.)	With self-activating smoke signals (pcs.)
passenger ships of classes II, III	45>L≥20	4	2	—
	60> L≥45	8	4	At least 1 on each side
	120>L≥60	12	6	
	180>L≥120	18	9	
	240>L≥180	24	12	
Cargo ships of service categories 2, 3	45>L≥20	4	1	—
	75>L≥45	6	3	—
	100>L≥75	8	4	At least 1 on each side
	150>L≥100	10	5	
	200>L≥150	12	6	
	L≥200	14	7	

(4) At least one lifebuoy on each side of the ship is to be fitted with a buoyant lifeline equal in length to not less than twice the height at which it is stowed above the waterline in the lightest seagoing condition, or 30 m, whichever is the greater.
(5) Lifebuoy self-igniting lights and self-activating smoke signals are to comply with the following requirements:
① For passenger ships of class I, cargo ships of unrestricted service or service category 1, not

less than one half of the total number of lifebuoys are to be provided with lifebuoy self-igniting lights, not less than two of these are to also be provided with lifebuoy self-activating smoke signals and be capable of quick release from the navigation bridge; lifebuoys with lights and those with lights and smoke signals are to be equally distributed on both sides of the ship and are not to be the lifebuoys provided with lifelines in compliance with the requirements of (4) of this regulation.

② For passenger ships of categories II and III, cargo ships of service categories 2 and 3, lifebuoy self-igniting lights and self-activating smoke signals are to be provided in accordance with Table 2.2.2(3).

2.2.3 Lifejackets

(1) A lifejacket complying with the requirements of 6.7 of this Chapter is to be provided for every person onboard the ship unless expressly provided otherwise.

(2) A sufficient number of lifejackets are to be carried for persons on watch and for use at remotely located survival craft stations. The lifejackets carried for persons on watch should be stowed on the bridge, in the engine control room and at any other manned watch station.

(3) For passenger ships, a number of lifejackets equal to at least 5% of the total number of passengers onboard are to be provided. In addition, a number of lifejackets suitable for children equal to at least 5% of the number of passengers onboard are to be provided.

(4) Each lifejacket provided for ro-ro passenger ships and cargo ships is to be provided with one lifejacket light. For other passenger ships, at least 50% of the lifejackets are to be provided with one lifejacket light.

2.2.4 Immersion suits

(1) For cargo ships, an immersion suit complying with the requirements of 6.8 of this Chapter, of an appropriate size, is to be provided for every crew member unless expressly provided otherwise.

(2) For passenger ships, an immersion suit as specified in (1) is to be provided for every person assigned to crew the rescue boat or assigned to the marine evacuation system party.

(3) If the ship is constantly engaged in warm climates, this protective clothing need not be carried.

2.3 Provision of life-saving communication equipment

2.3.1 For power-driven ships and manned non-power-driven ships, VHF radiotelephones and S&R positioning devices are to be provided in accordance with Table 2.1.1 of Chapter 4.

2.4 Provision of launching and recovery arrangements

2.4.1 For survival craft boarded from a position on deck 4.5 m or more above the waterline in the lightest seagoing condition as well as all survival craft other than those specified in 2.4.2, launching and recovery arrangements are to be provided. Where the marine evacuation system is used, the complement throw-overboard liferafts may not be provided with launching and recovery arrangements.

2.4.2 Unless expressly provided otherwise, launching and embarkation appliances complying with the requirements of 6.5 of this Chapter are to be provided for all survival craft except those which are:

(1) boarded from a position on deck less than 4.5 m above the waterline in the lightest seagoing condition and which have a mass of not more than 185 kg; or

(2) boarded from a position on deck less than 4.5 m above the waterline in the lightest seagoing condition and which are stowed for launching directly from the stowed position under unfavorable conditions of trim of up to 10 °and list of up to 20 °either way; or

(3) carried in excess of the survival craft for 200% of the total number of persons on board the ship and which have a mass of not more than 185 kg; or

(4) carried in excess of the survival craft for 200% of the total number of persons on board the ship, are stowed for launching directly from the stowed position under unfavorable conditions of trim of up to 10 °and list of up to 20 °either way; or

(5) provided for use in conjunction with a marine evacuation system, complying with the requirements of section 6.2, Chapter VI of IMO LSA Code and stowed for launching directly from the stowed position under unfavorable conditions of trim of up to 10 °and list of up to 20 °either way.

2.4.3 Each lifeboat is to be provided with an appliance which is capable of launching and recovering the lifeboat and the appliance is to be so arranged that it can be operated by one man on

the deck. Launching and recovery arrangements are to be such that the appliances operator on the ship is able to observe the survival craft at all times during launching and for lifeboats during recovery. In addition there is to be provision for hanging-off the lifeboat to free the release gear for maintenance. Only one type of release mechanism is to be used on board the ship.

2.4.4 Means are to be available to prevent any discharge of water onto survival craft during abandonment.

2.4.5 Launching stations are to be in such positions as to ensure safe launching having particular regard to clearance from the propeller and steeply overhanging portions of the hull and so that, as far as possible, survival craft, except survival craft specially designed for free-fall launching, can be launched down the straight side of the ship. If positioned forward, they are to be located abaft the collision bulkhead in a sheltered position. Preparation and operation of survival craft at any one launching station are not to interfere with the prompt preparation and operation of any other survival craft or rescue boat at any other station.

2.4.6 The survival craft, its launching appliance, and the area of water into which it is to be launched are to be adequately illuminated by lighting supplied from the emergency source of electrical power required by Chapter 2-1 of this PART as appropriate.

2.4.7 If there is a danger of the survival craft being damaged by the ship's stabilizer wings, means are to be available, powered by an emergency source of energy, to bring the stabilizer wings inboard; indicators operated by an emergency source of energy are to be available on the navigating bridge to show the position of the stabilizer wings.

2.4.8 Falls, where used, are to be long enough for the survival craft to reach the water with the ship in its lightest seagoing condition, under unfavourable conditions of trim of up to 10 ° and list of up to 20 ° either way.

2.4.9 If partially enclosed lifeboats are carried, a davit span is to be provided, fitted with not less than two lifelines of sufficient length to reach the water with the ship in its lightest seagoing condition, under unfavourable conditions of trim of up to 10 ° and list of up 20 ° either way.

2.4.10 The rescue boat launching arrangements are to comply with the requirements of 2.4.2 to 2.4.9.

2.4.11 Posters or signs are to be provided on or in the vicinity of survival craft and their launching controls are to:

(1) illustrate the purpose of controls and the procedures for operating the appliance and give relevant instructions or warnings;

(2) be easily seen under emergency lighting conditions;

(3) use symbols in accordance with 3.2.1.

2.5 Provision of other life-saving appliances

2.5.1 Line-throwing appliances

Passenger ships of unrestricted service or service categories 1 and 2 with $L \geq 40$ m and other ships with $L \geq 60$ m (excluding non-power-driven ships) are to be provided with four portable line-throwing appliances or one set of pistol-fired rocket (including one pistol, four set of lines, rockets and means of ignition).

2.5.2 Distress flares

Twelve approved rocket parachute flare signals are to be provided for ships of more than 500 gross tonnage. For ships equal to or less than 500 gross tonnage, the number of rocket parachute flare signals may be reduced half. They are to be stowed on or near the navigation bridge.

2.5.3 On-board communications and alarm systems

(1) For passenger ships and cargo ships of more than 500 gross tonnage, an emergency means comprised of either fixed or portable equipment or both are to be provided for two-way communications between emergency control stations, muster and embarkation stations and strategic positions on board.

(2) For passenger ships and cargo ships of more than 500 gross tonnage, a general emergency alarm system is to be provided. All passenger ships are to be fitted with a public address system, for summoning passengers and crew to muster stations and to initiate the actions included in the muster list. Entertainment sound systems are to automatically be turned off when the general emergency alarm system is activated.

(3) On passenger ships, the general emergency alarm system is to be audible on all open decks.

(4) On ships fitted with a marine evacuation system communication between the embarkation

station and the platform or the survival craft is to be ensured. The communication system may use the two-way VHF specified in Chapter 4 of this PART.
(5) Special purpose ships carrying more than 60 persons are to be fitted with on-board communications and alarm systems in accordance with the requirements for passenger ships.
2.5.4 Public address systems on passenger ships
(1) All passenger ships and special purpose ships carrying more than 60 persons are to be fitted with a public address system complying with the requirements of 6.11. The public address system is to be clearly audible above the ambient noise in all spaces, and is to be provided with an override function controlled from one location on the navigation bridge and such other places on board, so that all emergency messages will be broadcast if any loudspeaker in the spaces concerned has been switched off, its volume has been turned down or the public address system is used for other purposes.
(2) The public address system is to be connected to the emergency source of power required by 3.3 of Chapter 2-1.

3 Stowage, embarkation, launching and recovery of life-saving appliances

3.1 Stowage of life-saving appliances

3.1.1 Each survival craft is to be stowed:
(1) so that neither the survival craft nor its stowage arrangements will interfere with the operation of any other survival craft or rescue boat at any other launching station;
(2) as near the water surface as is safe and practicable and, in the case of a survival craft other than a liferaft intended for throw over board launching, in such a position that the survival craft in the embarkation position is not less than 2 m above the waterline with the ship in the fully loaded condition under unfavourable conditions of trim of up to 10 °and listed up to 20 °either way, or to the angle at which the ship's weather deck edge becomes submerged, whichever is less. For passenger ships provided with davit-launched survival craft, the height of the davit head with the survival craft in embarkation position, is, as far as practicable, not to exceed 15 m to the waterline when the ship is in its lightest seagoing condition;
(3) in a state of continuous readiness so that two crew members can carry out preparations for embarkation and launching in less than 5 min;
(4) fully equipped as required by this chapter;
(5) as far as practicable, in a secure and sheltered position and protected from damage by fire and explosion. In particular, survival craft on tankers, other than the liferafts required by 2.1.3(4) of this Chapter, are not to be stowed on or above a cargo tank, slop tank, or other tank containing explosive or hazardous cargoes.
(6) Lifeboats for lowering down the ship's side are to be stowed as far forward of the propeller as practicable. On cargo ships of 80 m in length and upwards but less than 120 m in length, each lifeboat is to be so stowed that the after end of the lifeboat is not less than the length of the lifeboat forward of the propeller. On cargo ships of 120 m in length and upwards and passenger ships of 80 m in length and upwards, each lifeboat is to be so stowed that the after end of the lifeboat is not less than 1.5 times the length of the lifeboat forward of the propeller. Where appropriate, the ship is to be so arranged that lifeboats, in their stowed positions, are protected from damage by heavy seas.
(7) Lifeboats are to be stowed attached to launching appliances.
(8) Every liferaft is to be stowed with its painter permanently attached to the ship.
(9) Each liferaft or group of liferafts is to be stowed with a float-free arrangement complying with the requirements of paragraph 4.l.6 of Chapter IV of IMO LSA Code so that each floats free and, if inflatable, inflates automatically when the ship sinks.
(10) Liferafts are to be so stowed as to permit manual release of one raft or container at a time from their securing arrangements.
(11) (8) and (9) above do not apply to liferafts required by 2.1.3(4).
(12) Davit-launched liferafts are to be stowed within reach of the lifting hooks.
3.1.2 Rescue boats are to be stowed:
(1) in a state of continuous readiness for launching in not more than 5 min, and if the inflated type, in a fully inflated condition at all times;
(2) in a position suitable for launching and recovery;

(3) so that neither the rescue boat nor its stowage arrangements will interfere with the operation of any survival craft at any other launching station; and
(4) if it is also a lifeboat, in compliance with the requirements of 3.1.1.

3.1.3 Stowage of marine evacuation systems

(1) The ship's side is not to have any openings between the embarkation station of the marine evacuation system and the waterline in the lightest seagoing condition and means are to be provided to protect the system from any projections.
(2) Marine evacuation systems are to be in such positions as to ensure safe launching having particular regard to clearance from the propeller and steeply overhanging positions of the hull and so that, as far as practicable, the system can be launched down the straight side of the ship.
(3) Each marine evacuation system is to be stowed so that neither the passage nor platform nor its stowage or operational arrangements will interfere with the operation of any other life-saving appliance at any other launching station.
(4) Where appropriate, the ship is to be so arranged that the marine evacuation systems in their stowed positions are protected from damage by heavy seas.

3.1.4 Lifejackets and lifebuoys

(1) Lifejackets are to be placed in readily accessible spaces, and those carried for persons on watch are to be placed in navigation bridge, telegraph room and engine room separately, and such stowage locations are to be plainly indicated. For passenger ships, the stowage of lifejackets is also to comply with the following requirements:

① the number of lifejackets stowed in the cabins is to equal to the number of passengers;
② a number of lifejackets equal to at least 5% of the total number of persons on board are to be stowed in the plainly indicated position on the deck or at the muster station.

(2) Lifebuoys are to be so distributed as to be readily available on both sides of the ship and at least one is to be placed in the vicinity of the stern and not be permanently secured in any way.
At least one readily available lifebuoy is to be stowed on either side of the navigation bridge. Such lifebuoys are to be provided with self-activating smoke signals except for those not required to be provided with self-activating smoke signals in Table 2.2.2(3) of this Chapter.

3.1.5 Life-saving line-throwing apparatus and smoke signals are to be stowed in the navigation bridge or accessible places in its vicinity and capable of being readily available.

3.1.6 Life-saving communications are to be placed in chart room or suitable places so as to be immediately removed to survival craft in emergency. Where survival craft are stowed amidships or astern, the life-saving communications are to be placed in suitable locations in vicinity of survival craft further from the main telegraph transmitter.

3.2 Embarkation, launching and recovery of survival craft and rescue boat

3.2.1 Muster stations are to be provided close to the embarkation stations. Each muster station is to have sufficient clear deck space to accommodate all persons assigned to muster at that station, but at least 0.35 m^2 per person. Passenger spaces and public spaces adjacent to the muster position for embarkation of survival craft may be included in the deck area of the muster position. Routes to muster stations are to be indicated with luminescent signs and muster stations are to use the muster station symbol[①].

3.2.2 Muster and embarkation stations are to be readily accessible from accommodation and work areas.

3.2.3 On passenger ships, survival craft and rescue boat embarkation arrangements are to be designed for:
(1) all lifeboats to be boarded and launched either directly from the stowed position or from an embarkation deck but not both;
(2) davit-launched liferafts to be boarded and launched from a position immediately adjacent to the stowed position or from a position to which, in compliance with the requirements of 3.1.1(12), the liferaft is transferred prior to launching;
(3) rescue boat arrangements are to be such that the rescue boat can be boarded and launched directly from the stowed position with the number of persons assigned to crew the rescue boat on board. If the rescue boat is also a lifeboat and the other lifeboats are boarded and launched from an

① Refer to the Symbols related to life-saving appliances and arrangements adopted by IMO resolution A.760(18), as amended by resolution MSC.82(70).

embarkation deck, the arrangements are to be such that the rescue boat can also be boarded and launched from the embarkation deck.

3.2.4 On cargo ships, survival craft embarkation arrangements are to be designed for:

(1) all lifeboats to be boarded and launched directly from the stowed position;

(2) davit-launched liferafts to be boarded and launched from a position immediately adjacent to the stowed position or from a position to which, in compliance with the requirements of 3.1.1(12), the liferaft is transferred prior to launching.

3.2.5 Davit-launched and free-fall launched survival craft muster and embarkation stations are to be so arranged as to enable stretcher cases to be placed in survival craft.

3.2.6 An approved embarkation ladder extending, in a single length, from the deck to the waterline in the lightest seagoing condition under all conditions of trim of up to 10 ° and a list of up to 20 ° either way is to be provided at each embarkation station or at every two adjacent embarkation stations for survival craft launched down the side of the ship. However, such ladders may be permitted to be replaced by approved devices to afford access to the survival craft when waterborne, provided that there is to be at least one embarkation ladder on each side of the ship. Other means of embarkation enabling descent to the water in a controlled manner may be permitted for the liferafts required by 2.1.3(5).

3.2.7 Emergency lighting complying with the requirements of 3.3 of Chapter 2-1 is to be provided for all passageways, stairways and exits giving access to the stowage places of survival craft and embarkation stations, survival craft stowage places and the area of water into which the survival craft is to be launched.

3.2.8 For passenger ships, if the height of the embarkation position of the throw-overboard liferaft to the waterline in the lightest seagoing condition does not exceed 4.5 m, the embarkation ladder, marine evacuation system or equivalent appliances are to be used so as to ensure that personnel onboard the ship are safely boarded and lowered to the water surface. The embarkation ladder, evacuation routes of the marine evacuation system are to extend, in a single length, from the deck to the waterline in the lightest seagoing condition under all conditions of trim of up to 10 ° and a list of up to 20 ° either way. Where the length and weight of the embarkation ladder make manual release impossible, the waterline in the lightest seagoing condition may be changed to the waterline when the ship reaches equilibrium in damaged condition (the maximum length required is to be taken).

3.2.9 If the rescue boat is one of the ship's survival craft, the embarkation arrangements and launching station are to comply with the requirements of 3.2.1 to 3.2.4 and 2.4.5. In addition, rescue boat embarkation and recovery arrangements are to allow for safe and efficient handling of a stretcher case. Foul weather recovery strops are to be provided for safety if heavy fall blocks constitute a danger.

3.2.10 Recovery time of the rescue boat is to be not more than 5 min in moderate sea conditions when loaded with its full complement of persons and equipment. If the rescue boat is also a lifeboat, this recovery time is to be possible when loaded with its lifeboat equipment and the approved rescue boat complement of at least six persons.

4 Musters and drills

4.1 Muster list

4.1.1 The muster list is to be provided for every ship and is to show the duties to members of the crew in case of emergency and is to indicate, in particular, the post to which each member must go, and the duties that he has to perform.

The muster list is to be prepared before the ship proceeds to sea and the copies posted up in the navigation bridge, engine room, accommodation and public spaces after the master has signed. If any change takes place in the crew which necessitates an alternation in the muster list, the master is to revise the list in time.

4.1.2 The muster list is to show the duties assigned to the different members of the crew including:

(1) closing of the watertight doors, fire doors, valves, scuppers, sidescuttles, skylights, portholes and other similar openings in the ship;

(2) equipping of the survival craft and other life-saving appliances;

(3) preparation and launching of survival craft;

(4) general preparation of other life-saving appliances;
(5) muster of passengers;
(6) use of communication equipment;
(7) manning of fire parties assigned to deal with fires;
(8) special duties assigned in respect of the use of fire-fighting equipment and installations.

4.1.3 The muster list is to show the duties assigned to members of the crew in relation to passengers in case of emergency. These duties are to include:
(1) warning the passengers;
(2) checking that the passengers are suitably clad and have donned their lifejackets correctly;
(3) assembling passengers at muster stations;
(4) keeping order in the passageways and on the stairways and generally controlling the movements of the passengers;
(5) ensuring that a supply of blankets is taken to the survival craft.

4.1.4 The muster list is to specify which officers are assigned to ensure that life-saving and fire-fighting appliances are maintained in good condition and are ready for immediate use.

4.1.5 The muster list is to specify substitutes for key persons who may become disabled, taking into account that different emergencies may call for different actions.

4.1.6 The muster list is to specify the definite signals for assembling all the crew to survival craft, and is to indicate the details of these signals, which will be given out by the emergency alarm system.

4.2 Lifeboat men and crew training

4.2.1 Certificated persons

A certificated person is to be any of the crew who is of proficiency in survival craft and has the following abilities, and holds a certificate of proficiency after being qualified by examinations:
(1) having been trained in all the operations connected with launching lifeboats and other life-saving appliances, and in the use of oars and propelling gears;
(2) being acquainted with the practical operation of lifeboats and of other life-saving appliances;
(3) being capable of understanding and answering the orders related to all kinds of life-saving appliances.

4.2.2 Number of certificated persons

(1) In passenger ships, there are to be, for every lifeboat carried, a number of certificated persons at least equal to that specified in Table 4.2.2.
(2) A deck officer or certified person is to be placed in charge of each lifeboat and a second-in-command is also to be nominated. The person in charge is to have a list of the lifeboat crew, and is to see that the crew under his command are acquainted with their duties.

Number of certificated persons **Table 4.2.2**

Carrying capacity of a lifeboat	The minimum number of certificated lifeboat man
Less than 41	2
41~61	3
62~85	4
More than 85	5

4.2.3 Non-certificated persons

(1) A man capable of operating and maintaining the engine is to be assigned to each motor lifeboat.
(2) A man capable of operating the radio and searchlight installations is to be assigned to each motor lifeboat carrying such equipment.
(3) Members of crew are to prove that they have been trained in the operations connected with launching liferafts and in the use of liferafts. A man practiced in the operation and operation of liferafts is to be assigned to each liferaft carried in passenger ships.

4.2.4 Training manuals

A training manual complying with the requirements of this regulation is to be provided in each crew mess room and recreation room or in each crew cabin.
The training manual is to contain instructions and information, in easily understood terms and illustrated wherever possible, on the life-saving appliances provided in the ship and on the best methods of survival. If it is possible, any part of such information may be provided in the form of audio-visual aids to improve the effectiveness of the training.

The following are to be explained in details:
(1) donning of lifejackets, immersion suits (if applicable);
(2) routes and stations of muster;
(3) boarding, launching and clearing the survival craft and rescue boats, including, where applicable, use of marine evacuation systems;
(4) protection and illumination in launching areas (if applicable);
(5) use of all survival equipment such as sea anchor, life-saving communication, smoke signals;
(6) use of engine and accessories;
(7) recovery of survival craft and rescue boat (including stowage and securing);
(8) methods of retrieval, including the use of helicopter rescue gear, ship's rescue and line-throwing apparatus;
(9) all other functions contained in the muster list;
(10) instructions for emergency repair of the life-saving appliances.
Every ship fitted with a marine evacuation system is to be provided with on-board training aids in the use of the system.

4.2.5 Onboard training and instructions

(1) On-board training in the use of the ship's life-saving appliances, including survival craft equipment, and in the use of the ship's fire-extinguishing appliances is to be given as soon as possible but not later than two weeks after a crew member joins the ship.
(2) Every crew member is to be given instructions which are to include but not necessarily be limited to:

① operation and use of the ship's inflatable liferafts;
② problems of hypothermia, first-aid treatment for hypothermia and other appropriate first-aid procedures;
③ special instructions necessary for use of the ship's life-saving appliances in severe weather and severe sea conditions.

(3) On-board training in the use of davit-launched liferafts is to take place at intervals of not more than six months on every ship fitted with such appliances. Whenever practicable this is to include the inflation and lowering of a liferaft. This liferaft may be a special liferaft intended for training purposes only, which is not part of the ship's life-saving equipment; such a special liferaft is to be conspicuously marked.

4.3 Passengers briefing

4.3.1 On a ship engaged on a voyage where passengers are scheduled to be on board for more than 1 h, passengers are to be instructed in the use of the lifejackets and the action to take in an emergency immediately before sailing, or immediately after sailing. The announcement is to be made on the ship's public address system, or by other equivalent means. Information cards or poster or video programmes may not be used to replace the announcement.

4.3.2 On a ship engaged on a voyage where passengers are scheduled to be on board for not more than 1 h, passengers are to be instructed in the use of the lifejackets and the action to take in an emergency immediately before sailing, or immediately after sailing. Information cards or poster or video programmes may be used to replace the announcement.

4.4 Drills

4.4.1 Every crew member is to participate in at least one abandon ship drill every month. The abandon ship drill of the crew is to take place within 24 h of the ship leaving a port if more than 25% of the crew have been replaced. When a ship enters service for the first time, after modification of a major character, the abandon ship drill is to be held before sailing.

4.4.2 Abandon ship drill

(1) Each abandon ship drill is to include:

① summoning of passengers and crew to muster stations with the alarm required by 2.5.3 followed by drill announcement on the public address or other communication system and ensuring that they are made aware of the order to abandon ship;
② reporting to stations and preparing for the duties described in the muster list;
③ checking that passengers and crew are suitably dressed;
④ checking that lifejackets are correctly donned;

⑤ lowering of at least one lifeboat after any necessary preparation for launching;
⑥ starting and operating the lifeboat engine;
⑦ operation of davits used for launching liferafts;
⑧ a mock search and rescue of passengers trapped in their staterooms;
⑨ instruction in the use of radio life-saving appliances.

(2) Different lifeboats are to, as far as practicable, be lowered in compliance with the requirements of (1)⑤ at successive drills.

(3) In abandon ship drills, all lifeboats are to be lowered at least once every three months and launched at least once every six months with their assigned crew aboard and manoeuvred in the water.

(4) In the case of a lifeboat arranged for free-fall launching, it is allowed to be lowered to the water surface instead of being free-fall launched.

(5) Rescue boats other than lifeboats which are also rescue boats, are to be launched once every three months with their assigned crew aboard and manoeuvred in the water.

(6) If a ship is fitted with marine evacuation systems, drills are to include exercising of the procedures required for the deployment of such a system in 5.1.5(2).

(7) Emergency lighting for mustering and abandonment is to be tested at each abandon ship drill.

4.5 Records

4.5.1 The date when musters are held, details of abandon ship drills and fire drills and on board training is to be recorded in log-books.

5 Maintenance and inspections of life-saving appliances

5.1 General requirements

5.1.1 The following maintenance documents are to be prepared for the life-saving appliances, including lifeboat equipment:

(1) monthly inspection checklist;

(2) maintenance and repair instructions;

(3) schedule of periodical maintenance;

(4) diagram of lubrication points with the recommended lubricants;

(5) lists of repaired parts;

(6) list of source of spare parts;

(7) log for records of inspection and maintenance.

5.1.2 Falls used in launching are to be inspected periodically with special regard for areas passing through sheaves, and renewed when necessary due to deterioration of the falls or at intervals of not more than 5 years, whichever is the earlier.

5.1.3 The following tests and inspections are to be carried out weekly and a report of the inspection are to be entered in the log-book:

(1) all survival craft, rescue boats and launching appliances are to be visually inspected to ensure that they are ready for use. The inspection is to include, but is not limited to, the condition of hooks, their attachment to the lifeboat and the on-load release gear being properly and completely reset;

(2) all engines in lifeboats and rescue boats are to be run provided the ambient temperature is above the minimum temperature required for starting and running the engine. During this period of time, it should be demonstrated that the gearbox and gearbox train are engaging satisfactorily. For the rescue boat fitted with an outboard motor, tests are to be carried out according to the manufacturer's manual.

(3) lifeboats, except free-fall lifeboats, on cargo ships are to be moved from their stowed position, without any persons on board, to the extent necessary to demonstrate satisfactory operation of launching appliances, if weather and sea conditions so allow;

(4) the general emergency alarm system is to be tested.

5.1.4 The following inspections are to be carried out monthly:

(1) all lifeboats, except free-fall lifeboats, are to be turned out from their stowed position, without any persons on board if weather and sea conditions so allow;

(2) inspection of the life-saving appliances, including lifeboat equipment, is to be carried out monthly using the checklist required by 5.1.1(1) to ensure that they are complete and in good

order. A report of the inspection is to be entered in the log-book.

5.1.5 Servicing of inflatable liferafts, inflatable lifejackets, marine evacuation systems, and maintenance and repair of inflated rescue boats are to be as follows:

(1) Every inflatable liferaft, inflatable lifejacket, and marine evacuation system are to be serviced:

① at intervals not exceeding 12 months, provided where in any case this is impracticable, this period may be extended to 17 months subject to agreement;

② at an approved servicing station.

(2) In addition to the servicing intervals of marine evacuation systems required by (1), each marine evacuation system should be deployed at least once every six years.

(3) Emergency repairs of inflated rescue boats may be carried out on board the ship; however, permanent repairs are to be effected at an approved servicing station.

5.1.6 Hydrostatic release units, other than disposable hydrostatic release units, are to be serviced:

(1) at intervals not exceeding 12 months, provided where in any case this is impracticable, this period may be extended to 17 months subject to agreement; and

(2) at an approved servicing station.

5.1.7 Launching appliances are to be:

(1) maintained in accordance with instructions for on-board maintenance as required by 5.1.1;

(2) subject to a thorough examination at annual surveys; and

(3) upon completion of the examination referred to in (2) subjected to a dynamic test of the winch brake at maximum lowering speed. The load to be applied is to be the mass of the survival craft or rescue boat without persons on board, except that, at intervals not exceeding five years, the test is to be carried out with a proof load equal to 1.1 times the weight of the survival craft or rescue boat and its full complement of persons and equipment.

5.1.8 Lifeboat or rescue boat on-load release gear, including free-fall lifeboat release systems, are to be:

(1) maintained in accordance with instructions for on-board maintenance as required by 5.1.1;

(2) subject to a thorough examination and operational test during the annual surveys by properly trained personnel familiar with the system;

(3) operationally tested under a load of 1.1 times the total mass of the boat when loaded with its full complement of persons and equipment whenever the release gear is overhauled. Such over-hauling and test are to be carried out at least once every five years.

5.1.9 Davit-launched liferaft automatic release hooks are to be:

(1) maintained in accordance with instructions for on-board maintenance as required by 5.1.1;

(2) subject to a thorough examination and operational test during the annual surveys by properly trained personnel familiar with the system; and

(3) operationally tested under a load of 1.1 times the total mass of the liferaft when loaded with its full complement of persons and equipment whenever the automatic release hook is over-hauled. Such over-hauling and test are to be carried out at least once every five years.

5.1.10 Immersion suits are to be inspected by the crew monthly according to the requirements of MSC/Circ.1047 and are to be serviced once every three years by approved shore-based companies according to the requirements of MSC/Circ.1114.

6 Requirements for life-saving appliances

6.1 General requirements

6.1.1 The life-saving appliances are to be capable of being ready for immediate use in emergency. Before the ship leaves port and at all times during the voyage, all life-saving appliances are to be in working order and ready for immediate use.

6.1.2 The life-saving appliances are to be constructed with proper workmanship and materials.

6.1.3 Unless expressly provided otherwise, the life-saving appliances are not to be damaged in stowage throughout the air temperature range 243 K to 338 K (-30℃ to 60℃) or the minimum air temperature of the agreed navigation water area and are normally to work throughout the water temperature range 272 K to 303 K (-1℃ to 30℃).

6.1.4 The life-saving appliances are to be rot-proof, corrosion resistant within the validity term, and not be unduly affected by sunlight, seawater, oil or fungal attack.

6.1.5 The life-saving appliances are to be of a highly visible colour on all parts where this will

assist detection and be fitted with approved retro-reflective material.

6.1.6 Testing of life-saving appliances

(1) Unless expressly provided otherwise, prototype testing and manufacturing as well as installation testing of life-saving appliances, launching and embarkation appliances and marine evacuation systems are to comply with the requirements of SOLAS regulations III/4 and 5 as well the LSA Code.

(2) During sea trials, at least 50% of the marine evacuation systems are to be subject to the release test.

(3) Testing of open reversible liferafts is to comply with the requirements of the International Code of Safety for High Speed Craft, 2000.

6.2 Lifeboats

6.2.1 Partially enclosed lifeboats are to comply with the requirements of Chapter III of SOLAS as well 4.4 and 4.5, Chapter IV of the LSA Code.

6.2.2 Totally enclosed lifeboats are to comply with the requirements of Chapter III of SOLAS as well 4.4 and 4.6, Chapter IV of the LSA Code.

6.2.3 Free-fall lifeboats are to comply with the requirements of Chapter III of SOLAS as well 4.4 and 4.7, Chapter IV of the LSA Code.

6.2.4 Fire-protected lifeboats are to comply with the requirements of Chapter III of SOLAS as well 4.4 and 4.9, Chapter IV of the LSA Code.

6.2.5 In 6.2.4 to 6.2.4 above, first aid kits in the lifeboat equipment are to be provided according to the Appendix.

6.2.6 Marking of lifeboats

(1) The principal dimensions of a lifeboat and the number of persons which the lifeboat is certified to accommodate are to be marked on each side of the bow near the rubbers in clear permanent characters which are not to be less than 38 mm in height. The name of the ship to which the lifeboat belongs and its number are to be painted in black on each side of the bow and the name of port of registry of the ship is to be painted in black on each side of the stern on clear persistent characters which are not to be less than 76 mm in height.

Lifeboats stowed on the starboard side of the ship are to be allocated odd number, from forward to aft, whilst those on the port side are to be allocated even number in the same manner.

(2) Every lifeboat is to be affixed with a nameplate at a conspicuous place on the forward thwart on which there are to be marked the principal dimensions of the lifeboat, the number of persons which a lifeboat is certified to accommodate, the cubic capacity and total mass of the boat, the aggregate volume of the buoyancy appliances, manufacturer, serial number, date of manufacture (month and year) and the qualified mark of inspection unit.

6.3 Liferafts

6.3.1 Liferafts are to comply with the requirements of Chapter III of SOLAS as well Chapter IV of the LSA Code.

6.3.2 Open reversible liferafts are to comply with the requirements of Appendix 11 of the International Code of Safety for High –Speed Craft, 2000.

6.3.3 Inflatable liferafts used in conjunction with the marine evacuation system are to also comply with the requirements of 6.13.

6.3.4 The provision of liferaft equipment is to be adjusted as follows:

(1) Liferaft equipment onboard the ship of unrestricted service is to be provided according to “SOLAS A PACK” in 4.1.5, Chapter IV of the LSA Code.

(2) Liferaft equipment onboard the ship of service categories 1, 2 and 3 may be provided according to “SOLAS B PACK” in 4.1.5, Chapter IV of the LSA Code.

(3) First aid kits in the liferaft equipment are to be provided according to the Appendix.

6.3.5 Marking of liferafts

The liferaft and its container are to be marked in clear permanent characters with the type and carrying capacity of the raft, gross mass, name of manufacturer, serial number, “A PACK” or “B PACK”, date of manufacture (month and year), and the mark of the inspection unit.

6.4 Rescue boats

6.4.1 Rescue boats are to comply with the requirements of Chapter III of SOLAS as well

Chapter V of the LSA Code.

6.5 Launching and recovery arrangements

6.5.1 Unless expressly provided otherwise, launching arrangements of the survival craft and rescue boat are to comply with the requirements of 6.1, Chapter VI of the LSA Code.

6.6 Lifebuoys

6.6.1 Lifebuoys, including lifebuoy self-igniting lights, self-activating smoke signals and buoyant lifelines, are to comply with the requirements of Chapter III of SOLAS as well 2.1, Chapter II of the LSA Code.

6.6.2 In addition to the requirements of 6.6.1, lifebuoys stowed on both side of the navigation bridge specified in 3.1.4(2) of this Chapter are to be fitted with self-activating smoke signals required by the LSA Code and are to have a mass sufficient to operate the quick-release arrangement or 4 kg, whichever is the greater.

6.6.3 The name and port of registry of the ship, in which the lifebuoy is carried are to be marked on one side of the lifebuoy in clear persistent characters. On the other side of the lifebuoy, the name and port of registry of the ship are to be marked in the same manner in English. Every lifebuoy is to be marked with its type, manufacturer, serial number, date of manufacture (month and year) and the mark of inspection unit.

6.7 Lifejackets

6.7.1 Lifejackets, including lifejacket lights, are to comply with the requirements of Chapter III of SOLAS as well 2.2, Chapter II of the LSA Code.

6.7.2 Every lifejacket is to be marked in clear persistent Chinese characters with the type, manufacturer, serial number, date of manufacture (month and year) and the mark of inspection unit. Lifejackets suitable for children are to be marked with “Special for Children" on both sides.

6.8 Immersion suits

6.8.1 Immersion suits are to comply with the requirements of Chapter III of SOLAS as well 2.3, Chapter II of the LSA Code.

6.9 Life-saving visual signals

6.9.1 Life-saving visual signals are to comply with the requirements of Chapter III of SOLAS as well Chapter III of the LSA Code.

6.10 Line-throwing appliances

6.10.1 Line-throwing appliances are to comply with the requirements of Chapter III of SOLAS as well 7.1, Chapter VII of the LSA Code.

6.11 Emergency alarms and public address systems

6.11.1 Emergency alarms and public address systems are to comply with the requirements of Chapter III of SOLAS as well 7.2, Chapter VII of the LSA Code.

6.12 Retro-reflective material

6.12.1 Retro-reflective material is to comply with the requirements of Chapter III of SOLAS as well 1.2.2(7), Chapter I of the LSA Code.

6.13 Marine evacuation systems

6.13.1 Marine evacuation systems are to comply with the requirements of Chapter III of SOLAS as well 6.2, Chapter VI of the LSA Code.

7 Decision support system for masters

7.1 Decision support system for masters

7.1.1 Passenger ships are to be provided with a decision support system for masters according to Reg.29, Part B, Chapter III of SOLAS.

Appendix List of First-aid Outfit for Survival Craft

The first-aids for survival craft are to be provided in accordance with the table below:

No.	Item	Specification	Unit	Provided in survival craft	Remarks
1	Bandages	4.8 ×600 cm	roll	5	
2	Gauge	34 ×40 cm	pcs	10	Sealed by plastic pack
3	Bandages, Triangular	90 cm each side, 130 cm base	pcs	3	
4	Plaster	1.2 ×100 cm	roll	l	Adhesive plaster
5	Cotton wool	10 g	packet	2	②
6	Tourniquet	55 cm	pcs	2	Rubber tube, 0.7 to 1.0 cm in diameter
7	Pincette	12 cm	pcs	l	①
8	Scissors	10 cm	pcs	1	Blunt point
9	Safety pins	3 cm	pcs	10	①
10	Alcohol	75%	ml	20	①
11	Wound plaster	2.5 ×2 cm	pcs	20	
12	Antiseptic Burn	20 g	tube	2	②
13	Chlortetracycline eye ointment	2.5 g	tube	2	①
14	Analgesic		tablet	50	Aspirin②
16	Sulfametho-Xazolum	0.5 g	tablet	80	②

Notes: ① Provision may be exempted in liferafts.

② Liferaft to be provided with one-half of this quantity is allowed.

Chapter 4 RADIOCOMMUNICATIONS

1 General provisions

1.1 Application

1.1.1 Radiocommunication equipment is to comply with the technical requirements and performance standards specified in 3 of this Chapter, and is also to be of an approved type.

1.1.2 If the conditions affecting safety are such as to render the full compliance of this Chapter unreasonable or unnecessary, suitable consideration may be granted subject to agreement.

1.2 Terms and definitions

1.2.1 For the purpose of this Chapter:

(1) *Bridge-to-bridge communications* means safety communications between ships from the position from which the ships are normally navigated.

(2) *Continuous watch* means that the radio watch concerned is not to be interrupted other than for brief intervals when the ship's receiving capability is impaired or blocked by its own communications or when the facilities are under periodical maintenance or checks.

(3) *Digital selective calling (DSC)* means a technique using digital codes which enables radio station to establish contact with, and transfer information to, another station or group of stations, and complying with the relevant recommendations of the ITU Radiocommunication Sector (ITU-R).

(4) *Direct-printing telegraphy* means automated telegraphy techniques which comply with the relevant recommendations of the ITU Radiocommunication Sector (ITU-R).

(5) *General radiocommunications* means operational and public correspondence traffic, other than distress, urgency and safety messages, conducted by radio.

(6) *Inmarsat* means the Organization established by the Convention on the International Maritime Satellite Organization adopted on 3 September 1976.

(7) *International NAVTEX service* means the coordinated broadcast and automatic reception on 518 kHz of maritime safety information by means of narrowband direct printing telegraphy using the English language①.

(8) *Locating* means the finding of ships, aircraft, units or persons in distress.

(9) *Maritime safety information* means navigational and meteorological warnings, meteorological forecasts and other urgent safety related messages broadcast to ships.

(l0) *Polar orbiting satellite service* means a service which is based on polar orbiting satellites which receive and relay distress alerts from satellite EPIRBs and which provides their position.

(11) *Radio Regulations* means the Radio Regulations annexed to, or regarded as being annexed to, the most recent International Telecommunication Convention which is in force at any time.

(12) *Sea area A1* means an area within the radiotelephone coverage of at least one VHF coast station in which continuous DSC alerting is available②.

(13) *Sea area A2* means an area, excluding sea area A1, within the radio telephone coverage of at least one MF coast station in which continuous DSC alerting is available.

(14) *Sea area A3* means an area, excluding sea areas A1 and A2, within the coverage of an INMARSAT geostationary satellite in which continuous alerting is available.

1.2.2 All other terms and abbreviations which are used in this Chapter and which are defined in the Radio Regulations are to have the meanings as defined in the Regulations.

1.3 Radio personnel

1.3.1 Every ship is to carry personnel qualified for distress and safety radiocommunication purposes. The personnel are to be holders of certificates specified in the Radio Regulations, any one of whom is to be designated to have primary responsibility for radiocommunications during distress incidents.

1.3.2 In passenger ships, at least one person qualified in accordance with 1.3.1 is to be assigned to perform only radiocommunication duties during distress incidents.

---

① Refer to the NAVTEX Manual approved by IMO (publication IMO 951-E).

② Refer to resolution A.801(19) adopted by IMO concerning provision of radio services for the global maritime distress and safety system(GMDSS).

1.4 Watches

1.4.1 Every ship, while at sea, is to maintain a continuous watch:

(1) on VHF DSC channel 70, if the ship is fitted with a VHF radio installation of DSC function;

(2) on the distress and safety DSC frequency 2187.5 kHz, if the ship is fitted with an MF radio installation;

(3) on the distress and safety DSC frequencies 2187.5 kHz and 8414.5 kHz and also on at least one of the distress and safety DSC frequencies 4207.5 kHz 6312 kHz, 12577 kHz or 16804.5 kHz, appropriate to the time of day and the geographical position of the ship, if the ship is fitted with an MF/HF radio installation. This watch may be kept by means of a scanning receiver;

(4) for satellite shore-to-ship distress alerts, if the ship is fitted with an INMARSAT ship earth station.

1.4.2 Every ship while at sea is to maintain, when practicable, a continuous listening watch on VHF channel 16. This watch is to be kept at the position from which the ship is normally navigated.

1.5 Radio records

1.5.1 A record is to be kept of all incidents connected with the radiocommunication services which appear to be of importance to safety of life at sea. Records are to comply with the requirements of Radio Regulations.

1.6 EPIRB testing

1.6.1 Satellite EPIRB is to be annually tested for all aspects of operational efficiency, with special emphasis on checking the emission on operational frequencies, coding and registration on board the ship or at an approved testing station within 3 months before the expiry date, or 3 months before or after the anniversary date, of the Certificate of Seaworthiness.

1.6.2 Satellite EPIRB is to be subject to maintenance at intervals not exceeding five years, to be performed at an approved shore-based maintenance facility.

1.7 Position-updating

1.7.1 All two-way communication equipment carried on board a ship to which this chapter applies which is capable of automatically including the ship's position in the distress alert is to be automatically provided with this information from an internal or external navigation receiver, if either is installed. If such a receiver is not installed, the ship's position and the time at which the position was determined are to be manually updated at intervals not exceeding 4 h, while the ship is under way, so that it is always ready for transmission by the equipment.

1.8 Distress panels and alarm panels

1.8.1 In passenger ships, a distress panel is to be installed at the conning position. This panel is to contain either one single button which, when pressed, initiates a distress alert using all radiocommunication installations required on board for that purpose or one button for each individual installation. The panel is to clearly and visually indicate whenever any button or buttons have been pressed. Means are to be provided to prevent inadvertent activation of the button or buttons. EPIRB provided onboard the ship is to be installed near the wheelhouse or at a location easily accessible from the wheelhouse.

1.8.2 In passenger ships, information on the ship's position is to be continuously and automatically provided to all relevant radiocommunication equipment to be included in the initial distress alert when the button or buttons on the distress panel is pressed.

1.8.3 In passenger ships, a distress alarm panel is to be installed at the conning position. The distress alarm panel is to provide visual and aural indication of any distress alert or alerts received on board, and is also to indicate through which radiocommunication service the distress alerts have been received.

2 Provision of radiocommunication equipment

2.1 Provision

2.1.1 Unless expressly provided otherwise, power-driven ships are to be provided with radiocommunications in accordance with the requirements given in Table 2.1.1.

Provision of radiocommunication equipment (power-driven ships) Table 2.1.1

No.	Description	A1	A1-A2	A1-A3	
1.	VHF	1	1	1	
2.	NAVTEX	1	1	1	
3.	EPIRB	1	1	1	
4.	MF	—	1	1	—
5.	MF/HF	—	—	—	1
6.	INMARSAT SES	—	—	1	—
7.	Search and rescue locating device①	2②	2②	2②	
8.	Survival craft TWO-WAY VHF	3③	3③	3③	

Notes: ① It may be either a SART or an AIS-SART.
② Every passenger ship and every cargo ship of 500 gross tonnage and upwards are to be provided with at least one search and rescue locating device at each side; every cargo ship of less than 500 gross tonnage is to be provided with at least one search and rescue locating device.
③ Every passenger ship and every cargo ship of 500 gross tonnage and upwards are to be provided with at 3 VHF radiotelephone apparatus; every cargo ship of less than 500 gross tonnage is to be provided with at least 2 VHF radiotelephone apparatus.

2.1.2 VHF, MF and MF/HF in Table 2.1.1 are to have telephone and DSC functions.

2.1.3 Every passenger ship is to be provided with means for two-way on-scene radiocommunications for search and rescue purposes using the aeronautical frequencies 121.5 MHz and 123.1 MHz from the position from which the ship is normally navigated.

2.1.4 Non-power-driven ships are to be provided with radiocommunication equipment as follows:

(1) For manned non-power-driven ships, when there are other ships standby, they are to be provided with VHF apparatus (with only telephone function) as listed in the first item of Table 2.1.1, or with portable VHF apparatus, so as to have effective communication with standby ships; when there are no ships standby, they are to be provided with equipment as listed in the first and third to sixth items of Table 2.1.1 according to their sea areas, so as to have effective communication with the shore.

(2) Manned non-power-driven ships, when provided with survival craft, are also to be provided with survival craft two-way VHF radiotelephone as listed in the eighth item and search and rescue locating device as listed in the seventh item of Table 2.1.1.

3 Basic technical requirements and performance standards

3.1 General requirements

3.1.1 Operation

(1) The number of operational controls, their design and manner of function, location, arrangement and size are to provide for simple, quick and effective operation. The controls are to be arranged in a manner which minimizes the chance of inadvertent operation.

(2) All operational controls are to permit normal adjustments to be easily performed and are to be easy to identify from the position at which the equipment is normally operated. Controls not required for normal operation are not to be readily accessible.

(3) Adequate illumination is to be provided in the equipment or in the ship to enable identification of controls and facilitate reading of indicators at all times. Means are to be provided for dimming the output of any equipment light source which is capable of interfering with navigation.

(4) The design of the equipment is to be such that misuse of the controls is not to cause damage to the equipment or injury to personnel.

(5) If a unit of equipment is connected to one or more other units of equipment, the performance of each is to be maintained.

(6) Where a digital input panel is provided, the digits 0 to 9 are to be arranged to comply with the accepted standards①.

① Where a digital input panel with the digits is provided, it shall be arranged to conform with relevant ITU-R

3.1.2 Power supply

(1) Means are to be incorporated for the protection of equipment from the effects of excessive current and voltage, transients and accidental reversal of the power supply polarity.

(2) If provision is made for operating equipment from more than one source of electrical energy, arrangements for rapidly changing from one source to the other are to be provided but not necessarily incorporated in the equipment.

3.1.3 Durability and resistance to environmental conditions

(1) Equipment is to be capable of continuous operation under the conditions of various sea states, ship's motion, vibration, humidity and temperature likely to be experienced in ships.

(2) The environmental conditions and tests of the radiocommunication equipment are to comply with the relevant provisions.

3.1.4 Anti-interference

(1) All reasonable and practicable steps are to be taken to ensure electromagnetic compatibility between the radiocommunication equipment and other equipment carried on board.

(2) Mechanical noise from all units is to be limited so as not to prejudice the hearing of sounds on which the safety of the ship might depend.

(3) Each unit of equipment normally to be installed in the vicinity of a standard compass or a magnetic steering compass is to be clearly marked with the minim um safe distance at which it may be mounted from such compasses.

3.1.5 Safety precautions

(1) As far as is practicable, accidental access to dangerous voltages is to be prevented. All parts and wiring in which the direct or alternating voltages or both (other than radio frequency voltages) combine to give a peak voltage greater than 55 V are to be protected against accidental access and are to be isolated automatically from all sources of electrical energy when the protective covers are removed. Alternatively, the equipment is to be so constructed that access to such voltages may only be gained after having used a tool for this purpose, such as spanner or screwdriver, and warning labels are to be prominently displayed both within the equipment and on protective covers.

(2) Means are to be provided for earthing exposed metallic parts of the equipment but this is not to cause any terminal of the source of electrical energy to be earthed.

(3) All steps are to be taken to ensure that electromagnetic radio frequency energy radiated from the equipment is not to be a hazard to personnel.

(4) Equipment containing elements such as vacuum tubes which are likely to cause X-radiation is to comply with the following requirements:

① external X-radiation from the equipment in its normal working condition is not to exceed the limits specified in the relevant provisions;

② when X-radiation can be generated inside the equipment above the levels specified in the relevant provisions, a prominent warning is to be fixed inside the equipment and the precautions to be taken when working on the equipment are to be included in the equipment manual;

③ if malfunction of any part of the equipment can cause an increase in X-radiation, adequate advice is to be included in the information about the equipment, warning of the circumstances which could cause the increase and stating the precautions which are to be taken.

3.1.6 Maintenance

(1) The equipment is to be so designed that the main units can be replaced readily, without elaborate recalibration or readjustment.

(2) Equipment is to be so constructed and installed that it is readily accessible for inspection and maintenance purposes.

3.1.7 Marking and identification

Each unit of the equipment is to be marked clearly externally with the identification of the manufacturer; equipment type, serial number of the unit, and the mark under which it was tested.

---

recommendations E161/Q11. However, where an alphanumeric keyboard layout, as used on office machinery and data processing equipment, is provided, the digits 0 to 9 may, alternatively, be arranged to conform with the relevant ISO 3791 standard.

3.2 Performance standards

3.2.1 All equipment to which this Chapter applies is to be of a type approved by CCS. The performance standards of such equipment are not to be inferior to the standards recognized by CCS①.

4 Installation and power supply

4.1 Location

4.1.1 The radiocommunication equipment is to be installed in the navigation bridge or a dedicated radio room located not below boat deck. If they are installed in a dedicated radio room, a direct two-way system for voice communication is to be provided between the navigation bridge and the operation position of radiocommunication equipment.

4.1.2 The radiocommunication equipment is to be so located that no harmful interference of mechanical, electrical or other origin affects its proper use, and so as to ensure electromagnetic compatibility and avoidance of harmful interaction with other equipment and systems.

4.1.3 The radiocommunication equipment is to be so located as to ensure the greatest possible degree of safety and operational availability, and protected against harmful effects of water, extremes of temperature and other adverse environmental conditions.

4.1.4 The radiocommunication equipment is to be provided with reliable, permanently arranged electrical lighting, independent of the main and emergency sources of electrical power, for the adequate illumination of the radio controls for operating the radio installations.

4.1.5 The radiocommunication equipment is to be clearly marked with the call sign, the ship station identity and other codes as applicable for the use of the radio installations.

4.1.6 Control of the VHF radiotelephone channels, required for navigational safety, is to be immediately available on the navigation bridge convenient to the conning position and, where necessary, facilities are to be available to permit radiocommunications from the wings of the navigation bridge. Portable VHF equipment may be used to meet the latter provision.

4.1.7 The search and rescue locating devices are to be stowed on two sides of ships and in such locations that they can be rapidly placed in survival craft.

4.2 Power supply

4.2.1 Distribution board for radiocommunication equipment is to be supplied directly from the main or emergency switchboard by separate feeders. Any current-consuming appliances which have no relation to the radio installations are not to be connected to the electrical system of the radio installations. For ships of less than 300 gross tonnage and ships of less than 500 gross tonnage which navigated in sea area A1 or which are of service category 3, the radiocommunication equipment may be supplied from other distribution board located in the navigation bridge, the distribution board is to be supplied from the main or emergency switchboard.

---

① Refer to the following resolutions adopted by IMO:

(1) Resolution MSC.68(68), annex 1 Performance standards for shipborne VHF radio installations capable of voice communication and digital selective calling, as amended.

(2) Resolution MSC.148(77) Adoption of the revised performance standards for narrow-band direct-printing telegraph equipment for the reception of navigational and meteorological warnings and urgent information to ships (NAVTEX).

(3) Resolution MSC.120(74) Adoption of amendments to performance standards for float-free satellite emergency position-indicating radio beacons (EPIRBs) operating on 406 MHz.

(4) Resolution MSC.68(68), annex 2 Performance standards for shipborne MF radio installations capable of voice communication and digital selective calling, as amended.

(5) Resolution MSC.68(68), annex 3 Performance standards for shipborne MF/HF radio installations capable of voice communication, narrow-band direct-printing and digital selective calling, as amended.

(6) Resolution MSC.68(68), annex 4 Performance standards for Inmarsat-C ship earth stations capable of transmitting and receiving direct-printing communications, as amended.

(7) Resolution A.802(19) Performance standards for survival craft radar transponders for use in search and rescue operations, as amended by resolution MSC.247(83).

(8) Resolution MSC 246(83) Performance standards for survival craft AIS search and rescue transmitters (AIS-SART) for use in search and rescue operations.

(9) Resolution MSC.80(70), annex 1 Performance standards for on-scene (aeronautical) two-way portable VHF radiotelephone apparatus.

4.2.2 A reserve source or sources of energy are to be provided on every ship, to supply radio installations, for the purpose of conducting distress and safety radiocommunications, in the event of failure of the ship's main and emergency sources of electrical power. The reserve source or sources of energy need not supply independent HF and MF radio installations at the same time. For ships of less than 300 gross tonnage and ships of less than 500 gross tonnage which navigated in sea area A1 or which are of service category 3, reserve source dedicated to radiocommunication equipment may not be provided and they are to be powered from emergency electrical source or other reserve electrical source onboard.

4.2.3 The supply period of reserve sources is to be at least 1 h.

4.2.4 While at sea, sufficient power supply is to be available from the ship's power plant for the operation of all radiocommunication equipment and simultaneous charging of the accumulator batteries of reserve sources.

4.2.5 Where a reserve source of energy consists of a rechargeable accumulator battery or batteries, a means of automatically charging such batteries is to be provided which is to be capable of recharging them to minimum capacity requirements within 10 h. The charging facilities are to be provided with measuring instruments for checking the voltage of the power supply network and the accumulator batteries and also for checking the charging current. The charging facilities are to also be provided with reverse current protection so as to prevent the current from being discharged to the ship's electrical network.

4.2.6 The siting and installation of accumulator batteries which provide a reserve source of energy are to be such as to ensure the highest degree of service and that when fully charged, the batteries will provide at least the minimum required hours of operation under all weather conditions.

4.2.7 If an uninterrupted input of information from the ship's navigational or other equipment to a radio installation required by this Chapter is needed to ensure its proper performance, means are to be provided to ensure the continuous supply of such information in the event of failure of the ship's main or emergency source of electrical power.

4.2.8 The batteries of reserve sources are to be located above the uppermost continuous deck and are to be readily accessible from the open deck. It is allowed to locate the accumulator batteries on the exposed deck which is on or above the uppermost continuous deck, provided that they are installed in watertight boxes and placed at a height of not less than 50 mm above the deck.

Chapter 5 NAVIGATIONAL EQUIPMENT

1 General provisions

1.1 General requirements

1.1.1 The navigational equipment installed onboard is to comply with the provisions of this Chapter.

1.1.2 Unless expressly provided otherwise, the navigational equipment onboard cargo ships less than 300 gross tonnage is to be provided according to the practical requirements subject to the agreement.

1.1.3 In addition to the surveys specified in PART ONE, when all reasonable steps are to be taken to maintain the navigational equipment involved in this Chapter in effective working condition, malfunction of such equipment is not to be considered as making a ship unseaworthy or as a reason for delaying the ship in ports where repair facilities are not readily available.

1.1.4 For the pushing vessel and barge combination, the range of navigation bridge visibility for pushing vessel is at least to comply with the provision in 2.2.1(1) of this Chapter. The combination is to be regarded as a single ship for the purpose of this Chapter and the length of ship is to be taken as that of the combination *Lc*.

1.2 General requirements of navigational equipment

1.2.1 If the navigational equipment has secondary means, in addition to meet the requirements of this Chapter and the corresponding criteria, such means are to be operated as far as reasonably practicable and the its failure could not effect the performances of main equipment.

1.2.2 The number, design and operation mode, position, arrangement and size of controls are to meet the simple, rapid and effective operation requirements. The controls are to be so arranged to reduce the inadvertent operation to the minimum.

1.2.3 All of the controls are to be facilitate for normal adjustment and readily identified in normal operation positions. Controls which are not often operated are not to be placed in accessible positions.

1.2.4 Adequate lighting is to be provided (self-igniting equipment or lighting onboard ship) so as to identify the controls at any time and readily take the readings on the indicators. Means are to be taken to attenuate the output from any light sources.

1.2.5 Where digital input keyboard is provided, the digits from 0 to 9 are to be so arranged to be in compliance with the standard accepted by CCS①. However, where the character input keyboard used for office machinery and data processing is provided, the digits from 0 to 9 are to be so arranged to be in compliance with the relevant standard of ISO.

1.2.6 In the case of various sea conditions, ship's movement, vibration, humidity, temperature and power supply flutter which ships normally occur, the navigational equipment is to run continuously. Relevant tests are to be carried out for the equipment.

1.2.7 Navigational equipment is to be provided with protection arrangement to prevent excess current, overvoltage, power supply transient and accidental reverse polarity effect.

1.2.8 The navigational equipment can only be supplied by main electrical source, except those onboard ships of 5000 gross tonnage and above supplied by both main and emergency electric sources.

1.2.9 Where more than one electric sources are used for navigational equipment, change-over switch is to be provided to rapidly convert from one electric source to another. However, such switch is unnecessary to be provided in equipment.

1.2.10 Means are to be so taken that the exposed metal components of equipment is earthed, but any terminations of electric source are not to be earthed.

1.2.11 All steps are to be taken to ensure the electromagnetic energy of radiation for equipment will be harmless to personnel.

1.2.12 The equipment with the elements which could cause the X-ray radiation is to meet the following requirements:

(1) In a normal working condition, the X-ray external radiation of equipment is not to exceed the limitation specified in its performance standards.

---

① Where the digital input keyboard (0 to 9) is provided, the digits are to be arranged to meet the ITU-R Recommendation.

(2) When the X-ray radiation caused in the interior of equipment exceeds the values specified by performance standards of equipment, conspicuous warning signs are to be placed in the interior or equipment, and the protection measures to be taken when the equipment is used are to be indicated in the equipment manual.
(3) Where any part of the equipment is failed which possibly increases X-ray radiation, suitable description is to be provided in the equipment information. Warning is to be given to the potential added radiation and protection measures are to be indicated.
1.2.13 Various reasonable and practicable measures are to be taken so as to ensure electromagnetic compatibility between navigational equipment and other equipment installed onboard ship.
1.2.14 Mechanical noises caused by various components of navigational equipment are to be so restricted not to hinder the audition related to ship's safety. The noise level caused by navigational equipment and its components installed in navigation bridge, chartroom and other noise sensitive areas are not to exceed 65 dB(A).
1.2.15 The equipment and its components adjacent to standard magnetic compass or steering magnetic compass are to be installed according to the provisions, and the minimum safe distance between such equipment and magnetic compasses is to be clearly indicated.
1.2.16 The enclosure protection type of navigational equipment is to be suitable for its installation position.
1.2.17 The cables and networks connecting to navigational equipment are to be so laid to be in compliance with the provisions of Chapter 2-1 in this PART and the relevant requirements in CCS Rules.
1.2.18 The equipment is to be so designed to be easily to replace the main installations without careful and complicated calibration or adjustment.
1.2.19 The equipment is to be so manufactured and installed to be facilitate for examination and maintenance.
1.2.20 The navigational equipment is to be provided with nameplates which are marked with manufacturers, types and serial numbers, manufacturer dates and the sign of survey unit.

2 Requirements of provision

2.1 Provision of navigational equipment

2.1.1 The passenger ships and cargo ships are to be provided according to the provisions in Table 2.1.1 of this Chapter. The navigation areas are to be categorized according to the provisions of GENERAL of the Guidelines.

Provision of navigational equipment onboard passenger ships and cargo ships Table 2.1.1

Minimum provision / Service area / Name of equipment	Unrestricted service	service category 1	service category 2	service category 3	Requirements of provision
Standard magnetic compass	l	1	l	1	Required for ships of 300 gross tonnage and above, only steering compass is required for ships less than 300 gross tonnage
Steering magnetic compass	1	1	1	1	Not required for ships provided with reflecting magnetic compass
Standby standard magnetic compass	1	1	1		Required for ships of 300 gross tonnage and above, not required for ships provided with steering magnetic compass or gyroscopic compass
Apparatus to detect direction within the range of 360 °in plane	1	1	1	1	Required for all ships
Gyroscopic compass	l	1			Required for ships of 500 gross tonnage and above
Azimuth compass of gyroscopic compass	2	2			
Vector compass of gyroscopic compass	Provided as needed				At least required to provide at main steering position (it may be exempted if readings of main compass can be clearly taken from this position) and emergency steering position
Rudder indicator	1	l	1	1	Required for ships of 500 gross tonnage and above

Propeller shaft revolution indicator	1	1	1	l	
Radar	1	1	1		(1) Required for all passenger ships and cargo ships of 300 gross tonnage and above; (2) Radar installation is capable of running at the frequency band of 9 GHz; (3) Provided with electronic plotting aid, and automatic tracking aid is provided for ships of 500 gross tonnage and above
	2	2			(1) Required for ships of 10000 gross tonnage and above; (2) At least one radar installation is to be capable of running at the frequency band of 9 GHz; (3) One automatic radar plotting aid is provided; (4) One automatic tracking aid is provided
Electronic positioning equipment	1	1	1		Required for ships of 150 gross tonnage and above
Echo-sounding device	1	1	1	l	Required for ships of 500 gross tonnage and above
Automatic identification system (AIS)	1	1	1	1	Required for all passenger ships and cargo ships of 500 gross tonnage and above

2.1.2 The navigational equipment required to provide by this Chapter may be allowed to replace by other equivalent means subject to special consideration.

2.1.3 Ships engaged on short voyages not exceeding 2 h may be provided according to service category 3. In addition, ships engaged on navigating in certain special routes, requirements of provision may be properly reduced subject to the agreement.

2.2 Visibility of navigation bridge

2.2.1 For ships of 55 m in length and above, the visibility of navigation bridge is to meet the following requirements:

(1) The view of the sea surface from the conning position is not to be obscured by more than two ship lengths, or 500 m, whichever is less, forward of the bow to 10° on either side under all conditions of draught, trim and deck cargo.

(2) No blind sector, caused by cargo, cargo gear or other obstructions outside of the wheelhouse forward of the beam which obstructs the view of the sea surface as seen from the conning position, is to exceed 10°. The total arc of blind sectors is not to exceed 20°. The clear sectors between blind sectors are to be at least 5°. However, in the view described in .1, each individual blind sector is not to exceed 5°.

(3) The horizontal field of vision from the conning position is to extend over an arc of not less than 225°, that is from right ahead to not less than 22.5° abaft the beam on either side of the ship.

(4) From each bridge wing, the horizontal field of vision is to extend over an arc of at least 225°, that is from at least 45° on the opposite bow through right ahead and then from right ahead to right astern through 180° on the same side of the ship.

(5) From the main steering position, the horizontal field of vision is to extend over an arc from right ahead to at least 60° on each side of the ship.

(6) The ship's side is to be visible from the bridge wing.

(7) The height of the lower edge of the navigation bridge front windows above the bridge deck is to be kept as low as possible. In no case is the lower edge present an obstruction to the forward view as described in this regulation.

(8) The upper edge of the navigation bridge front windows is to allow a forward view of the horizon, for a person with a height of eye of 1,800 mm above the bridge deck at the conning position, when the ship is pitching in heavy seas. In a special case, it may allow reduction of the height of eye but not to less than 1,600 mm.

(9) Windows are to meet the following requirements:

① to help avoid reflections, the bridge front windows are to be inclined from the vertical plane top out, at an angle of not less than 10° and not more than 25°;

② framing between navigation bridge windows are to be kept to a minimum and not be installed immediately forward of any work station;

③ polarized and tinted windows are not to be fitted;

④ a clear view through at least two of the navigation bridge front windows and, depending on the bridge configuration, an additional number of clear-view windows is to be provided at all times, regardless of weather conditions.

(10) On ships of unconventional design, subject to the agreement, are to be provided to achieve a level of visibility that is as near as practical to that prescribed in this regulation.

2.3 Pilot transfer arrangements

2.3.1 Ships of 500 gross tonnage and above are likely to be employed are to be provided with pilot transfer arrangements. For the performance standards, refer to IMO resolution A.1045(27).

2.3.2 Mechanical pilot hoists are not to be used for all ships.

2.3.3 Shipside doors used for pilot transfer are not to open outwards.

2.3.4 Arrangement is to be provided to enable the pilot to embark and disembark safely on either side of the ship.

2.3.5 In all ships where the distance from sea level to the point of access to, or egress from, the ship exceeds 9 m, and when it is intended to embark and disembark pilots by means of the accommodation ladder, or other equally safe and convenient means in conjunction with a pilot ladder, the ship is to carry such equipment on each side, unless the equipment is capable of being transferred for use on either side.

2.3.6 Safe and convenient access to, and egress from, the ship is to be provided by either:

(1) a pilot ladder requiring a climb of not less than 1.5 m and not more than 9 m above the surface of the water, so positioned and secured that:

① it is clear of any possible discharges from the ship;

② it is within the parallel body length of the ship and, as far as is practicable, within the mid-ship half length of the ship;

③ each step rests firmly against the ship's side; where constructional features, such as rubbing bands, would prevent the implementation of this provision, special arrangements are, to the satisfaction of the Administration, to be made to ensure that persons are able to embark and disembark safely;

④ the single length of pilot ladder is capable of reaching the water from the point of access to, or egress from, the ship and due allowance is made for all conditions of loading and trim of the ship, and for an adverse list of 15°; the securing strong point, shackles and securing ropes are to be at least as strong as the side ropes; or

(2) an accommodation ladder in conjunction with the pilot ladder (i.e. combination arrangement), or other equally safe and convenient means, whenever the distance from the surface of the water to the point of access to the ship is more than 9 m. The accommodation ladder is to be sited leading aft. When in use, means are to be provide to secure the lower platform of accommodation ladder to the ship' side, so as to ensure that the lower end of the accommodation ladder and the lower platform are held firmly against the ship's side within the parallel body length of the ship and, as far as is practicable, within the mid-ship half length and clear of all discharges; or

① when a combination arrangement is used for pilot access, means are to be provided to secure the pilot ladder and manropes to the ship's side at a point of nominally 1.5 m above the bottom platform of the accommodation ladder. In the case of a combination arrangement using an accommodation ladder with a trapdoor in the bottom platform (i.e. embarkation platform), the pilot ladder and man ropes are to be rigged through the trapdoor extending above the platform to the height of the handrail.

2.3.7 Means are to be provided to ensure safe, convenient and unobstructed passage for any person embarking on, or disembarking from, the ship between the head of the pilot ladder, or of any accommodation ladder or other appliance, and the ship's deck. Where such passage is by means of:

(1) a gateway in the rails or bulwark, adequate handholds are to be provided;

(2) a bulwark ladder, two handhold stanchions rigidly secured to the ship's structure at or near their bases and at higher points are to be fitted. The bulwark ladder is to be securely attached to the ship to prevent overturning.

2.3.8 The following associated equipment is to be kept at hand ready for immediate use when persons are being transferred:

(1) two man-ropes of not less than 28 mm and not more than 32 mm in diameter properly secured to the ship if required by the pilot; man-ropes are to be fixed at the rope end to the ring plate fixed on deck and are to be ready for use when the pilot disembarks, or upon request from a pilot approaching to board (the manropes is to reach the height of the stanchions or bulwarks at the point of access to the deck before terminating at the ring plate on deck);

(2) a lifebuoy equipped with a self-igniting light;
(3) a heaving line.
When required by 2.3.7 above, stanchions and bulwark ladders are to be provided.
2.3.9 Adequate lighting is to be provided to illuminate the transfer arrangements overside and the position on deck where a person embarks or disembarks.

2.4 Provision of nautical publications

2.4.1 All ships are to be provided adequate and latest nautical charts, sailing directions, lists of lights, notices to mariners, tide tables and all other nautical publications necessary for the intended voyages.

3 Performance standards

3.1.1 All navigational equipment installed according to the provisions in this Chapter is to be of the CCS approved type. The performance standards of such equipment are not to be lower than the standards accepted by CCS①.

① Refer to the following resolutions adopted by IMO:
(1) Recommendation on performance standards for magnetic compass (resolution A.382(X));
(2) Recommendation on performance standards for gyro-compass (resolution A.424(XI));
(3) Revised recommendation on performance standards for radar equipment (resolution MSC.192(79));
(4) Recommendation on performance standards for shipborne global positioning system receiver equipment (resolution A.819(19), as amended by resolution MSC.112(73));
(5) Recommendation on performance standards for echo-sounding equipment (resolution A.224(VII), as amended by resolution MSC.74(69), annex 4);
(6) Recommendation on performance standards for automatic tracking aid (resolution MSC.64(67) annex 4, appendix 1);
(7) Performance standards for automatic radar plotting aids (ARPAs) (resolution A.823(19));
(8) Recommendation standards for a universal shipborne automatic identification system (AIS) (resolution MSC.74(69), annex 3).

Chapter 6 CARRIAGE OF CARGOES

1 General provisions

1.1 Application

1.1.1 This chapter applies to the carriage of cargoes (except liquids in bulk, gases in bulk and those aspects of carriage covered by other chapters) which, owing to their particular hazards to ships or persons on board, may require special precautions. However, for cargo ships of less than 500 gross tonnage, subject to the agreement, if it considers that the sheltered nature and conditions of voyage are such as to render the application of any specific requirements of 1 and 2 of this chapter unreasonable or unnecessary, may take other effective measures to ensure the required safety for these ships.

1.1.2 To supplement the provisions of 1 and 2 of this Chapter, appropriate information on cargo and its stowage and securing is to be provided, specifying, in particular, precautions necessary for the safe carriage of such cargoes.

1.1.3 The carriage of dangerous cargoes is to be in accordance with the provisions of 4 of this Chapter.

1.2 Cargo information

1.2.1 The shipper is to provide the master or his representative with appropriate information on the cargo sufficiently in advance of loading to enable the precautions which may be necessary for proper stowage and safe carriage of the cargo to be put into effect. Such information is to be confirmed in writing and by appropriate shipping documents prior to loading the cargo on the ship.

1.2.2 The cargo information is to include:

(1) in the case of general cargo, and of cargo carried in cargo units, a general description of the cargo, the gross mass of the cargo or of the cargo units, and any relevant special properties of the cargo;

(2) in the case of bulk cargo, information on the stowage factor of the cargo, the trimming procedures. In the case of a concentrate or other cargo which may liquefy, additional information in the form of a certificate on the moisture content of the cargo and its transportable moisture limit;

(3) in the case of a bulk cargo not classified in accordance with the provisions of the dangerous cargoes, but which has chemical properties that may create a potential hazard, in addition to the information required by the preceding subparagraphs, information on its chemical properties.

1.2.3 Prior to loading cargo units on board ships, the shipper is to ensure that the gross mass of such units is in accordance with the gross mass declared on the shipping documents.

1.3 Oxygen analysis and gas detection equipment

1.3.1 When transporting a bulk cargo which is liable to emit a toxic or flammable gas, or cause oxygen depletion in the cargo space, an appropriate instrument for measuring the concentration of gas or oxygen in the air is to be provided together with detailed instructions for its use. Such an instrument is to be subjected to approval.

1.3.2 Measures are to be taken to ensure that crews of ships are trained in the use of such instruments.

1.4 The use of pesticides in ships

1.4.1 Appropriate precautions are to be taken in the use of pesticides in ships, in particular for the purposes of fumigation.

1.5 Stowage and securing

1.5.1 Cargo and cargo units carried on or under deck are to be so loaded, stowed and secured as to prevent as far as is practicable, throughout the voyage, damage or hazard to the ship and the persons on board, and loss of cargo overboard.

1.5.2 Cargo units are to be so packed and secured within the loading vessel as to prevent, throughout the voyage, damage or hazard to the ship and the persons on board.

1.5.3 Appropriate precautions are to be taken during loading and transport of heavy cargoes or cargoes with abnormal physical dimensions to ensure that no structural damage to the ship occurs

and to maintain adequate stability throughout the voyage.
1.5.4 Appropriate precautions are to be taken during loading and transport of cargo units onboard ro-ro ships, the securing arrangements onboard such ships and on the loading vessels and the strength of the securing points and lashings are to meet the relevant requirements of Chapter 5, PART EIGHT of the Guidelines.
1.5.5 Freight containers are not to be loaded to more than the maximum gross weight indicated on the Safety Approval Plate.
1.5.6 All cargoes, other than solid and liquid bulk cargoes, cargo units and cargo transport units, are to be loaded, stowed and secured throughout the voyage in accordance with the Cargo Securing Manual. The Cargo Securing Manual is to be drawn up to a standard at least equivalent to CCS Guidelines for Preparation of Cargo Securing Manual.

2 Special provisions for bulk cargoes other than grain

2.1 Acceptability for shipment
2.1.1 Prior to loading a solid bulk cargo, the master is to be in possession of comprehensive information on the ship's stability and on the distribution of cargo for the standard loading conditions.
2.1.2 Concentrates or other cargoes which may liquefy are only to be accepted for loading when the actual moisture content of the cargo is less than its transportable moisture limit. However, such concentrates and other cargoes may be accepted for loading even when their moisture content exceeds the above limit, provided that the approved safety arrangements are made to ensure adequate stability in the case of cargo shifting and further provided that the ship has adequate structural integrity.
2.1.3 Prior to loading a bulk cargo which is not a cargo classified in accordance with the provisions of the dangerous cargoes, but which has chemical properties that may create a potential hazard, special precautions for its safe carriage are to be taken.

2.2 Stowage of bulk cargoes
2.2.1 Bulk cargoes are usually to be loaded and trimmed reasonably level, as necessary, to the boundaries of the cargo space so as to minimize the risk of shifting and to ensure that adequate stability will be maintained throughout the voyage.
2.2.2 When bulk cargoes are carried in 'tween-decks, the hatchways of such 'tween-decks are to be closed in those cases where the loading information indicates an unacceptable level of stress of the bottom structure if the hatchways are left open. The cargo is to be trimmed reasonably level and is either to extend from side to side or be secured by additional longitudinal divisions of sufficient strength. The safe load-carrying capacity of the 'tween-decks is to be observed to ensure that the deck-structure is not overloaded.

3 Carriage of grain

3.1 Application
3.1.1 Section 3 of this Chapter only applies to the sea-going ships carrying with grain and engaged on domestic voyages, including dedicated ships, multi-purposed ships and general bulk carriers.
3.1.2 Ships having several partly filled compartments after partial unlading are to be in compliance with the following conditions:
(1) ships are to have adequate longitudinal strength and avoid excess stress of hull after unloading;
(2) masters are to know the weather conditions possibly occur during the voyages, measures are to be taken on time or the navigation is to be suspended if the bad weather comes;
(3) partly filled compartments are to be reduced as far as possible so as to minimize the heeling moment;
(4) partly filled compartments are to be trimmed and maintain the ship is in the upright position.

3.2 Definitions
3.2.1 For the purpose of Section 3 of this Chapter:

(1) *Grain* means wheat, maize (corn), oats, rye, barley, rice, pulses, seeds and processed forms thereof whose behaviour is similar to that of grain in its natural state.
(2) *Filled compartment, trimmed* means any cargo space in which, after loading and trimming as required by 3.6.2 of this Chapter, the bulk grain is at its highest possible level.
(3) *Filled compartment, untrimmed* means a cargo space which is filled to the maximum extent possible in way of the hatch opening but which has not been trimmed outside the periphery of the hatch opening.
(4) *Partly filled compartment* means any cargo space wherein the bulk grain is not loaded in the manner prescribed in 3.2.1(2) or 3.2.1(3).
(5) *Common filled compartment* means a cargo space of lower compartment and its upper 'tween-deck with the hatch covers of lower cargo compartments not closed when grain is carried in bulk by a multi-purposed ship or general bulk carrier.
(6) *Specially suitable compartment* means a cargo space which is constructed with at least two vertical or sloping, longitudinal, grain-tight divisions which are coincident with the hatch side girders or are so positioned as to limit the effect of any transverse shift of grain. If sloping, the divisions are to have an inclination of not less than 30 °to the horizontal.
(7) *Heeling moment due to grain shift* means the heeling moment caused by grain shift loaded within the cargo compartments.
(8) *Permissible heeling moment* means the maximum heeling moment due to grain shift which the ship is capable of withstanding, in compliance with the stability requirements of 3.5.2 of this Chapter, according to the ship's characteristics.
(9) *Angle of flooding* (θ_f) means the angle of heel at which openings in the hull, superstructures or deckhouses, which cannot be closed weathertight, immerse. In applying this definition, small openings through which progressive flooding cannot take place need not be considered as open
(10) *Stowage factor* means the volume per unit weight of the cargo.

3.3 Approved documents

3.3.1 Every ship loaded in accordance to the Section 3 of this Chapter is to be issued with an approved document which could prove that the ship is in compliance with the requirements of Section 3 of this Chapter.
3.3.2 A copy of stability calculations for the ship carrying grain in bulk and an approved document of grain carriage are to be placed onboard in order that the master, if so required, is to produce them for the inspection of the Authority of the state of the port of loading.
3.3.3 A ship without such an approved document of grain carriage could not load grain until the master satisfies the Authority of the port of loading that the ship will comply with the requirements of the Section 3 of this Chapter in its proposed loaded condition.

3.4 Stability information of ship loaded grain in bulk

3.4.1 Stability information of ship loaded grain in bulk is to be provided to enable the master to ensure that the ship complies with the Section 3 of this Chapter when carrying grain in bulk on a voyage. This information is to include the following:
(1) The approved information is to include:

① curves or forms of volume, vertical center of volume, center of gravity and assumed volumetric heeling moments for each filled compartment or partly filled compartment or common filled compartment;
② maximum permissible heeling moment or other information provided to master to demonstrate compliance with the requirements of 3.5 of this Chapter;
③ typical loaded service departure and arrival conditions and where necessary intermediate worst service conditions[①].
④ a worked example for the guidance of the master;
⑤ loading instructions in the form of notes summarizing the requirements of Section 3 of this Chapter.

(2) Ship's particulars submitted for information are to include:

① It is recommended that loading conditions be provided for four representative stowage factors, e.g. 1.17, 1.25, 1.50, and 1.75 cubic metres per tonne.

① ship's main scantlings and characteristic parameters;
② lightship displacement and the vertical distance from the intersection of the moulded base line and midship section to the center of gravity (KG);
③ table of liquid free surface corrections;
④ capacities and centroid position
⑤ curves or tables of angle of flooding suitable for the range of operating drafts (or displacement);
⑥ curves or tables of hydrostatic properties suitable for the range of operating draft;
⑦ cross curves of stability which include curves at 12 °and 40 °.

3.5 Stability requirements

3.5.1 Ships carrying grain in bulk are to meet the intact requirements for dry cargo ships specified in Chapter 7 of this PART.

3.5.2 The intact stability characteristics of any ship carrying bulk grain are to be shown to meet, throughout the voyage, at least the following criteria after taking into account in the manner described in 3.7 of this Chapter the heeling moments due to grain shift (see Figure 3.5.2):

(1) the angle of heel due to the shift of grain is not to be greater than 12 ° or in the case of ships constructed on or after 1 January 1994 the angle at which the deck edge is immersed, whichever is the lesser;

(2) in the righting arm curve diagram, the residual area *A* between the heeling arm curve and the righting arm curve up to the angle of heel of maximum difference between the ordinates of the two curves, or 40 ° or the angle of flooding (θ_f), whichever is the least, is to be in all conditions of loading be not less than 0.075 metre-radians; and

(3) the initial metacentric height, after correction for the free surface effects of liquids in tanks, is not to be less than 0.30 m.

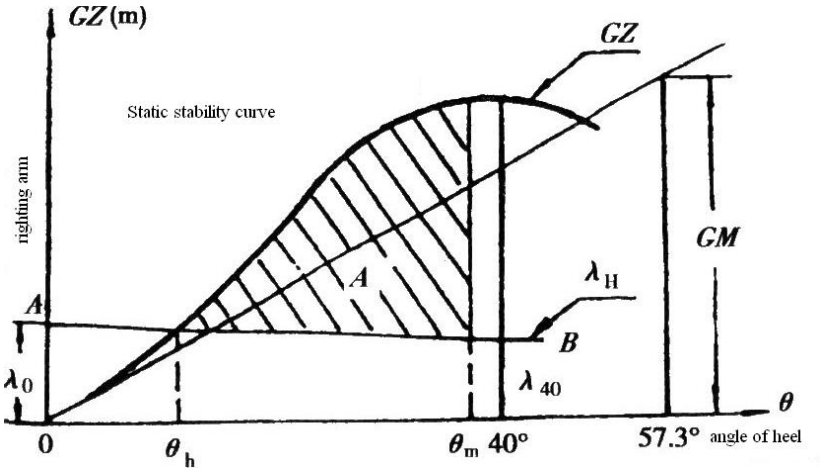


Figure 3.5.2 Intact Stability Characteristics of a Ship Carrying with Grain in Bulk

① where: GZ— righting arm curve;

λ_H — assumed heeling moment curve due to grain shift (may be approximatively substituted by straight line);

GM— initial metacentric height, in m;

θ_h — angle of heel due to grain shift, in degree;

θ_m — corresponding angle of heel in way of the maximum difference between the curves of GZ and λ_H, in degree;

A — residual area between GZ curve and λ_H curve up to the angle of θ_m, or 40 °or the angle of flooding (θ_f), whichever is the least;

λ_0 — assumed heeling arm due to grain shift in way of the angle of 0 °, in m;

$$\lambda_0 = \frac{M_H}{SF \cdot \Delta}$$

where: M_H —assumed volumetric heeling moment due to grain shift, in m^4;

SF — stowage factor of grain, in m^3/t;

Δ — displacement of calculated loading condition, in t;

$$\lambda_{40} = 0.8\lambda_o$$

λ_{40}— assumed heeling moment due to grain shift when the angle of heeling is 40 °, in m;

② The righting arm curve is to be derived from cross-curves which are sufficient in number to accurately define the curve for the purpose of these requirements and is to include cross-curves at 12 °and 40 °.

3.5.3 Before loading bulk grain the master is to demonstrate that the ship at all stages of any voyage to comply with the stability criteria required by Section 3 of this Chapter.

3.5.4 After loading, the master is to ensure that the ship is upright before proceeding to sea.

3.6 Stowage of bulk grain

3.6.1 All necessary and reasonable trimming is to be performed to level all free grain surfaces and to minimize the effect of grain shifting.

3.6.2 In any filled compartment, trimmed, the bulk grain is to be trimmed so as to fill all spaces under the decks and hatch covers to the maximum extent possible.

3.6.3 In any filled compartment, untrimmed, the bulk grain is to be filled to the maximum extent possible in way of the hatch opening but may be at its natural angle of repose outside the periphery of the hatch opening. A filled compartment may qualify for this classification if it falls into one of the following categories:

(1) dispensation from trimming in those cases may be granted where the underdeck void geometry resulting from free flowing grain into a compartment, which may be provided with feeder ducts, perforated decks or other similar means, is taken into account when calculating the void depths; or

(2) the compartment is "specially suitable" as defined in 3.2(6) of this Chapter, in which case dispensation may be granted from trimming the ends of that compartment.

3.6.4 If there is no bulk grain or other cargo above a lower cargo space containing grain, the hatch covers are to be secured in an approved manner having regard to the mass and permanent arrangements provided for securing such covers.

3.6.5 When bulk grain is stowed on top of closed 'tween-deck hatch covers which are not grain-tight, such covers are to be made grain-tight by taping the joints, covering the entire hatchway with tarpaulins or separation cloths, or other suitable means.

3.6.6 After loading, all free grain surfaces in partly filled compartments are to be level.

3.6.7 Lower cargo spaces and 'tween-deck spaces in way thereof may be loaded as one compartment provided that, in calculating transverse heeling moments, proper account is taken of the flow of grain into the lower spaces.

3.6.8 In filled compartments, trimmed, filled compartments untrimmed, and partly filled compartments, longitudinal divisions may be installed as a device to reduce the adverse heeling effect of grain shift provided that:

(1) the division is grain-tight, with the structure subjected to agreement;

(2) in 'tween-decks the division extends from deck to deck;

(3) in filled compartments, trimmed, the division is to extend from deck or hatch cover to 0.6 m below the lowest point of main deck girder from;

(4) in a partly filled compartment, a longitudinal division, if fitted, is to extend from one eighth of the maximum breadth of the compartment above the level of the grain surface and to the same distance below the grain surface.

3.7 Assumed volumetric heeling moment and permissible heeling moment

3.7.1 In both filled compartments and partly filled compartments, the surface of grain after shifting is to be assumed 12 °to the horizontal.

3.7.2 Calculation of assumed volumetric heeling moment:

(1) For ships having assumed volumetric heeling moments calculated according to the

International Code for the Safe Carriage of Grain in Bulk in Part B of the Annex of IMO resolution MSC.23(59), the assumed volumetric heeling moment for the ship engaged on domestic voyages could be calculated by the multiply of heeling volumetric moment obtained from the above-mentioned information with the following factors:

① 0.46, for filled compartments, untrimmed and partly filled compartment;

② 0.8, for filled compartments, trimmed.

(2) For the ships in absence of the information required in 3.7.2(1) of this Chapter:

① The assumed volumetric heeling moment M_h for partly filled compartments may be calculated according to the following equation:

$$M_h = 0.0177lb^3 \quad \text{m}^4$$

where: l — length of partly filled compartment, in m;

b — maximum breadth of grain surface in partly filled compartments, in m.

② Where the filled compartment needs to be trimmed according to the requirement of 3.6.2 of this Chapter, its volumetric heeling moment may be negligible.

3.7.3 Permissible heeling moment

(1) For ships having tables or curves of maximum permissible heeling moments specified in A.6.3.2 of International Code for the Safe Carriage of Grain in Bulk in Annex of IMO resolution MSC.23(59), the permissible heeling moment in such curve or table could be used;

(2) For the ships in absence of the information required in 3.7.3(1) of this Chapter, the permissible heeling moment M_a could be calculated by the following equation:

$$M_a = 0.228GM \cdot \Delta \quad \text{t·m}$$

where: GM — initial metacentric height under the calculated loading condition, in m;

Δ — displacement under the calculated loading condition, in t.

3.7.4 For ships having the information required by 3.7.2(1) of this Chapter, the center of gravity and mass for filled compartment are to be taken from such information. However, for ships in absence of such information, the center of gravity of cargo in filled compartment is to be the center of volume of whole cargo compartment, and the mass of cargo in filled compartment is to be the total volume of cargo compartment multiplying with stowage factor.

4 Carriage of dangerous goods

4.1 General provisions

4.1.1 This Section applies to the carriage of dangerous goods in packaged form and dangerous goods in solid form in bulk on board all ships, including non-powered ships and cargo ships less than 20 m in length, but not applies to ship's stores and equipment.

4.1.2 The carriage of any dangerous goods in packaged form or dangerous goods in solid form in bulk which are not in compliance with the provisions of this Section are to be prohibited.

4.1.3 The carriage of dangerous goods in liquid form in bulk is to be in compliance with the CCS relevant provisions.

4.1.4 The electrical installations on board the ships carrying dangerous goods are to be in compliance with the relevant requirements in Section 18, Chapter 2, PART FOUR of CCS Rules for Classification of Sea-going Steel Ships.

4.2 Definitions

4.2.1 *Dangerous goods* mean the substances, materials and articles covered by the IMDG Code.

4.2.2 *Packaged form* means the form of containment specified in the IMDG Code.

4.2.3 *Dangerous goods in solid form in bulk* means any material, other than liquid or gas, consisting of a combination of particles, granules or any larger pieces of material, generally uniform in composition, and is loaded directly into the cargo spaces of a ship without any intermediate form of containment, and includes such materials loaded in a barge on a barge-carrying ship.

4.2.4 *INF Code* means the International Code for the Safe Carriage of Packaged Irradiated Nuclear Fuel, Plutonium and High-Level Radioactive Wastes on Board Ships specified in Chapter VII of SOLAS.

4.3 Requirements for the carriage of dangerous goods

4.3.1 The carriage of dangerous goods in packaged form is to be in compliance with the relevant provisions of the IMDG Code.

4.3.2 Each ship carrying dangerous goods or dangerous goods in solid form in packaged form is to hold a document of compliance for special requirements of ships carrying dangerous goods, having a special list or manifest setting forth, in accordance with the classification set out in the IMDG Code, the dangerous goods onboard and the location thereof. A detailed stowage plan, which identifies by class and sets out the location of all dangerous goods onboard, may be used in place of such a special list or manifest. A copy of one of these documents is to be made available before departure to the person or organization designated by the port State authority.

4.3.3 Cargo, cargo units and cargo transport units are to be loaded, stowed and secured throughout the voyage in accordance witch the Cargo Securing Manual. The Cargo Securing Manual is to be drawn up to a standard at least equivalent to the CCS Guidelines for Preparation of Cargo Securing Manual.

4.3.4 A ship carrying INF cargo is to comply with the requirements of the International Code for the Safe Carriage of Packaged Irradiated Nuclear Fuel, Plutonium and High-Level Radioactive Wastes on Board Ships.

Chapter 7 INTACT STABILITY

1 General provisions

1.1 Application

1.1.1 Instead of the requirements of 2 and 3 of this Chapter, as an equivalent, the provisions of the International Code on Intact Stability, 2008, may be used for ships navigating in the unrestricted service except for catamarans, tugs, crane ships and dredgers (excluding normal type crane ships and dredgers in navigation), if applied in their entirety. However, the requirements of 3.7 of this Chapter are to be additionally complied with for oil tankers.

1.1.2 Unless expressly provided otherwise by the Guidelines, for ships not specified in this Chapter, reference is to be made to this Chapter having regard to the features of these ships, subject to agreement.

1.2 Determination of lightship displacement and center of gravity

1.2.1 Ships upon completion of construction are to be subject to inclining test. The first ship of the same type of the series under construction at the same yard is to be inclined and a lightweight survey is to be carried out to subsequent ships upon completion of construction. If, in comparison with the data for the first ship, a deviation from the lightship displacement exceeding 2% or a deviation of the longitudinal centre of gravity exceeding 0.01 L (L being the length between the perpendiculars) is found, this ship is also to be inclined.

1.2.2 The purpose of the inclining test is to determine the displacement and actual position of the centre of gravity of the lightship. Based on the test results, a report of inclining test containing the displacement, actual position of the centre of gravity and initial metacentric height of the lightship is to be prepared and submitted to the surveyor.

1.2.3 The inclining test of an individual ship may be exempted, subject to agreement, if basic stability data are available from the inclining test of ship of the same type or reference to existing stability data for similar ships is available or there is evidence indicating that due to the ship's proportions and arrangements more than sufficient metacentric height will be available, or, for a special ship type, more than sufficient metacentric height will be available in all probable loading conditions and operational conditions. However, the ship is to be inclined, if, in comparison with the stability information of the ship of the same type, a deviation from the lightship displacement exceeding 2% or a deviation of the longitudinal centre of gravity exceeding 0.01L(L being the length between the perpendiculars) is found.

1.2.4 The inclining test is to be carried out in compliance with the relevant approved standards.

1.3 Calculation of stability and information on stability

1.3.1 Each ship is to be provided with the Information on Stability or Loading Manuals so as to enable the navigators to assess with ease and certainty the stability of the ship in different service conditions. The information is to comprise the following main particulars:

(1) Principal particulars of the ship;

(2) A summary table of stability characteristics of typical loading conditions;

(3) Instructions for the use of the Information on Stability or Loading Manuals;

(4) Stability calculation under each basic loading conditions;

(5) Notes on the Table of moment of inertia of free surface in liquid tanks, and on the correction for free surface effect of liquids to the initial metacentric height;

(6) Positions of flooding points and its flooding angle curves;

(7) Curve of the maximum allowable vertical height of centre of gravity (KG) versus draught, or curve of the minimum allowable initial metacentric height (GM) versus draught;

(8) Operation Manual of Oil Tankers①.

Based on the report of inclining test, the ship designer or the shipyard is responsible for the calculation and preparation of the Information on Stability or Loading Manuals which are to be subject to agreement.

---

① Applying to all double-shell oil tankers without longitudinal bulkheads fitted inside the cargo oil tank. The manual is to include the operation procedure of loading and unloading cargo tanks and free surface datum of cargo and ballast tanks during loading and unloading as well as the ship's initial metacentric height and floatation datum.

1.3.2 Where the loading instrument is used on board, it is to be in compliance with the relevant requirements provided in the CCS Rules for the Classification of Sea-going Steel Ships.

1.3.3 Even though the calculated stability has met the requirements of this Chapter, the master of the ship is still to navigate with caution, with due regard being paid to the loading conditions of the ship, weather and sea state. The master is also to pay attention to the ship's stability to prevent capsizing when he takes means under the ship's special conditions or in emergency cases.

2 Basic requirements for stability

2.1 Stability criterion numeral

2.1.1 Stability criterion numeral K calculated under various loading conditions is to comply with the following formula:

$$K = \frac{l_q}{l_f} \geq 1$$

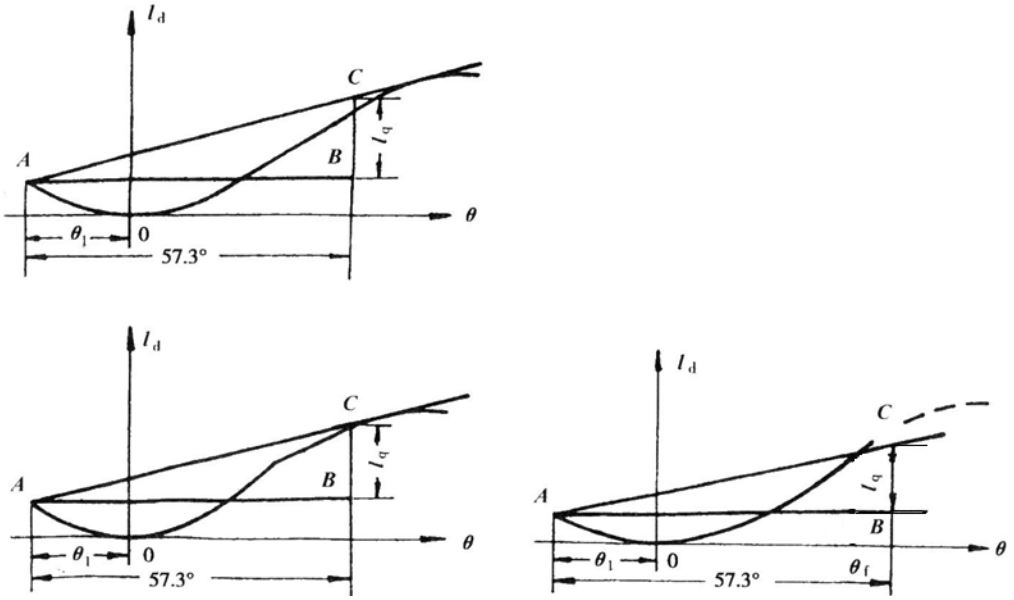
where: l_q — minimum capsizing lever, in m, is to be taken from 2.1.2 of this Chapter;

l_f — wind heeling lever, in m, is to be calculated in accordance with the formula given in 2.1.3 of this Chapter.

2.1.2 The minimum capsizing lever is to be determined by means of the curve of dynamical stability, to which the rolling effect of the ship has been taken into account.

(1) For ships having a dynamical stability curve of normal form or with stepping, the minimum capsizing lever is to be measured as follows:

Prolong symmetrically the dynamical stability curve towards the negative direction of axis θ, and set a point on the negative side of the abscissa so that the length from this point to origin is equal to the rolling angle θ_1. Through this point, draw a line perpendicular to the abscissa, which intersects the prolonged dynamical stability curve at point *A*. From point *A* draw a line tangent to the dynamical stability curve, and again from point *A* draw a line parallel to the abscissa and lay off a segment *AB* equal to 1 rad (57.3°). Then from B draw a line perpendicular to AB, which intersects the tangent at C. Segment BC is the minimum capsizing lever.



(1) (2)

Figure 2.1.2 Dynamical Stability Curve

(2) Where the dynamical stability curve is interrupted due to the effect of flooding angle θ_j, the same method as described in 2.1.2(1) may be used (see Figure 2.1.2(2)), except that the above mentioned tangent is to be substituted by a secant drawn from point *A* to the interruption point on the dynamical stability curve.

2.1.3 The wind heeling lever l_f is to be obtained from the following formula:

$$l_f = \frac{PA_f Z}{9810\Delta} \quad \text{m}$$

where: P — calculated unit wind pressure, in Pa, to be calculated in accordance with 2.1.5 of this Chapter;

A_f — ship's windage area, in m^2, to be calculated in accordance with 2.1.6 of this Chapter

Z — calculated wind pressure lever, in m, to be calculated in accordance with 2.1.4 of this Chapter;

Δ — displacement of the ship, in t, for the loading condition under consideration.

2.1.4 The calculated wind pressure lever Z is the vertical distance between the centre of the windage area and the actual waterline for the loading condition under consideration when the ship is in the upright position. The position of the centre of windage area is to be generally obtained by means of determining the centre of gravity for a plane figure.

2.1.5 The calculated unit wind pressure P is to be determined by Table 2.1.5, depending upon the calculated wind pressure lever Z and the service areas.

Calculated Unit Wind Pressure *P* (Pa) **Table 2.1.5**

Service area	Calculated wind pressure lever *Z* (m)						
	1.0	1.5	2.0	2.5	3.0	3.5	4.0
Unrestricted service	829	905	976	1040	1099	1145	1185
Service Category 1	448	493	536	574	603	628	647
Service Categories 2 & 3	228	248	268	284	301	314	326
Service area	Calculated wind pressure lever *Z* (m)						
	4.5	5.0	5.5	6.0	6.5	≥7.0	
Unrestricted service	1219	1249	1276	1302	1324	1347	
Service Category 1	667	683	698	711	724	736	
Service Categories 2 & 3	336	343	350	357	363	368	

2.1.6 The windage area A_f of the ship is the projected lateral area of all parts of the ships on the centreline plane above the actual waterline for the loading condition under consideration when the ship is in the upright position. The windage area consists of two parts, the continuous surfaces and discontinuous surfaces.

(1) The continuous surfaces include the projected lateral areas of the ship's hull, bulwarks, superstructures, deckhouses, masthouses, deck machinery, masts, derricks, derrick posts, funnels, large ventilators, lifeboats and liferafts on the centreline plane; for ships intended to carry deck cargoes, such as timber, container, etc., the projections of these cargoes are also to be taken into account. For isolated circular section structures, such as funnels, ventilators, masts, etc., the projected lateral areas are to be multiplied by a flow coefficient of 0.6.

(2) The discontinuous surfaces include the projected lateral areas of riggings, rails, trusses of lattice type, aerials and various small objects on the centreline plane.

When calculating the projected lateral area of discontinuous surfaces, 3% of the projected lateral area of the continuous surfaces and 6% of the statical moment of the continuous surfaces calculated for the minimum draught of the basic loading conditions are to be taken for passenger ships, cargo ships, tugs, dredgers and crane ships; and 5% of the projected lateral area and 10% of the statical moment for fishing vessels and oil tankers.

For all other loading conditions, the value of the projected lateral area of discontinuous surfaces and the position of its geometrical centre in relation to the base line are to be assumed to be the same as that obtained from the abovementioned minimum draught.

(3) The projected lateral area of discontinuous surfaces may be determined by precise calculation case by case. The overall areas taken into consideration are to be multiplied by the following filling factors:

for rails covered with meshed wire 0.6;

for rails without meshed wire 0.2;

for crane trusses of lattice type 0.5;

for riggings, shrouds and other similar objects $0.044\,h/b$.

where: h — height from the point of the mast or derrick post to which riggings are attached to the bulwark (to the deck if there is no bulwark), in m;

b — space of the riggings in way of the bulwark (in way of deck side if there is no bulwark), in m.

Where the projections of two or more than two objects overlap one another on the longitudinal centreline plane, only one overlapped area is to be taken into account, in m.

(4) The calculation of the windage area for crane ships and dredges is to comply with the relevant requirements of 3 of this Chapter.

2.1.7 For round bilged ships the rolling amplitude θ_1 is to be obtained from the following formula:

$$\theta_1 = 15.28 C_1 C_4 \sqrt{\frac{C_2}{C_3}} \qquad (^o)$$

where: C_1— coefficient, taken from 2.1.8 of this Chapter;

C_2 — coefficient, taken from 2.1.9 of this Chapter;

C_3 — coefficient, taken from 2.1.10 of this Chapter;

C_4 — coefficient, taken from 2.1.11 of this Chapter.

2.1.8 Coefficient C_1 in the formula for the calculation of rolling amplitude is to be taken from Figure 2.1.8, depending upon the period T_θ of ship's natural roll as obtained from the following formula and the service area:

$$T_\theta = 0.58 f \sqrt{\frac{B^2 + 4KG^2}{GM_o}} \quad \text{s}$$

where: f — coefficient, taken from Table 2.1.8 depending up on the ratio B/d;

B — maximum breadth of the ship, excluding shell plating, in m;

d — moulded draught for the loading condition under consideration, in m;

KG — vertical height from the centre of gravity of the ship to the base line for the loading condition under consideration, in m;

GM_o— initial metacentric height of the ship for the loading condition under consideration, without taking into account the correction for the free surface effect of liquids, in m.

Coefficient f **Table 2.1.8**

B/d	≤ 2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	≥ 7 .0
f	1.00	1.03	1.07	1.10	1.14	1.17	1.21	1.24	1.27	1.30

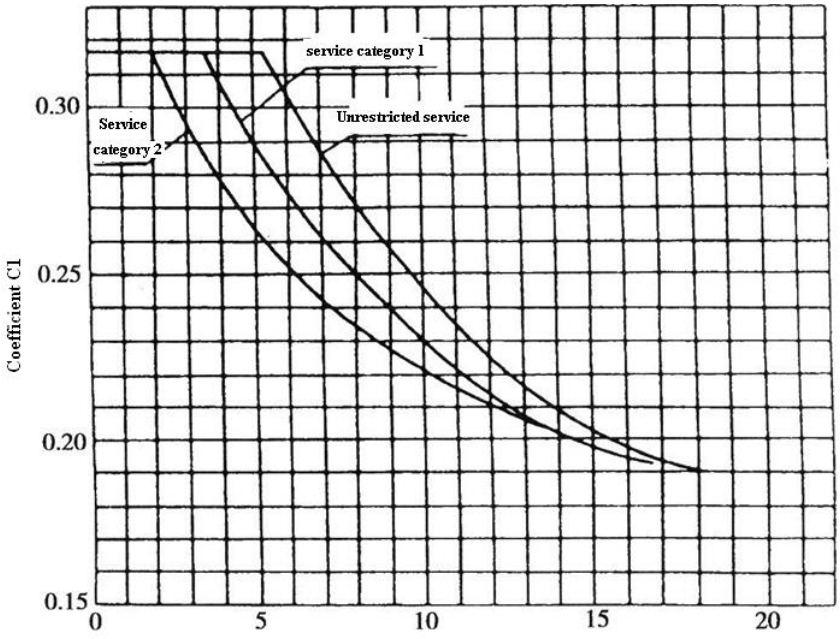


Figure 2.1.8 Coefficient C_1

Note: When T_θ >20s, C_1 is to be taken as 0.19.

For ships only for Category 3 service, coefficient C_1 taken from Figure 2.1.8 in accordance with service category 2 is to be multiplied by a factor of 0.80.

2.1.9 Coefficient C_2 in the formula for the calculation of rolling amplitude is to be taken from the following formula:

$$C_2 = 0.13 + 0.6\frac{KG}{d}$$

where: KG, d— same as defined in 2.1.8 of this Chapter;

when C_2 is greater than 1, it is to be taken as 1.0; when C_2 is less than 0.68, it is to be taken as 0.68.

2.1.10 Coefficient C_3 in the formula for the calculation of rolling amplitude is to be taken from the Table 2.1.10 depending upon the ratio B/d.

Coefficient C_3 **Table 2.1.10**

B/d	≤ 2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	≥ 7.0
C_3	0.011	0.013	0.015	0.017	0.018	0.019	0.020	0.021	0.022	0.023

Note: B, d— same as defined in 2.1.8 of this Chapter.

2.1.11 Coefficient C_4 in the formula for the calculation of rolling amplitude is to be taken from Table 2.1.11 depending upon the type of the ship and the size of the bilge keels.

Coefficient C_4 **Table 2.1.11**

$\frac{A_b}{LB}$(%)	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	≥ 4.0
dry cargo ships, oil tankers, container ships and sea-going barges	1.000	0.754	0.685	0.654	0.615	0.577	0.523	0.523	0.523
passenger ships, fishing vessels and tugs	1.000	0.885	0.823	0.769	0.708	0.654	0.577	0.546	0.523

Notes: A_b— total area of bilge keels, in m^2. For ships having a bar keel, its lateral area may be included in the total area of bilge keels A_b;

L— length between perpendiculars, in m;

B— same as defined in 2.1.8.

2.1.12 For ships having sharp bilges, rolling amplitude θ_1 is to be obtained from the following formula:

$$\theta_1 = 0.8\theta_1' \qquad (°)$$

where: θ_1'— rolling amplitude (°), corresponding to the ship having round bilge without bilge keels.

2.1.13 For ships of special shape, the coefficients C_2, C_3 and C_4 are to be obtained subject to agreement.

2.1.14 For ships provided with anti-rolling devices, the rolling amplitude is to be calculated without taking into account the effect of these devices.

2.2 Initial metacentric height and curves of righting lever

2.2.1 The initial metacentric height and curves of righting lever calculated under various loading conditions are to comply with the requirements of this paragraph. Unless expressly provided in 3 of this Chapter, 2.2.2 to 2.2.7 of this Chapter are not apply to crane ships, dredgers, non-self-propelled sea-going barges, passenger catamarans, tugs operating in harbour and operating fire boats and semi-submersible vessels.

2.2.2 The initial metacentric height is not to be less than 0.15 m.

2.2.3 The righting lever is not to be less than 0.2 m at an angle of heel equal to or greater than 30°. If the angle of flooding of the ship is less than 30°, the righting lever at the angle of flooding is not to be less than the prescribed value of the abovementioned righting lever.

2.2.4 The angle of heel corresponding to the maximum righting lever is not to be less than 25°, and if the angle of flooding is less than the angle of heel corresponding to the maximum righting

lever, then this angle of flooding is to be taken as the angle of heel corresponding to the maximum righting lever.

2.2.5 Where the ratio $B/D > 2$, the angle of heel corresponding to the maximum righting lever specified in 2.2.4 of this Chapter may be allowed to reduce the value $\Delta\theta$ from the following formula:

$$\Delta\theta = 20(\frac{B}{D} - 2)(K - 1) \qquad (^\circ)$$

where: D — moulded depth of the ship, in m;

B — same as defined in 2.1.8 of this Chapter, however, when B is greater than 2.5 D, it is to be taken as 2.5 D;

K— stability criterion numeral calculated in accordance with 2.1.1 of this Chapter, however, when K is greater than 1.5, it is to be taken as 1.5.

2.2.6 For ships in service category 3, the following requirements may be regarded as an equivalent to the requirements specified in 2.2.3, 2.2.4 and 2.2.5 of this Chapter:

(1) the angle of heel corresponding to the maximum righting lever is not to be less than 15°;

(2) the maximum righting lever l_m is not to be less than the value taken from the following formula:

$$l_m = 0.2 + 0.022(30 - \theta_m) \qquad \text{m}$$

where: θ_m — the angle of heel corresponding to the maximum righting lever.

(3) If the angle of flooding is less than the angle of heel corresponding to the maximum righting lever, then this angle of flooding is to be taken as the angle of heel corresponding to the maximum righting lever, and the righting lever in way of the angel of flooding is to be taken as the maximum righting lever.

2.2.7 The requirements of 2.2.2 to 2.2.6 are to be complied with for the values after the correction to free surface effect of liquids.

2.2.8 Hydrostatic and righting lever curves are normally to be prepared on a designed trim basis. However, where the operative trim or the form and arrangement of the ship are such that change in trim has an appreciable effect on righting levers, such change in trim is to be taken into account.

2.2.9 When calculating the curves of the righting lever, the buoyancy of the following structures may be taken into account:

(1) the first tier superstructure on the upper continuous deck and other tiers of similarly enclosed superstructures, provided that they comply with the requirements for enclosed superstructures specified in PART THREE of the Guidelines;

(2) the deckhouses on the upper continuous deck, which is to comply with the requirements of the enclosed superstructure specified in PART THREE of the Guidelines and have an additional exit to a deck above;

(3) trunks and cargo hatches which meet the weathertight requirements specified in PART THREE of the Guidelines;

(4) the first tier superstructure and deckhouses which do not meet the requirements of (1) and (2) above, the parts up to the angle at which their openings are flooded are to be taken into account.

2.2.10 When calculating the curves of the righting lever, the effect of the flooding angle openings is to be taken into account:

(1) If water can penetrate into the hull through the openings not regarded as the weathertight openings in the ship's sides, upper continuous deck, superstructure or deckhouses, as well as cargo hatches, ventilators, etc., these openings are all to be regarded as the flooding angle openings.

(2) Small openings such as those for passing through wire ropes, chains, tackles and anchors, as well as holes of scuppers, discharges and sanitary pipes may not be regarded as the flooding angle openings, provided that the Surveyor does not consider it to be a source of significant flooding if they are submerged.

(3) When a ship is under the influence of the angle of flooding, a curve showing the relations between the flooding angle and displacement is to be made, and the position of the flooding angle openings is to be indicated.

(4) If a ship sinks due to flooding through openings, the stability curve is to be cut short at the corresponding angle of flooding and the ship is regarded as totally losing its stability.

2.2.11 In any loading condition, the initial metacentric height and curves of righting lever are to be corrected for the free surface effect of liquids as follows:

(1) Where tanks with filling levels fixed have free surfaces (e.g., liquid cargo tanks, water ballast tanks, etc.), the free surface effect is be calculated for the actual filling level to be used in each tank; or
(2) Where tanks with filling levels variable have free surfaces (e.g., consumable liquid tanks, slop tank, liquid cargo tanks during liquid transfer operations and ballast tanks which are to be added ballast water at midway, etc.), the initial metacentric height and the curves of righting lever are to be corrected for the free surface effect of liquids, with the liquids in tanks assumed to be 50% full. Where the tank has a special form with a more severe effect of free liquid surface, the free surface effect is to be calculated. Where connection pipe is fitted between two liquid tanks, the two tanks are to be regarded as one for calculating the free surface effect of liquids.
For consumable liquid tanks and ballast tanks which are to be added ballast water at midway, it is to be assumed that at least a single tank on the centreline or one pair of side tanks for each kind of liquid have free surfaces, and the tank or combination of tanks assumed slack are to be those which develop the greatest free surface effect.
(3) For the liquid cargo tank fully loaded, each tank is to be regarded as 98% full and the free surface effect at an angle of heel of 0 °are to be taken into account.
(4) Except the above-mentioned (3), for liquid tanks filled up to 98% and more, and empty tanks with usual residues of liquids, the free surface effect of liquids may not be taken into account.
(5) Where liquid tanks are in compliance with the following condition, the free surface effect of liquids on curves of righting lever may not be included in the calculation:

$$M_{30} < 0.0981\Delta_{\min} \qquad \text{kN·m}$$

where: M_{30} — the free surface moment at a 30 °inclination, in kN·m;

$\Delta_{\min}$ — displacement in the empty arrival condition, in t;

(6) Alternatively, the free surface effect of liquids may be taken into account by means of correcting the height of center of gravity.
(7) The requirements of (1) to (6) may be complied with by static calculation. In this case, for the ship's initial stability calculation, consideration is to be taken to the correction of initial metacentric height by the moment of inertia of free surface of actual liquid level in fully-loaded tank (98% capacity of tank), partially loaded tank and tank with residual liquid as the ship is floating on even keel. For the calculation of ship's stability at large inclination, consideration is to be taken to the correction of righting lever by the shifting lever of actual liquid level in fully loaded tank (98% capacity of tank), partially loaded tank and tank with residual liquid at the different heeling angles. Where the mentioned fully loaded tank is a ballast water tank and kept with 100% capacity loaded during the whole voyage, the free surface correction may not be calculated.

2.3 Allowance for icing

2.3.1 For ships intended for winter navigation, their stability under icing is to be calculated to the worst loading condition.
2.3.2 When calculating stability of the ship under icing, the increasing in displacement is to be taken into account. The weight of ice is to be regarded as an overload.
2.3.3 The places subject to icing and the weight of ice are to be in accordance with the following provisions:
(1) The weight of ice for the total area of horizontal projection of exposed weather decks and gangways before the forwardmost superstructures (not including forecastle) or deckhouses, or within forward L/3 of the design waterline, whichever is the greater, is to be assumed 15 kg/m^2, and 5 kg/m^2 for those after that region. The deck machinery, equipment, hatch covers, etc. are to be included in the area of horizontal projection of exposed weather decks, and the weight of ice for them is not to be calculated separately.
(2) The weight of ice for the area of lateral projection of the sides of the hull, superstructures, deckhouses, and deck cargos above the actual waterline within forward L/3 of design waterline is to be assumed 10 kg/ m^2.
(3) The weight of ice for the area of orthogonal projection of the fronts of the forwardmost superstructures (not including forecastle) or deckhouses is to be assumed 7.5 kg/m^2.
(4) The weight of ice per metre length of the masts, derricks, derrick posts, ventilators, etc. before the fronts of the forwardmost superstructures (not including forecastle) or deckhouses, or within

forward L/3 of design waterline, whichever is the greater, is to be assumed 20 kg/m, and 5 kg/m for that of flag staffs, rails, riggings, aerials, etc.
(5) The weight of ice for the area of horizontal projection of life boats and davits is to be assumed 5 kg/m^2.
(6) The vertical extent of the abovementioned icing condition is all to be assumed from the actual waterline up to 10 m height.

2.4 Rolling acceleration criterion numeral

2.4.1 For self-propelled ships of river-sea navigation which cargoes are carried on upper deck, rolling acceleration criterion numeral K_a calculated under various loading conditions is to comply with the following formula:

$K_a = \frac{0.25}{a_c} \geq 1$, for sea-going ships engaged on service category 1 or unrestricted service;

$K_a = \frac{0.30}{a_c} \geq 1$, for sea-going ships engaged on service category 2, service category 3;

where: a_c — rolling acceleration factor, taken from 2.4.2 of this Chapter.

2.4.2 Rolling acceleration factor a_c is to be taken from the following formula:

$$a_c = \frac{0.035 B \theta_1}{T_\theta^2}$$

where: B— same as defined in 2.1.8 of this Chapter;

θ_1 — rolling amplitude, taken from 2.1.7 to 2.1.12 of this Chapter;

T_θ — period of ship's natural roll, taken from 2.1.8 of this Chapter.

3 Additional requirements for stability

3.1 General requirements

3.1.1 In addition to complying with the aforesaid provisions, ships are to meet the following additional requirements for stability.
3.1.2 If the loading condition in normal services of a ship as regarding stability is worse than the basic loading conditions as required below, the stability is also to be checked for this condition.
3.1.3 When the stability of a ship in the arrival condition is unsatisfactory without the addition of ballast, the stability of the ship at midway is to be added in the calculation. In this case, the ballast is to be the same as that in the departure condition.
3.1.4 When calculating the stability of the ship under various loading conditions, unless otherwise stated, the amount of fuel and stores is be taken as 100% for departure, 50% for midway and 10% for arrival.
3.1.5 Where the stability of the ship is unsatisfactory and the ship needs permanent water ballast, it is necessary to be with the consent of the shipowner and the Surveyor beforehand, and efficient means is to be provided to ensure the reliability of the ballast.

3.2 Passenger ships

3.2.1 The stability of passenger ships is to be checked for the following basic loading conditions and in addition, the intact stability of class I passenger ships is to comply with the requirements of this Chapter concerning passenger ships engaged on unrestricted service:
(1) in fully loaded departure condition;
(2) in fully loaded arrival condition;
(3) in departure condition, with full number of passengers but without cargoes;
(4) in arrival condition, with full number of passengers but without cargoes;
(5) in ballasted departure condition;
(6) in ballasted arrival condition.
3.2.2 The angle of statical heel of the ship caused by crowding of passengers to one side or by turning with full speed is not to exceed the following limit angle of statical heel:
(1) the limit angle of statical heel for ships in unrestricted service is to be the angle of flooding at the lower edge of the sidescuttle which can be opened without using special spanners, the angle of flooding at the lower edge of side port, 2/3 of the angle of flooding for other openings, 2/3 of the

angle at which the edge of upper continuous deck immerses or 10°, whichever is the least;
(2) the limiting angle of statical heel for ships in other than unrestricted service is to be the angle of flooding at the lower edge of the sidescuttle which can be opened without using special spanners, the angle of flooding at the lower edge of side port, 4/5 of the angle of flooding for other openings, 4/5 of the angle at which the edge of upper continuous deck immerses or 12°, whichever is the least.

3.2.3 The distribution of passengers crowding to one side and the weight of each passenger is to be assumed as follows:
(1) the density of passengers is to be calculated at 4 persons per square metre, and the weight of each passenger is to be assumed 75 kg;
(2) the passengers are to be assumed to be distributed on one side on the external passageways of decks to the full areas from accessible uppermost tier to the lower tiers, and then to be distributed on the same side on the free areas of the internal passageways of decks from accessible uppermost tier to the lower tiers, as well as stairs, etc., but not exceeding the longitudinal centreline of the ship; for narrow spaces less than 0.7 m in width, the area of distribution is to be calculated as 50% of the actual area;
(3) when the above free areas are not enough for the distribution of the total number of passengers, the remainder passengers are to be normally distributed in the passengers accommodations on upper decks, so as to take into account of their adverse influence due to the raising of centre of gravity;
(4) the height of the centre of gravity for standing passengers is to be taken as 1.0 m above the deck level and that for sitting passengers as 0.3 m above the seats.

3.2.4 According to the requirements of 3.2.2 of this Chapter, for the angle of statical heel due to turning of the ship with full speed, the heeling lever l_R is to be calculated by the following formula:

$$l_R = 0.02\frac{V_m^2}{L_{\omega l}}(KG - \frac{d}{2}) \qquad \text{m}$$

where: V_m— maximum design speed of the ship, in m/s;
L_{wl}— design waterline length of the ship, in m;
KG— vertical height of the ship's centre of gravity above the baseline for the loading condition under consideration, in m;
d — moulded draught of the ship for the loading condition under consideration, in m.

3.2.5 The calculation of the angle of statical heel caused by passengers crowding to one side or by turning of the ship with full speed may be carried out without taking into account the effect of icing.

3.3 Catamaran passenger ships

3.3.1 For conventional catamaran passenger ships, the rolling amplitude θ_1 is to be calculated according to 3.3.4. For unconventional catamaran passenger ships such as small waterplane area twin hulls, the rolling amplitude is to be determined according to model testing, and if such data or information is not available, the rolling amplitude may be assumed as 15°.

3.3.2 The stability of catamaran passenger ships are to be checked for the following normal loading conditions:
(1) in fully loaded departure condition;
(2) in fully loaded arrival condition;
(3) in ballasted departure condition;
(4) in ballasted arrival condition.

3.3.3 For the loading condition under consideration, the calculation of the flooding angle is to be carried out taking into account the effect of change in trim.

3.3.4 The rolling amplitude θ_1 of the catamaran passenger ships is to be obtained from the following formula:

$$\theta_1 = 11.75 C_1 C_4 \sqrt{\frac{C_2}{C_3}} \qquad (°)$$

where: C_1 — coefficient, taken from 3.3.5 of this Chapter ;
C_2 — coefficient, taken from 3.3.6 of this Chapter;

C_3 — coefficient, taken from 3.3.7 of this Chapter;

C_4 — coefficient, taken from 3.3.8 of this Chapter.

3.3.5 Coefficient C_1 in the formula for the calculation of rolling amplitude is to be taken from Figure 2.1.8, depending upon the period of ship's natural roll T_θ as obtained from the following formula and the service area:

$$T_\theta = 1.05\frac{B}{\sqrt{GM_o}} \qquad \text{s}$$

where: B — maximum breadth of the ship, excluding shell plating, in m;

GM_o — initial metacentric height of the ship for the loading condition under consideration, without taking into account the correction of the free surface effect of liquids, in m.

3.3.6 Coefficient C_2 in the formula for the calculation of rolling amplitude is to be taken from the following formula:

$$C_2 = (0.13 + 0.6\frac{KG}{d})[1 - 0.411(\frac{B}{T_\theta^2})^2]$$

where: KG— vertical height of the centre of gravity of the ship above the base line for the loading condition under consideration, in m;

d— moulded draught for the loading condition under consideration, in m;

B, T_θ — same as defined in 3.3.5 of this Chapter.

In calculation, where KG/d is greater than 1.45, it is to be taken as 1.45; where $\frac{B}{T_\theta^2} \geq 0.94$, $\frac{B}{T_\theta^2} = 0.94$ is to be taken.

3.3.7 Coefficient C_3 in the formula for the calculation of rolling amplitude is to be taken from the following formula:

$$C_3 = 0.024 f_3 f_4$$

where: f_3— coefficient, taken from Table 3.3.7 (1), depending upon $\sqrt[3]{\nabla}$ /b;

f_4— coefficient, taken from Table 3.3.7 (2), depending upon W/b;

Coefficient f_3 **Table 3.3.7(1)**

$\sqrt[3]{\nabla}/b$	≥2.0	1.9	1.8	1.7	1.6	≤1.5
f_3	1.00	1.29	1.54	l.83	2.13	2.42

Notes: ∇ —Total displacement volume for the loading condition under consideration, in m^3;

b — the breadth of single hull at the level of draught for the loading condition under consideration, in m.

Coefficient f_4 **Table 3.3.7(2)**

W/b	≤0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	≥1.7
f_4	1.00	1.12	1.23	1.35	1.48	1.62	1.75	1.88	2.01

Note: W——distance between the inner boards at the level of draught for the loading condition under consideration, in m.

3.3.8 Coefficient C_4 in the formula for the calculation of rolling amplitude is to be taken as follows:

when $A_b/(L*b) \geq 0.03$, C_4=0.90;

when $A_b/(L*b)$ <0.03 or no bilge keels, C_4=1.00.

where: A_b— total area of bilge keels, in m^2;

L— length between perpendiculars, in m;

b— same as that in 3.3.7 of this Chapter.

3.3.9 The calculation of wind heeling lever is to be the same as provided in 2 of this Chapter.

3.3.10 For catamaran passenger ships of which the single hulls have vertical sides near the level of draught, the minimum capsizing lever l_q may be taken from the following formula:

$$l_q = \frac{\theta_j - \theta_1}{57.3}\frac{GM}{2} \qquad \text{m}$$

where: GM— initial metacentric height of the ship for the loading condition under consideration,

taking into account the correction for the free surface effect of liquids, in m;

θ_j — flooding angle of the ship for the loading condition under consideration, (°);

θ_1 — rolling amplitude of the ship for the loading condition under consideration, (°).

3.3.11 The angle of statical heel of the ship caused by crowding of passengers to one side or by turning with full speed is to be calculated and checked in accordance with the requirements of 3.2.2 to 3.2.5 of this Chapter.

3.4 Dry cargo ships

3.4.1 The stability of dry cargo ships is to be checked for the following basic loading conditions:
(1) in fully loaded departure condition;
(2) in fully loaded arrival condition;
(3) in ballasted departure condition;
(4) in ballasted arrival condition.

3.4.2 For dry cargo ships with cargo carried on deck, if the ratio of the moulded width to moulded depth is more than 2.5, the angle of heel corresponding to the maximum righting lever in the stability curves may be less than 25°, but not to be less than 15°, and the area under the righting lever curve up to the angle of heel corresponding to the maximum righting lever is not to be less than:

$$0.055+0.001(30°-\theta_m) \quad \text{m·rad}$$

where: θ_m — the angle corresponding to the maximum righting lever, (°).

3.5 Timber carriers

3.5.1 The stability of timber carriers is to be checked for the following basic loading conditions:
(1) in fully loaded departure condition, with light timber cargo having the greatest stowage factor;
(2) in fully loaded arrival condition, with light timber cargo;
(3) in fully loaded departure condition, with heavy timber cargo having the least stowage factor;
(4) in fully loaded arrival condition, with heavy timber cargo;
(5) in ballasted departure condition;
(6) in ballasted arrival condition.

3.5.2 The fully loaded condition of timber carriers means that the timber cargo is also carried on the upper deck, and the stowage of the timber cargo on the deck is to meet the requirements of PART THREE of the Guidelines.

3.5.3 When calculating the curves of the righting lever, 75% of the buoyancy of outline volume of the timber deck cargo may be taken into account.

3.5.4 The initial metacentric height of timber carriers for any loading condition under consideration, after the correction of free surface effect of liquids, is not to be less than 0.1 m.

3.5.5 The maximum value for the curve of the righting lever is not to be less than 0.25 m.

3.5.6 Timber carriers when carrying general cargoes are to meet the requirements of 3.4 of this Chapter for the stability of dry cargo ships.

3.5.7 When calculating the stability of timber carriers for the arrival condition and in the midway of the voyage, an increase of weight by 10% is to be assumed to timber deck cargo due to absorption of water.

3.5.8 When calculating icing for timber carriers, the actual weight of ice on the outer surfaces of timber deck cargo is to be taken into account; where the data of actual weight of ice are not available, the weight of ice is to be assumed as 3 times that specified in 2.3 of this Chapter.

3.6 Container ships

3.6.1 The stability of container ships is to be checked for the following basic loading conditions:
(1) in fully loaded departure condition;
(2) in fully loaded arrival condition;
(3) in ballasted departure condition;
(4) in ballasted arrival condition.

3.6.2 In calculating the stability of container ships in fully loaded conditions as specified in 3.6.1 of this Chapter, in the fully loaded departure condition, ships may be permitted to ballast up to the summer load line if necessary and at least the following loading conditions are to be taken into

account: the number of containers is to be the sum of the maximum design cargo container number and the empty container number, and the mass of cargo container is to be the same mass for each type of containers which may be possibly carried by the ship in the fully loaded departure condition.

3.6.3 In calculating the stability of container ships, the position of vertical centre of gravity of each container is to be taken at one half the height of the container.

3.6.4 In determining the statical heeling angle due to the wind pressure, the wind heeling lever is to be equal to one half the value as obtained from 2.1.3 of this Chapter and it is to be assumed that the heeling lever does not depend on the ship's inclination.

3.6.5 The stability of container ships under any loading conditions is to be such that the statical heeling angle under the effect of beam wind as determined from the curves of righting lever does not exceed one half the angle at which the edge of upper continuous deck immerses, but in any case, the heeling angle is not to exceed 12°.

3.6.6 In calculating the righting lever curves, the effect of buoyancy of the container stowed on decks is not to be taken into account.

3.6.7 The initial metacentric height of container ships checked under various loading conditions, after the correction for free surface effect of liquids, is not to be less than 0.3 m.

3.6.8 The requirements of 3.6 of this Chapter may be also applicable to non-container ships which may carry containers. However, in calculating the stability of the ships in accordance with the requirements specified in 3.6.2, the maximum draught in fully loaded conditions may be less than the draught corresponding to the summer load line.

3.6.9 For container ships where they are designed and put into service after construction, means is to be taken as far as possible to reduce the free surface effect of residual liquid after the double-bottom ballast water tank being discharged. Where the effect causes the initial metacentric height to be less than 0.15 m during loading and unloading cargo conditions or in navigating conditions, the corresponding remedial means may be required.

3.7 Liquid cargo carriers

3.7.1 The stability of liquid cargo carriers is to be checked for the following basic loading conditions:

(1) in fully loaded departure condition;
(2) in fully loaded arrival condition;
(3) in partially loaded departure condition;
(4) in partially loaded arrival condition;
(5) in ballasted departure condition;
(6) in ballasted arrival condition.

3.7.2 In various ships' loading conditions, the initial metacentric height and righting lever curve are to be taken into account the free surface effect of liquids in accordance with the requirements of 2.2.11 of this Chapter.

3.7.3 In the loading conditions as mentioned in 3.7.1(3) and (4), at least one center tank or a pair of port and starboard tanks are to be taken into consideration for each kind of liquid cargoes which develop the maximum free surface effect.

3.7.4 For double-shell oil tankers of which the longitudinal bulkheads are not arranged in all cargo tanks, the initial metacentric height is to be so designed as not to be less than 0.15m during loading and unloading cargo conditions and taking into account the correction for the free surface effect of liquids, and Operation Manual of Oil Tankers are to be formulated in accordance with the requirements of 1.3.1(8) of this Chapter when operating means is necessarily used for meeting such requirement.

3.7.5 For double-shell oil tankers of which the longitudinal bulkheads are not arranged in all cargo tanks, where they are designed and put into service after construction, means is to be taken as far as possible to reduce the free surface effect of residual liquid after ballast water being pumped out of the double bottom tank. Where the effect causes the initial metacentric height to be less than 0.15m during loading and unloading cargo conditions or in navigating conditions, the corresponding remedial means may be required.

3.8 Non-self-propelling sea-going barges

3.8.1 The stability of sea-going barges is to be checked for the following basic loading

conditions:
(1) in fully loaded departure condition;
(2) in fully loaded arrival condition;
(3) in ballasted departure condition;
(4) in ballasted arrival condition.
For barges without consumable stores, only a fully loaded condition and a ballasted condition are to be considered.
3.8.2 Stability criteria for barges of conventional form
(1) Stability criterion numeral *K* calculated under various loading conditions is to comply with the requirements specified in 2.1.1 to 2.1.14 of this Chapter.
(2) The maximum righting lever for the loading condition under consideration is not to be less than 0.37 m, the angle of heel corresponding to the maximum righting lever is not to be less than 25°. Alternatively, the area under the righting lever curve is not to be less than 0.1 m·rad up to the angle of heel corresponding to the maximum righting lever or the flooding angle, whichever is lesser. However, the angle of heel corresponding to the maximum righting lever is not to be less than 20°.
Where the flooding angle is less than the angle of heel corresponding to the maximum righting lever, the righting lever at the flooding angle is not to be less than the value specified above.
3.8.3 For box type sea-going barges, the hull form is to have the following characters:
(1) Cargo is carried on deck only;
(2) The block coefficient under fully loaded draft is to be 0.8 or over;
(3) The ratio of *B* to *D* is to be more than 3;
(4) There is no other hatchway in the deck except for small manholes closed by covers with gasket.
3.8.4 The stability criteria of box type barges without crew is to be given as follows:
(1) Stability criterion numeral *K* calculated under various loading conditions is to comply with the requirements specified in 2.1.1 to 2.1.6 of this Chapter. The rolling amplitude for unrestricted service is to be taken as 15° and for service area other than unrestricted service is to be taken as 13°.
(2) For ships of 100 m in length *L* or below (*L* being the length between the ship perpendiculars) the positive range for the curve of the righting lever calculated under various loading conditions is not to be less than 20°; for ships of 150 m in length or above, the positive range for the curve of the righting lever calculated under various loading conditions is not to be less than 15°. For intermediate lengths the range may be obtained by linear interpolation. The area under the righting lever curve is not to be less than 0.08 m·rad up to the angle of heel corresponding to the maximum righting lever or the flooding angle, whichever is less.
3.8.5 Barges carrying containers are to meet the requirements specified in 3.6 of this Chapter in addition to complying with the corresponding requirement s of 3.8 of this Chapter.

3.9 Tugs

3.9.1 The stability of tugs is to be checked for the following basic loading conditions:
(1) departure;
(2) arrival.
3.9.2 Tugs are to meet the requirements for the stability both in operation in harbour and on towing at sea. However, tugs restricted to operate in harbor are to be required to meet the requirements only for the stability in operation in harbour.
3.9.3 The stability criterion numeral K_1 of tugs operating in harbour is to comply with the following formula:

$$K_1 = \frac{l_q}{l_t} \geq 1$$

where: l_q— minimum capsizing lever, without taking into account the effect of rolling, in m;
l_t — heeling lever due to the transverse jerk of towline, in m.
3.9.4 The heeling lever due to the transverse jerk of towline l_t is to be calculated in accordance with the following formula:

$$l_t = 0.067(C_t V)^2 \frac{Z_t - d}{BC_b} \qquad \text{m}$$

where: Z_t — vertical height of the suspension point of the towing hook above the base line, in m;

d — moulded draught of the ship for the loading condition under consideration, in m;

B — maximum breadth of the ship not including shell plating, in m;

C_b — block coefficient of the ship for the loading condition under consideration;

C_t — factor of correction for the longitudinal position of the towing hook in accordance with the following formula. However, the value C_t is not to be less than 0.75 for rated output of main engine of 736 kW and over, and not be less than 0.80 for that of 294 kW and less;

$$C_t = 1.0 - 1.7\frac{X_t}{L_{\omega l}}$$

where: X_t — the longitudinal distance between the suspension point of the towing hook and the ship's centre of gravity, in m;

$L_{\omega l}$ — the length of design waterline of the ship, in m.

V — velocity of the towline jerk, in m/s, is to be taken from the curve of velocity of the towline jerk as give n in Figure 3.9.4 in accordance with the towline jerk factor $f = \dfrac{0.15N_e^{3/2}}{\Delta}$;

where: N_e — the rated output of the main engine of the tug, in kW;

Δ — the displacement of the ship for the loading condition under consideration, in t.

For tugs of main engine with rated output less than 736 kW, the V obtained from Figure 3.9.4 is to be multiplied by a factor q:

$$q = 0.60 + 0.544N_e \times 10^{-3}$$

when $q < 0.76$, it is to be taken as 0.76.

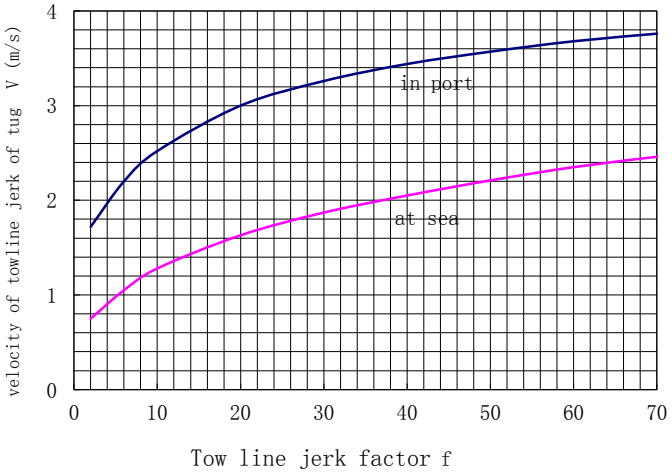


Figure 3.9.4 Velocity of towline jerk of the tug

3.9.5 When calculating the stability of tugs operating in harbour, the following requirements are to be complied with:

(1) The flooding angle is to be calculated up to the upper edge of the sills of openings in end or side bulkheads of superstructures or deckhouses, irrespective of the condition of the closures of these openings.

(2) The effect of icing is not to be taken into account.

3.9.6 The stability criterion numeral K_t of tugs towing at sea is to comply with the following formula:

$$K_t = \frac{l_q}{l_f + l_t} \geq 1$$

where: l_q — minimum capsizing lever, in m;

l_f — wind heeling lever, in m;
l_t — heeling lever due to the transverse jerk of towline, taken from 3.9.4.

3.10 Crane ships

3.10.1 The stability of crane ships is to be checked for the following basic loading conditions:
(1) with full fuel and stores;
(2) with 10% fuel and stores.

3.10.2 The stability of crane ships is to be checked for operating, sheltering from wind and transit conditions. For crane ships engaged in harbor service only, the calculation of stability in transit conditions may be exempted.

3.10.3 The wind heeling moment M_f and wind heeling lever l_f of crane ships are to be obtained from the following formulae, with the windage area to be segmented for every 15 m in height from the waterline upwards.

$$M_f = 0.001P\sum C_i A_{fi} Z_i \qquad \text{kN·m}$$

$$l_f = \frac{P}{9810\Delta}\sum C_i A_{fi} Z_i \qquad \text{m}$$

where: P — calculated unit wind pressure, in Pa, obtained from Table 3.10.3 (1);
C_i — coefficient of height correction, obtained from Table 3.10.3(2);
A_{fi} — windage area, in m^2, determined in accordance with 2.1.6 and 3.10.4 of this Chapter;
Z_i — vertical distance from the centre of windage area A_{fi} to the waterline for the loading condition under consideration, in m;
Δ — displacement for the loading condition under consideration, in t.

Calculated unit wind pressure *P* **Table 3.10.3(1)**

Mode of operation	Operating	Sheltering from wind	Transit		
Service area			unrestricted service	Service category 1	Categories 2, 3
P (Pa)	177	1844	1347	736	368

Coefficient of height correction C_i **Table 3.10.3(2)**

Z_i (m)	0—15	15—30	30—45	45—60	60—75	75—90	90—105	105—120
C_i	1.00	1.16	1.32	1.44	1.53	1.61	1.68	1.74

3.10.4 In calculating the windage area of crane ships, the following requirements are also to be complied with:
(1) For crane trusses of lattice type, a filling factor of 0.5 is to be taken;
(2) Where the projections of several objects overlap one another on the longitudinal centreline plane, the overlapped area is to be multiplied by an overlapping factor of 1.5;
(3) The centre of windage area of the load on hook is to be assumed to be located at the point of suspension, and the windage area A_f of the load is to be obtained from the following formula:

$$A_f = 2.78W^{0.556} \qquad \text{m}^2$$

where: W — mass of load on hook, in t.

3.10.5 The limit angle of statical heel θ_c of crane ships is to be equal to 4/5 of the angle at which the edge of upper deck immerses, or 4/5 of the angle at which the bilge comes out of water, or the angle at which the residual freeboard is 0.3 m, whichever is the least; furthermore, the limit angle of statical heel is not to exceed:
8° for crane ships under sheltering from wind conditions;
5° for slewing crane ships under operating conditions;
3° for crane ships with the booms fixed in relation to the longitudinal centreline plane.

3.10.6 The stability of crane ships under operating conditions is to comply with the following formulae:
(1) Initial metacentric height *GM*:

$$GM \geq \frac{M_f + M_h + M_l}{0.1716\theta_c\Delta} \qquad \text{m}$$

where: GM— initial metacentric height for the loading condition under consideration, taking into account the free surface effect of liquids and the effect of heavy load on hook to the initial metacentric height, in m;

M_f— wind heeling moment, in kN·m, acting on the crane ships, determined in accordance with 3.10.3 of this Chapter;

M_h— heeling moment, in kN·m, due to load on the hook of slewing cranes;

M_l— heeling moment, in kN·m, due to unsymmetrical distribution of load on the crane ships;

θ_c— permissible limit statical heeling angle of crane ships, (°), determined in accordance with 3.10.5 of this Chapter;

Δ— displacement for the loading condition under consideration, in t.

(2) Stability criterion numeral K_c:

$$K_c = \frac{l_q}{l_f + \dfrac{M_h + M_l}{9.81\Delta}} \geq 1$$

where: l_q— minimum capsizing lever, in m, without taking into account the rolling effect;

l_f— wind heeling lever, in m, determined in accordance with 3.10.3 of this Chapter;

M_h, M_l, Δ— see 3.10.6 (1) above.

3.10.7 The stability of crane ships under sheltering from wind conditions is to comply with the following formulae:

(1) Initial metacentric height GM:

$$GM \geq \frac{M_f + M_l}{0.1716\theta_c\Delta} \qquad \text{m}$$

where: M_f, M_l, θ_c, Δ— see 3.10.6 of this Chapter.

(2) Stability criterion numeral K_c:

$$K_c = \frac{l_q}{l_f + \dfrac{M_l}{9.81\Delta}} \geq 1$$

where: l_q, l_f, M_l, Δ— see 3.10.6 of this Chapter.

3.10.8 The stability of crane ships under transit conditions is to comply with the following requirements:

(1) The initial metacentric height after the correction of free surface effect of liquids is not to be less than 0.16 B (B is the moulded breadth of the crane ships);

(2) The maximum value of the righting lever curve is not to be less than 1.5 m, and the heeling angle corresponding to that lever is not to be less than 15°;

(3) Stability criterion numeral K_c:

$$K_c = \frac{l_q}{l_f} \geq 1$$

where: l_f — see 3.10.6 of this Chapter;

l_q — minimum capsizing lever, in m.

3.10.9 The rolling amplitude θ_1 of crane ships is to be obtained from the following formula:

$$\theta_1 = 11.75 C_1 \sqrt{\frac{C_2}{C_3}} \qquad (°)$$

where: C_1— coefficient, taken from Figure 2.1.8 based on the period of natural roll T_θ of the crane ships calculated in accordance with 3.10.10 of this Chapter;

C_2— coefficient, taken from 3.10.11 of this Chapter;

C_3— coefficient, taken from 3.10.12 of this Chapter.

3.10.10 The period of natural roll T_θ of crane ships is to be obtained from the following formula:

$$T_\theta = \frac{B}{\sqrt{GM_o}}(0.73 + 0.046\frac{B}{d}) \quad \text{s}$$

where: B — moulded breadth, in m;

d — mouled draught for the loading condition under consideration, in m;

GM_o — initial metacentric height, in m, of the crane ships for the loading condition under consideration, without taking into account the correction of free surface effect of liquids.

3.10.11 The coefficient C_2 in the formula for calculating the rolling amplitude is to be obtained from the following formula:

$$C_2 = 0.66 - 0.05\frac{B}{d} + 0.11\frac{KG}{d}$$

where: B, d— see 3.10.10 of this Chapter;

KG — vertical height of the centre of the gravity of the crane ships above the base line for the loading condition under consideration , in m.

When $C_2 > 0.85$, it is to be taken as 0.85.

3.10.12 The coefficient C_3 in the formula for calculating the rolling amplitude is to be obtained from the following formula:

$$C_3 = \frac{1}{10^4 dKG}(49BKG + 37dGM_o - 6BGM_o + 18dKG)$$

where: B, d, GM_o — see 3.10.10 of this Chapter;

KG — see 3.10.11 of this Chapter.

When $C_3 < 0.05$, it is to be taken as 0.05.

3.11 Dredgers

3.11.1 The stability of dredgers fitted with hoppers is to be checked for the following basic loading conditions:

(1) Under navigating and sheltering from wind conditions:

① without mud in hoppers① and with full fuel and stores;

② without mud in hoppers① and with 10% fuel and stores.

(2) Under operating conditions:

① with full mud in hoppers and full fuel and stores;

② with full mud in hoppers and 10% fuel and stores;

③ without mud in hoppers① and with full fuel and stores;

④ without mud in hoppers① and with 10% fuel and stores;

⑤ with half full mud in hoppers and 50% fuel and stores.

3.11.2 The stability of dredgers not fitted with hoppers is to be checked for the following basic loading conditions in navigating, operating and sheltering from wind cases:

(1) with full fuel and stores;

(2) with 10% fuel and stores.

3.11.3 For self-propelled dredgers, the calculation of stability in sheltering from wind condition may be exempted.

3.11.4 The stability of various dredgers under the navigating conditions (including navigation in operation area) is to comply with the following requirements:

(1) The stability criterion numeral calculated under various loading conditions is to comply with the requirements specified in 2.1.1 and 2.1.2 of this Chapter;

(2) The initial metacentric height taking into account the correction for free surface effect of liquids, is not to be less than 0.3 m;

(3) For bucket dredgers and cutter suction dredgers in box form, the maximum righting lever is not to be less than 0.25 m, and the angle of heel corresponding to the maximum righting lever is not to be less than 25°. Where the corresponding angle of heel is less than 25°, but is not less than 15°, the maximum righting lever is not to be less than 0.4 m. For grab dredgers in box form, the maximum righting lever is not to be less than 1.2 m or 0.13B, whichever is the lesser; and the

① Without mud in hoppers, but with water in hoppers, and in calculations the water level is to be in common with the open sea.

corresponding angle of heel is not to be less than 15°.
Where the flooding angle is less than the angle of heel corresponding to the maximum righting lever, the righting lever at the flooding angle is not to be less the maximum righting lever as mentioned above;
(4) The righting lever curves of dredgers in ordinary form are to comply with the requirements specified in 2.2.3 to 2.2.8 of this Chapter.
3.11.5 The initial metacentric height of dredgers under the operating condition, after the correction of free surface effect of liquids, is to comply with the following requirements:
(1) Cutter suction dredger:

$$GM \geq \frac{1}{0.1716\theta_c \Delta}(M_f + M_h + M_d + M_p) \quad \text{m}$$

where: M_f — wind heeling moment, in kN·m, taken from 3.1 1.9 of this Chapter;
M_h — heeling moment due to transverse movement of the dredger, in kN·m, taken from 3.11.12 of this Chapter;
M_d — heeling moment due to putting down the positioning spuds, in kN·m, taken from 3.11.13 of this Chapter;
M_p — heeling moment due to discharging mud, in kN·m, taken from 3.11.14 of this Chapter;
θ_c — limit angle of statical heel of the dredger for the loading condition under consideration, (°), taken from 3.11.6 of this Chapter;
Δ— displacement of the dredger for the loading condition under consideration, in t.
(2) Bucket dredger:

$$GM \geq \frac{1}{0.1716\theta_c \Delta}(M_f + M_h + M_p) \quad \text{m}$$

where: M_f, M_h, M_p, θ_c, Δ— see 3 .11.5(1) of this Chapter.
(3) Grab dredger:

$$GM \geq \frac{1}{0.1716\theta_c \Delta}(M_f + M_x) \quad \text{m}$$

where: M_f, θ_c, Δ— see 3.11.5(1);
M_x — maximum heeling moment under operating conditions, as the boom is swung out the side of the dredger, in kN·m, taken from 3.11.15.

3.11.6 The limit angle of statical heel of the dredger for the loading conditions under consideration is not to exceed 4 /5 of the angle at which the edge of deck immerses, 4/5 of the angle at which the bilge comes out of water, or the angle at which the residual freeboard is only 0.3 m, whichever is the least. The limit angle of statical heel may be proposed by the user to ensure the normal safety operation.
3.11.7 For dredgers without propelling machinery, the initial metacentric height *GM* in sheltering from wind condition after the correction of free surface effect of liquids is to comply with the following formula:

$$GM \geq \frac{M_f}{0.1716\theta_c \Delta} \quad \text{m}$$

where: M_f, Δ— see 3.11.5 (1) of this Chapter;
θ_c — limit angle of statical heel of the dredger for the loading condition under consideration, (°), taken from 3.11.8 of this Chapter.
3.11.8 For dredgers without propelling machinary, the limit angle of statical heel for the loading conditions under considerations is not to exceed 4/5 of the angle at which the edge of deck immerses, 4/5 of the angle at which the bilge comes out of water, or the angle at which the residual freeboard is equal to 0.3 m, whichever is the least.
3.11.9 The wind heeling moment and the wind heeling lever are to be obtained respectively from the following formulae:
(1) For trailing suction dredgers and bucket dredgers, the wind heeling lever is to be taken in accordance with the requirements described in 2.1.3, 2.1.4, 2.1.6 and 3.11.10 of this Chapter, and the wind heeling moment M_f is to be taken from the following formula:

$$M_f = 9.81 l_f \Delta \quad \text{kN·m}$$

where: Δ— displacement of the dredger for the loading condition under consideration, in t.

(2) For cutter suction dredgers and grab dredgers, the wind heeling moment M_f and the wind heeling lever l_f are to be obtained respectively from the following formulae:

$$M_f = 0.001 P \sum C_i A_{fi} Z_i \quad \text{kN·m}$$

$$l_f = \frac{P}{9810\Delta} \sum C_i A_{fi} Z_i \quad \text{m}$$

where: P — calculated unit wind pressure, in Pa, see 3.11.1 0 of this Chapter;

A_{fi} — windage area, in m^2, taken in accordance with the requirements described in 2.1.6 and 3.11.11 of this Chapter;

Z_i — calculated wind pressure lever, in m, is to be the vertical distance between the centre of the windage area and the actual waterline for the loading condition under consideration when the ship is in the upright position;

Δ— displacement of the dredger for the loading condition under consideration, in t;

C_i — factor of correction of height, taken from Table 3.11.9 (2).

Factor of correction of height C_i **Table 3.1 1.9(2)**

Z_i (m)	0 ~ 15	> 15
C_i	1.0	1.16

3.11.10 Calculated unit wind pressure

(1) The calculated unit wind pressure of various dredgers under navigating conditions is to be taken from 2.1.5 of this Chapter.

(2) For bucket dredgers, cutter suction dredgers and grab dredgers under operating conditions, the calculated unit wind pressure is not to be less than 235 Pa and is not to be less than 1559 Pa for sheltering from wind conditions.

3.11.11 For cutter suction dredgers and grab dredgers, the windage area of framed gantry is to be calculated in accordance with the following requirements:

Where the projections of two or more than two framed structures overlap one another on the longitudinal centreline plane, the overlapped area is to be multiplied by the factor of 1.5. The other values of the factor, if available, are to be subject to agreement.

3.11.12 The heeling moment M_h, due to transverse movement of the dredger, is to be calculated in accordance with the following formula:

$$M_h = P_n (Z_n - \frac{1}{2} d) \quad \text{kN·m}$$

where: P_n— pull of the winch, in t, when a transverse movement is made to the dredger;

Z_n— vertical height of the suspension point of the girtline, when a transverse movement is made to a dredger, from the base line for the loading conditions under consideration, in m, is to be taken as a positive where in upward direction, and a negative where in downward direction. Where the suspension point for a cutter suction dredger is in way of the pull ring fitted on the cutter ladder, and the cutter suction dredger is in the operating condition, the ring fit ted on the cutter ladder (suspension point) may be below d/2 of the moulded draught, in such a condition, M_h may be negative, however, when calculating GM in 3.11.5 (1), M_h is to be taken as its absolute value;

d — moulded draught for the loading condition under consideration, in m.

3.11.13 Heeling moment M_d due to putting down the positioning spuds is to be calculated in accordance with the following formula:

$$M_d = 9.81 W_d b_d \quad \text{kN·m}$$

where: W_d— one positioning spud's weight, in t;

b_d — distance from the centerline of the positioning spud to the longitudinal centerline plane of the dredger, in m.

3.11.14 Heeling moment M_p due to discharging mud overboard from the side of the dredger is to be calculated in accordance with the following formula:

$$M_p = 9.81 W_p b_p \quad \text{kN·m}$$

where: W_p — total weight of mud in discharge device, in t ;

b_p — distance from the gravity centre of mud in discharge device to the longitudinal centreline plane of the dredger, in m.

3.11.15 For grab dredgers, the maximum heeling moment under operating condition, as the boom being swung out the side of the dredger, is to be calculated. Where the grab is hung by wire ropes, the moment M_x is to be calculated in accordance with the following formula:

$$M_x = 9.81\sum_{i=1}^{n}[C_d(W_{1i}+P_i)y_{1i} - W_{1i}y_{0i} + W_{2i}(y_{2i}-y_{0i})] \qquad \text{kN m}$$

where: C_d= 1.30;

i =1, 2, 3……serial number of the grabs;

W_{1i} — weight of serial grabs for the ith grab machine, in t;

P_i — weight of mud in grabs when the ith grab machine is in operation, in t;

y_{1i} — distance from the centre of gravity of the grab (incluing the mud contained) to the longitudinal centreline plane of the dredger, when the ith grab machine is in operating condition, in m;

y_{0i} — distance from the centre of gravity of the grab machine to the longitudinal centreline plane of the dredger, where the centreline of the boom of the ith grab machine is in parallel with or within the longitudinal centreline plane of the dredger, in m;

W_{2i} — total weight of the ith grab machine (excluding the grabs), in t;

y_{2i} — distance from the centre of gravity of the grab machine (excluding the grabs) to the longitudinal centreline plane of the dredger where the boom of the ith grab machine is swung out the side of the dredger, in m;

y_{1i}, y_{0i} and y_{2i} above are to be taken as a positive for the starboard side, and negative value for the port side.

3.11.16 For dredgers fitted with hoppers, the initial metacentric height and the stability curves are to be corrected for the free surface effect of mud in hoppers. Where the density of the mud in hoppers is 1.4 t/m^3 or less, consideration is to be given to spilling the mud through the spillway openings or hatch coaming as the ship heels, and the righting lever curves and dynamical stability levers are to be calculated by the actual positions of the displacement and centre of gravity of the mud in hoppers of the dredger.

3.11.17 The rolling amplitude is to be calculated in accordance with the following requirements:

(1) For trailing suction dredgers and all types of dredgers in ordinary form, the rolling amplitude is to be calculated in accordance with the requirements in 2.1.7 to 2.1.13 of this Chapter, where the coefficient C_4 is to be taken from the corresponding dry cargo ship;

(2) For grab dredgers in box form, the rolling amplitude is to be calculated in accordance with 3.10.9;

(3) For cutter suction dredgers and bucket dredgers, in box form, the rolling amplitude θ_1 is to be obtained from the following formula:

$$\theta_1 = 11.75C_1\sqrt{\frac{C_2}{C_3}} \qquad (^\circ)$$

where: C_1 — coefficient, taken from Figure 2.1.8 of this Chapter , depending upon the period of natural roll as obtained from 3.11.18 of this Chapter;

C_2 — coefficient, taken from 3.11.19 of this Chapter;

C_3 — coefficient, taken from 3.11.20 of this Chapter.

3.11.18 For cutter suction dredgers and bucket dredgers, the period of natural roll T_θ is to be obtained from the following formula:

$$T_\theta = \frac{B}{\sqrt{GM_o}}(0.7 + 0.08\frac{B}{d}) \qquad \text{s}$$

where: B — moulded breadth, in m;

d — moulded draught for the loading condition under consideration, in m;

GM_o — initial metacentric height of the ship for the loading condition under consideration, without taking into account the correction for the free surface effect of liquids, in m.

3.11.19 Coefficient C_2 in the formula for the calculation of rolling amplitude is to be obtained from the following formula:

$$C_2 = 0.40 + 0.06\frac{KG}{d}$$

where: d — see 3.11.18 of this Chapter;

KG — vertical height of the gravity centre of the dredger above the base line for the loading condition under consideration, in m.

3.11.20 Coefficient C_3 in the formula for the calculation of rolling amplitude is to be obtained from the following formula:

$$C_3 = \frac{1}{10^4 dKG}(66BKG + 55dGM_o - 21BGM_o + 77dKG)$$

where: B, d, GM_o — see 3.11.18 of this Chapter;

KG — see 3.11.19 of this Chapter.

In calculation, when C_3 is less than 0.04, it is to be taken as 0.04.

3.11.21 For the dredgers fitted with hoppers, where unsymmetrical mud discharging happens due to failure of the control facilities, the stability criterion numeral for this condition is to be checked as follows:

(1) The distance of parallel movement for the gravity centre of the dredger Y_g is to be obtained from the following formula:

$$Y_g = \frac{WY}{\Delta_1} \qquad \text{m}$$

where: W— total weight of the mud discharged from the hoppers, in t, taken as 20% of the hopper loading;

Y— distance from the gravity centre of the mud discharged (center of the door of the hopper) to the longitudinal centreline plane of the dredger, in m;

Δ_1 — the displacement of the dredger after discharging mud, in t, to be obtained from the following formula:

$$\Delta_1 = \Delta - W, \quad \text{t;}$$

where: Δ— the displacement of the dredger before discharging mud, in t.

(2) The righting lever curve l_1 and the dynamical stability curve l_{d1} are to be obtained respectively from the following formula:

$$l_1 = l - Y_g \cos\theta$$

$$l_{d1} = l_d - Y_g \sin\theta$$

where: l, l_d — righting lever and dynamical stability lever respectively in m, where Δ_1 is the displacement, and the gravity centre is within the longitudinal centreline plane;

θ — heeling angle of the ship, (°).

The stability curve having an angle of statical heel obtained from the formulae above is shown in Figure 3.11.21, where θ_{PR} is the angle of statical heel.

(3) Where the density of the mud in hoppers is equal to 1.4 t/m^3 or less, the rolling amplitude θ_r is to be taken as 10 ° from point A to left direction.

(4) Where the density of the mud in hoppers is greater than 1.4 t/m^3, the rolling amplitude θ_r, taking into account the dynamic characters of discharging mud, is to be calculated in accordance with the following formula:

$$\theta_r = 10 + 0.2\theta_{PR} \qquad (°)$$

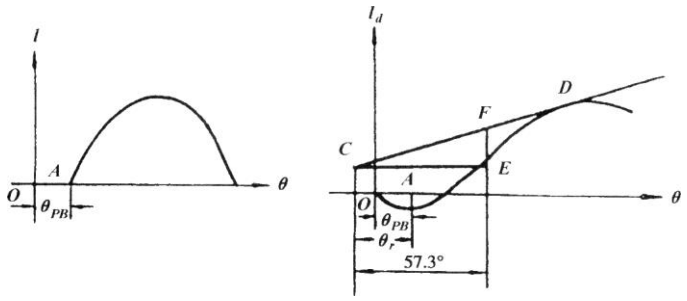


Figure 3.11.21 Stability curve having an angle of statical heel

3.12 Fire Boats

3.12.1 The stability of fire boats is to be checked for the following basic loading conditions:

(1) departure condition (with 100% fuel, stores and foam concentrate);

(2) arrival condition (with 10% fuel, stores and foam concentrate).

3.12.2 The stability of fire boats under the operating conditions is to comply with the following requirements:

$$GM \geq \frac{M}{0.1716\theta_c \Delta} \quad \text{m}$$

where: GM — initial metacentric height of the ship for the loading condition under consideration, taking into account the correction for the free surface effect of liquids, in m;

M — maximum heeling moment due to simultaneous spraying of all the fire water/foam monitors, in kN·m;

θ_c — permissible limit static heeling angle, assumed as 5°;

Δ — displacement for the loading condition under consideration, in t.

3.13 Semi-submersible vessels

3.13.1 The intact stability of self-propelling semi-submersible vessels under operating conditions is to comply with the provisions in 3.4 for dry cargo ships.

3.13.2 The intact stability of non-self-propelling semi-submersible vessels under towing conditions is to comply with the provisions in 3.8 for non-self-propelling sea-going barges.

3.13.3 Semi-submersible vessels are to operate in semi-submerged mode in the wind and wave conditions not more severe than those specified in paragraph 3.13.6. Such external environmental conditions are to be noted in stability calculations, operating manual and relevant certificates.

3.13.4 The stability in semi-submerged mode is to be checked to 10% of fuels, consumables and stores for operational loading conditions of 3.13.5 to 3.13.8.

3.13.5 Immediately before submerging with full deck cargo load, the initial metacentric height as corrected for free surface is not to be less than 1.0 m.

3.13.6 During the emerging and submerging of lifting cargo deck with full deck cargo load, the stability is to meet one of the following criteria:

(1) at the sea area with significant wave height less than 0.3 m and wind force not exceeding Beaufort scale 3, the initial metacentric height as corrected for free surface is not to be less than 0.05 m, or not less than 0.1 m with wind force not exceeding Beaufort scale 5;

(2) at the sea area with wind force not exceeding Beaufort scale 6 and significant wave height less than 0.5 m or with wind force not exceeding Beaufort scale 4 and significant wave height less than 1 m, the initial metacentric height as corrected for free surface is not to be less than 0.15 m.

3.13.7 At the maximum submerged depth, the initial metacentric height as corrected for free surface is not to be less than 0.5 m.

3.13.8 Throughout the emerging and submerging without deck cargo load, the initial metacentric height as corrected for free surface is not to be less than 0.15 m.

3.13.9 Whenever free liquid surface exists in a tank, the maximum effect of free surface in the tank is to be taken into account.

3.13.10 For submerging with large items, ships or offshore installations being carried, their effects on stability may be considered according to their actual positions and floating condition.

3.13.11 An appropriate operating manual for operations in semi-submerged mode is to be prepared to specify submerging procedure and operational steps for ensuring compliance with the requirements of 3.13.3 to 3.13.10. This manual is to be submitted to CCS for information.

3.14 Offshore supply vessels

3.14.1 The intact stability of offshore supply vessels is to additionally comply with relevant provisions in PART NINE of the Guidelines.

3.15 Pusher tug-barge combinations

3.15.1 For pusher tug-barge combinations connected in articulated manner, the pusher tugs and the barges acting as single vessels are to comply with corresponding requirements of this Chapter. For the pusher tug, corresponding requirements are also to be complied with if towing operation is additionally required; the combination acting as a single unit is also to comply with the requirements of this Chapter for cargo ships in (fully loaded pusher tug + fully loaded barge) conditions.

3.15.2 For a fixed pusher tug-barge combination, the combination acting as a single unit is to comply with the requirements for cargo ships in this Chapter.

3.15.3 Stability of the combination acting as a single unit under conditions that are worse than fully loaded pusher tug + fully loaded barge condition is to be checked.

3.15.4 Stability of the combination is to be calculated as follows:

The pusher tug and the barge of a combination are connected at design draught. The line of the combination is obtained when it acts as a single unit (i.e. taking the baseline of the barge as the baseline of the combination, and design waterlines of the pusher tug overlap with that of the barge), and the length is to be taken as L_c (the definition of L_c is given in 6.1 of chapter 2 of PART THREE), the ship width and draught are obtained from the barge. Then the stability of the combination is calculated and checked by imposing the weight of both the pusher tug and the barge on the combination.

3.16 Special purpose vessels

3.16.1 For a special purpose vessel of less than 100 m in length L_L (L_L being the length as defined in 2.1(1) of Chapter 1 of PART THREE of the Guidelines), if its design and characteristics are similar to that of an offshore supply vessel, its intact stability is to comply with the requirements of 3.14 concerning offshore supply vessels.

3.16.2 For a special purpose vessel of 100 m in length or above, its intact stability is to comply with the requirements of 3.4 concerning cargo ships.

3.17 Marking of operating draft of working ships

3.17.1 General provisions

3.17.1.1 This section applies to working ships the operating draught of which is marked in accordance with Chapter 6 of PART THREE.

3.17.1.2 In operational areas defined by the limited sea conditions in 3.17.2 of this Chapter, the process of hoisting and handling operations of floating cranes, that of dredging operations of dredgers and that of loading, carrying and discharging operations of dredgers and barges are considered as their operating conditions.

3.17.2 Limitations on sea conditions for operations

3.17.2.1 For working operations at the maximum operating draught assigned in accordance with this Section, limitations on sea conditions for areas, in which the working ship is to operate, are as follows:

(1) For floating cranes, wind force is not to exceed Beaufort scale 5 and significant wave height is not to exceed 1 m.

(2) For dredgers and barges, wind force is not to exceed Beaufort scale 6 and significant wave height is not to exceed 2 m.

3.17.2.2 Where the environmental limitations as required by design regarding wind and wave for sea areas, in which working ships are to operate, are beyond those specified in 3.17.2.1, relevant technical proof and calculations or model test information for ensuring safe operation are to be submitted for approval or agreement. And this is to be indicated in the operating draught marking instruction in accordance with section 4 of chapter 6 of PART THREE.

3.17.3 Intact stability in operating condition

3.17.3.1 The stability of crane ships is to be checked for the following loading conditions:

(1) maximum lifting load, necessary ballast and all fuels and stores, the ship being at the

maximum operating draught;
(2) maximum lifting load, necessary ballast and 10% of fuels and stores.
3.17.3.2 The stability of crane ships in operating condition is to comply with the requirements of 3.10.6 of this Chapter:
3.17.3.3 The stability of dredgers and barges in operating condition is to comply with the following requirements:
(1) The stability of dredgers and barges in operating condition is to be checked for the following loading conditions:

① hopper fully loaded, with all fuels and stores;
② hopper fully loaded, with 10% of fuels and stores;
③ hopper partially loaded, with 10% of fuels and stores;
④ hopper unloaded, but being open to sea, with all fuels and stores;
⑤ hopper unloaded, but being open to sea, with 10% of fuels and stores.

When the hopper is fully loaded, spoil is to be loaded to the lower edge of the opening of the means for overflow specified in 3.2 of Chapter 6 of PART THREE, and the least of the values obtained is to be taken.
When the hopper is partially loaded, an additional layer of seawater is to be assumed on the top of spoil to reach the lower edge of the opening of the means for overflow specified in 3.2 of Chapter 6 of PART THREE, and the least of the values so obtained is to be taken.
(2) The density of spoil in hopper is to be taken as follows:

① the stability with the density of spoil ρ_{m1}, ρ_{m2} at the maximum operating draught according to the above (1)①,② is to be checked;
② the stability is to be checked according to (1)②, density of spoil ρ=1.4− 0.2 i t/m^3, (i = 0, 1, 2) whichever is the closest to and less than ρ_{m2};
③ the stability is to be checked according to (1)③, density of spoil ρ=2.2− 0.2 i t/m^3, (i=0,1…6) whichever is the closest to and over ρ_{m2}; where at the maximum operating draught, an additional layer of seawater on the top of spoil is to be regarded as overload.

(3) Characteristic values of righting lever curves for dredgers and barges in operating condition:

① the initial metacentric height is not to be less than 0.15 m;
② the righting lever GZ is to be at least 0.2 m at heeling angles equal to or over 30°;
③ the heeling angle θ_{max} corresponding to the maximum righting lever is to be not less than 15°;
④ up to the heeling angle θ_{max} corresponding to the maximum righting lever, the area under the righting lever curve (GZ curve) is to be not less than 0.055＋0.001(30°− θ_{max}) m·rad, and θ_{max} is taken as 30° if greater than 30°;
⑤ the area under the righting lever curve (GZ curve) between the heeling angles of 30° and 40°, or between 30° and immersion angle θ_f (if this angle is less than 40°) is not to be less than 0.03 m·rad.

(4) Weather criterion for dredgers and barges in operating condition:
The weather criterion in 2.3, Chapter 2, Part A of the International Code on Intact Stability, 2008 (2008 IS Code) is to be complied with, where the wind pressure P is taken as 215 N/m^2 and the angle of roll may be reduced by 20% but not less than 10°.
(5) For stability calculation, where the density of spoil in the hopper is equal to or less than 1.4 t/m^3, the effects of free surface of spoil on the initial metacentric height and righting lever curves are to be calculated and in this case, the outflow of liquid spoil and inflow of seawater over the upper edge of the hopper coaming by ship's heeling may be taken into account. Where the density of spoil in the hopper is greater than 1.4 t/m^3, the inflow and outflow of seawater through the lower edge of the opening of the means for overflow specified in 3.2 of Chapter 6 of PART THREE (and the least of the values obtained is to be taken) by ship's heeling is to be taken into account. The righting lever curves are to be calculated according to the actual changes of displacement and of centre of gravity of spoil.
(6) For dredgers and barges with bottom doors or similar opening means for the hopper, asymmetric discharging, which is possible due to failure of control mechanism of the door or other opening means, is to be taken into account. 20% of the total hopper load is to be assumed to be discharging only at one side of the longitudinal centre line of the hopper, horizontally and equally

distributed at the discharging side, according to the loading condition and the density of spoil respectively specified in (1)② and (2)① above.

In this situation, the stability is to comply with the following requirements:

① the angle of equilibrium is not to exceed 25°;

② the range of positive righting lever beyond the angle of equilibrium is not to be less than 30°;

③ the righting lever *GZ* within the range of positive righting lever beyond the angle of equilibrium is to be at least 0.1 m.

(7) Working ships intended for operations in icing areas are to comply with the relevant requirements in Chapter 6 of Part B of the International Code on Intact Stability, 2008 (2008 IS Code).

3.18 Pontoons

3.18.1 The stability of pontoons is to be checked for the following basic loading conditions:

(1) in fully loaded condition;

(2) in ballasted condition.

3.18.2 The stability of pontoons at mooring or in sheltering from wind condition is to be checked.

3.18.3 The intact stability of pontoons at mooring is to comply with the following requirements:

(1) The requirements for stability of non-self-propelling sea-going barges in paragraph 3.8 of this Chapter are to be complied with. For catamaran pontoons, the rolling amplitude is to be calculated according to the provisions in 3.3 of this Chapter. For multi-hull pontoons the rolling amplitude may be determined according to model testing, and if such data or information is not available, the rolling amplitude may be assumed as 15°.

(2) For a pontoon intended to carry passengers, the angle of statical heel of the pontoon caused by crowding of passengers to one side or by turning with full speed is to be calculated and checked in accordance with the requirements of 3.2.2 to 3.2.5 of this Chapter.

(3) For single-hull pontoons, if the angle of heel θ_m corresponding to the maximum righting lever cannot meet the requirement, this angle may be less than 25°, but not to be less than 15°, and the area under the righting lever curve up to the angle of heel corresponding to the maximum righting lever is not to be less than:

$$0.055+0.001(30^\circ-\theta_m) \quad \text{m·rad}$$

For catamaran or multi-hull pontoons, if the angle of heel θ_m corresponding to the maximum righting lever cannot meet the requirement, this angle may be less than 25°, but not to be less than 10°, and the area under the righting lever curve up to the angle of heel θ (the angle of heel corresponding to the maximum righting lever or the angle of flooding or 30°, whichever is least) is not to be less than:

$$0.055\bullet 30^\circ/\theta \quad \text{m·rad}$$

3.18.4 The stability of pontoons in sheltering from wind condition is to comply with the following formula:

(1) Initial metacentric height *GM*:

$$GM \geq \frac{M_f}{0.1716\theta_c \Delta} \quad \text{m}$$

where:

GM — the initial metacentric height after the correction of free surface effect of liquids, in m;

M_f — wind heeling moment for the pontoon in sheltering from wind condition, in kN·m;

θ_c — limit angle of statical heel for the loading condition under consideration, (°); this angle is not to exceed 4/5 of the angle at which the edge of deck immerses, 4/5 of the angle at which the bilge comes out of water, or the angle at which the residual freeboard is equal to 0.3 m, whichever is the least.

Δ— displacement for the loading condition under consideration, in t.

(2) The wind heeling moment M_f is to be obtained from the following formula:

$$M_f = 0.001P\sum C_i A_{f_i} Z_i \quad \text{kN·m}$$

where: *P* — calculated unit wind pressure, to be taken not less than 1559 Pa;

A_{fi} — windage area, in m^2;

Z_i — calculated wind pressure lever, in m, is to be the vertical distance between the centre of the windage area and the actual waterline for the loading condition under consideration when the ship is in the upright position;

C_i — factor of correction of height, taken from Table 3.18.4(2).

Factor of correction of height C_i **Table 3.18.4(2)**

Z_i (m)	0 ~ 15	> 15
C_i	1.0	1.16

3.19 Cargo ships carrying not more than 12 passengers

3.19.1 The angle of statical heel of the ship caused by crowding of passengers to one side or by turning with full speed is to be calculated and checked in accordance with the requirements of 3.2.2 to 3.2.5 of this Chapter.

Chapter 8 SIGNAL EQUIPMENT

1 General provisions

1.1 Application

1.1.1 Signal equipment is to include the following:

(1) lights;

(2) flashing lights;

(3) shapes;

(4) sound signaling appliance.

1.1.2 Ships of special construction or purpose cannot comply fully with the provisions of this Chapter with respect to the number, position, range or arc of visibility of lights or shapes, as well as to the disposition and characteristics of sound signaling appliances, may be partly relaxed the requirements of this Chapter subject to agreement.

1.2 Definitions

1.2.1 For the purposes of this Chapter:

(1) *Ship's length and breadth* mean the overall length and greatest breadth.

(2) *Height above the hull* means the height above the topside continuous deck, measured from the lower position of light vertically.

(3) *Towing length* means the horizontal distance measured from the stern of towing vessel to the aft end of the last towed object.

(4) *Ship not under command* means a ship which through some exceptional circumstance is unable to manoeuvre according to the collision prevention requirements and is therefore unable to keep out of the way of another ship.

(5) *Ship restricted in her ability not manoeuvre* means a ship which from the nature of her work is restricted in her ability to manoeuvre according to the collision prevention requirements and is therefore unable to keep out of the way of another ship, but not to be limited to:

① a ship engaged on laying, servicing or picking up a navigation mark, submarine cable or pipeline;

② a ship engaged on dredging, surveying or underwater operations;

③ a ship engaged on replenishment or transferring persons, provisions or cargo *en route*;

④ a ship engaged on the launching or recovery of aircraft;

⑤ a ship engaged on mine clearance operations;

⑥ a ship engaged on a towing operation such as severely restricts the towing ship and her tow in their ability to deviate from their course.

(6) *Ship constrained by her draught* means a power-driven ship which, because of her draught in relation to the available depth and width of navigable water, is severely restricted in her ability to deviate from the course she is following.

(7) *Forepart of ship* means the area before the midpoint of ship's overall length.

(8) *Non-displacement ship* means a dynamic supported craft such as hovercraft, air cushion ship, etc.

(9) *Wing-in-ground craft* means a dynamic air cushion high-speed craft which, in its main operational mode, flies by using ground effect above the water or some other surface, mainly, by an aerodynamic lift generated on a wing (wings), hull, or their parts, which are intended to utilize the ground effect action.

(10) *Navigation lights* mean the lights (such as masthead light, sidelight, sternlight, towing light and all-round light) specified in 2.1.1, all-round flashing yellow light specified in 3.1.2, manoeuvring light specified in 3.1.3 and flashing light (excluding daytime communication flashing light specified in 3.2.1) specified in 3.1.4.

(11) *Navigation light controller (NLC)* means a device enabling operational control of a navigation light.

1.3 General requirements

1.3.1 The environmental conditions and tests of electrical signal equipment are to be in compliance with the provisions of approved standards.

1.3.2 The type of protective enclosure for the electrical signal equipment is to be IP55.

1.4 Power supply

1.4.1 Navigation light controller is to be provided in an accessible place in bridge, each light is to be supplied power by independent circuit from the navigation light controller, and controlled by switches and fuses or breakers inside the controller on each insolation pole of such circuit. Duplicating lights provided are to be capable of converting on the control panel.

1.4.2 Navigation light controller is to be supplied power directly by main switchboard and emergency switchboard. Where temporary emergency electrical source is provided according to the requirements of Chapter 2-1 of PART FOUR, the navigation light controller is to be supplied power directly by emergency switchboard and temporary impulse discharging panel.

1.4.3 The power supply duration of all lights is to meet the requirements of Chapter 2-1.

1.4.4 The portable daytime communication lights are not to be supplied power by the main electrical source independently.

1.4.5 The electrical sound signaling appliances are to be capable of being supplied power by main electrical source, emergency electrical source and temporary emergency electrical source (if fitted, as required by Chapter 2-1).

1.5 Control

1.5.1 The navigation light controller is to be facilitate ON/OFF controls of individual light.

1.5.2 The navigation light controller is to provide visual indications of ON/OFF status of individual light.

1.5.3 Pre-programmed navigation light group settings may be provided.

1.5.4 The navigation light controller onboard a ship not less than 50 m in length is to provide the alarm for:

(1) failure of power supply to navigation lights; and

(2) failure, including short circuit, of a lamp which is switched ON.

1.5.5 The navigation light controller onboard a ship not less than 50 m in length is to present the status of all navigation lights in a logical presentation, meeting the requirements set out in resolution MSC.191(79), e.g., by symbol marks on a display.

1.5.6 All indicators of a navigation light controller are to be dimmable to ensure easy reading without disturbing the night vision of the officer of the watch. The brightness of a display, if fitted, of navigation light controller is to be controllable.

1.5.7 The navigation light controller is to support the use of standardized serial interfaces for marine navigation and communication systems, such as IEC 61162 series.

1.5.8 The navigation light controller is to have a bi-directional interface to transfer alarms to external systems and receive acknowledgements of alarms from external systems. The interface is to comply with the relevant international standards, such as IEC 61162 series.

1.5.9 The navigation light controller may be expanded to other lights specified of this Chapter, but excluding daytime communication light. However, other consumers are not to be connected to such controller.

2 Lights

2.1 Technical requirements

2.1.1 The main characteristics, such as color, range and arc of visibility of lights are to be in compliance with the requirements of Table 2.1.1.

Technical Requirements of Lights **Table 2.1.1**

No.	Name	Color	Minimum range of visibility (n mile)		Arc (°)	
			L ≥ 50 m	50 m > L ≥ 20 m	Total angle	Distribution
1	Masthead light	White	6	5	225	From right ahead to 22.5° abaft the beam on either side of the ship
2	Port sidelight	Red	3	2	112.5	From right ahead to 22.5° abaft the beam on port side
3	Starboard sidelight	Green	3	2	112.5	From right ahead to 22.5° abaft the beam on starboard side
4	Sternlight	White	3	2	135	From right aft to 67.5° on each side of the ship
5	Towing light	Yellow	3	2	135	From right aft to 67.5° on each side of the ship

6	All-round red light	Red	3	2	360	All-round
7	All-round white light	White	3	2	360	All-round
8	All-round green light	Green	3	2	360	All-round
9	All-round yellow light	Yellow	3	2	360	All-round

2.1.2 The chromaticity of all navigation lights is to lie within the boundaries of the area of the diagram specified for each color. The boundaries of the area for each color are given by indication the corner co-ordinates, which are shown in Table 2.1.2.

Corner Co-ordinates of Boundaries of the Area for Each Color Table 2.1.2

Color	Co-ordinates	Corner					
		1	2	3	4	5	6
White	X	0.525	0.525	0.453	0.310	0.310	0.443
	Y	0.382	0.440	0.440	0.348	0.283	0.382
Green	X	0.028	0.009	0.300	0.203		
	Y	0.385	0.723	0.511	0.356		
Red	X	0.680	0.660	0.735	0.721		
	Y	0.320	0.320	0.265	0.259		
Yellow	X	0.612	0.618	0.575	0.575		
	Y	0.382	0.382	0.425	0.406		

2.1.3 The range of visibility for lights is to be in compliance with the requirements of Table 2.1.1, and determined by measuring of intensity of lights. The minimum intensity of lights is to be calculated by the following equation:

$$I = 3.43 \times 10^6 TD^2 K^{-D}$$

where: I — luminous intensity in candelas under service conditions, in cd;

T — threshold factor $T = 2 \times 10^{-7}$, in lx;

D — range of visibility of the light, in n miles;

K — atmospheric transmissivity. For prescribed lights the value of K is to be 0.8, corresponding to a meteorological visibility of approximately 13 n miles.

2.1.4 Horizontal sectors:

(1) In the forward direction, sidelights as fitted on the vessel are to show how the minimum required intensities. The intensities are to decrease to reach practical cut-off between 1° and 3° outside the prescribed sectors;

(2) For sternlights and masthead lights at 22.5° abaft the beam for sidelights, the minimum required intensities are to be maintained over the arc of the horizon up to 5° within the limits of the sectors prescribed in Table 2.1.1. From 5° within the prescribed sectors the intensity may decrease by 50% up to the prescribed limits; it is to decrease steadily to reach practical cut-off at not more than 5° outside the prescribed sectors.

2.1.5 Vertical sectors:

(1) The vertical sectors of electric lights as fitted, with the exception of lights on sailing boats are to ensure that:

① at least the required minimum intensity is maintained at all angles from 5° above to 5° below the horizontal;

② at least 60% of the required minimum intensity is maintained from 7.5° above to 7.5° below the horizontal.

(2) In the case of lights other than electric these specifications are to be met as closely as possible.

2.1.6 Non-electric lights are so far as practicable to comply with the minimum intensities specified in 2.1.3 of this Chapter.

2.1.7 Lights are to be capable of normally operated under the ambient temperature of -30℃~ +50℃. The temperature rise in way of terminal blocks for lights is not to exceed +40℃. The glass

products of lights are to be capable of bearing the temperature shock.
2.1.8 The lights are to be provided with automatic leak-off devices on their enclosures.
2.1.9 The interior of enclosures for lights is to be painted in matt black.
2.1.10 Marine light bulbs are to be approved.
2.1.11 The structure and sign of lights are to be in compliance with the following requirements:
(1) The structure is to be facilitate for dismounting, jacking, parts renewal and portable, and capable of preventing from bulb loose and prolapse.
(2) The lights are to be connected by external wiring.
(3) Except all-round lights, the top of enclosure is to have arrow mark indicating the direction of bow or stern.
(4) The light enclosure is to have nameplate, marked with name, range of visibility, specification of bulb (or lampwick), electric source and voltage, manufacturer, manufacturing code, manufacturing date, sign and approval number of survey unit. Where it is infeasible for the small type lights, the signs of manufacturer and survey unit could be used for substitution.
(5) The manufacturer code and approval number are to be marked at the edge of lens or filter.
(6) Marine product certificate issued by survey unit is to be attached.

2.2 Provision

2.2.1 The lights are to be so provided as to meet the following requirements:
(1) The sea-going ships are to be provided with basic lights and manoeuvring lights in accordance with the provisions of 2.2.2 and 2.2.3 of this Chapter, respectively. Additional one set of masthead light, sidelight and sternlight is to be provided for the ships installed with propellers both at bow and stern. The multi-purposed ships are to be provided with various corresponding manoeuvring lights.
Where the following lights have the identical performances and are provided in compliance with the requirements of 2.3 of this Chapter, their duplicated number may be exempted:

① all-round red lights used for a ship not under command, a ship restricted in her ability to manoeuvre, a ship constrained by her draught;
② the identical lights of various manoeuvring lights.

(2) The lights specially required by port authority or shipper are to be considered.
(3) Fuel lights are prohibited to provide for ships engaged on carrying inflammable and explosive dangerous goods and the towboats used for towing and pushing such ships.
2.2.2 The basic lights are to be provided in accordance with Table 2.2.2. Duplexed or double bulbs are to be provided for masthead light, sidelight and sternlight onboard the ships of 50 m in length and above.

Provision of Basic Lights **Table 2.2.2**

No.	Ship's length (m) and type / Lights (number)	$L \geq 50$		$20 \leq L < 50$	
		Power-driven ship	Non power-driven ship	Power-driven ship	Non power-driven ship
1	Masthead light	2		1①	
2	Port sidelight	1	1	1	1
3	Starboard sidelight	1	1	1	1
4	Stern light	1	1	1	1
5	All-round white light (anchor light)	2	2	1②	1②
6	All-round red light (not under command light)	2		2	

Notes: ① Two masthead lights may be provided.
② Two all-round white lights may be provided to use as fore and aft anchor lights.

2.2.3 The manoeuvring lights are to be provided in accordance with Table 2.2.3.

Provision of Manoeuvring Lights **Table 2.2.3**

No.	Ship's type / Light (number)	Tow boat	Pilot vessel	Ship restricted in her ability to manoeuvre	Ship constrained by her draught

1	Masthead light	2①			
2	Towing light	1			
3	All-round white light	1	1	1	
4	All-round red light	2	1	2	3
5	All-round green light			3②	

Notes: ① Pushing vessel and towboat with the towing length of 200 m or less are to be provided with two masthead lights vertically, towboat with the towing length more than 200 m is to be provided with three lights vertically so as to substitute masthead light.

② Ships engaged on mine clearance operations are to be provided with three all-round green lights, other than two all-round red lights and one all-round white light.

2.2.4 In addition to the lights provided in accordance with the 2.2.1~2.2.3 of this Chapter, ships engaged on towing and pushing are to be provided with lights as specified by the following provisions:

(1) When a pushing vessel and a ship being pushed ahead are rigidly connected in a composite unit, they are to be regarded as a power-driven ship and basic lights are to be provided.

(2) A power-driven ship when pushing ahead or towing alongside, except in the case of a composite unit, is to be provided with two sidelights, one sternlight and two masthead lights vertically so as to substitute the masthead lights required by 2.3.2 or 2.3.3 of this Chapter.

(3) Provided that any number of ships being towed alongside or pushed in a group is to be lighted as one ship:

① a ship being pushed ahead, not being part of a composite unit, is to be provided two sidelights at the forward end;

② a ship being towed alongside is to be provided with a stern light and two sidelights at the forward end.

(4) An inconspicuous, partly submerged ship or object, or combination of such vessels or objects being towed, is to be provided with:

① if it is less than 25 m in breadth, one all-round white light at or near the forward end and one at or near the after end except that dracones need not exhibit a light at or near the forward end;

② if it is 25 m or more in breadth, two additional all-round white lights both for port side and starboard side at or near the extremities of its breadth;

③ if it exceeds 100 m in length, additional all-round white lights between the lights prescribed in ① and ② so that the distance between the lights is not to exceed 100 m.

(5) A power-driven ship engaged on a towing operation such as severely restricts the towing vessel and her tow in their ability to deviate from their course is, in addition to the basic lights or manoeuvring lights as required, to be provided with the lights which exhibit the manoeuvring ability restriction.

2.2.5 Where the wing-in-ground craft could not be provided with lights of various characteristics or at the positons required in this Chapter, at least sidelights and sternlights are to be provided.

2.3 Installation positions

2.3.1 The all-round lights are to be installed in:

(1) a position where is easily to see.

(2) All-round lights are to be so located as not to be obscured by masts, topmasts or structures within angular sectors of more than 6°, except anchor lights, which need not be placed at an impracticable height above the hull. If it is impracticable to comply with the above-mentioned requirements by exhibiting only one all-round light, two all-round lights are to be used suitably positioned or screened so that they appear, as far as practicable, as one light at a distance of 1 n mile.

(3) Where two or three lights are exhibited vertically, they are to be spaced as follows:

① on a ship of 20 m in length or more such lights are to be spaced not less than 2 m apart, except where a towing light is required, to be placed at a height of not less than 4 m above the hull;

② equally spaced if three lights are provided.

(4) When it is impracticable to carry the all-round lights required by 2.3.11 and 2.3.12 of this Chapter below the masthead lights, they may be carried above the after masthead lights or vertically in between the forward masthead lights and after masthead lights, provided that in the latter case all-round lights are to be placed at a horizontal distance of not less than 2 m from the fore and aft centerline of the ship in the athwart ship direction.
(5) Other luminaires are not to be provided so as not to impair the performances lights specified in this Chapter.
(6) Lights installed permanently are to be so provided as to be facilitate for dismounting, and proper jacking system is to be fitted to hang the lights, and the positions are to in compliance with the requirements of 2.3 of this Chapter.
2.3.2 The forward masthead lights are to be so provided:
(1) at the vertical position:
① the masthead are to be so placed as to be above and clear of all other lights and obstructions except the manoeuvring lights and the provisions in 2.3.1(4) of this Chapter;
② the height of forward masthead lights is to be not less than 6 m above the hull; if the ship's breadth is more than 6 m, the height of such lights is not to be less than the ship's breadth, but not more than 12 m;
(2) at the horizontal position:
① the forward masthead lights are to be placed in ship's longitudinal section;
② the forward masthead lights are to be placed not more than one quarter of the length of the ship from the stem.
(3) Where only one masthead light is provided, it is to be placed at the forepart of ship, with the installation height is identical to that of the forward masthead light.
2.3.3 The after masthead lights are to be so provided
(1) at the vertical position:
① the after masthead lights are to be at least 4.5 m higher than the forward masthead light;
② the vertical distance between the forward and after masthead lights is to be such that in all normal conditions of trim the after light will be seen over and separate from the forward light at a distance of 1000 m from the stem when viewed from sea-level;
(2) at the horizontal position:
① the after masthead lights are to be placed in ship's longitudinal section;
② the horizontal distance between forward and after masthead lights is to be not less than one half of the length of the ship, but not more than 100 m.
2.3.4 Installation of sidelights
(1) at the vertical positon: the sidelights of a power-driven ship are to be placed at a height above the hull not greater than three quarters of that of the forward masthead light. They are not to be so low as to be interfered with by deck lights;
(2) at the horizontal position:
① on a power-driven ship of 20 m in length or above, the sidelights are not to be placed in front of the forward masthead lights. They are to be placed at or near the side of the ship;
② the sidelights of a towed or pushed ship are to be placed at the forward of the ship.
(3) The sidelights of ships of 20 m in length or above are to be fitted with inboard screens painted matt black, and meeting the requirements of 2.1.4 of this Chapter.
2.3.5 Installation of sternlights: the sternlights are to be placed near the stern as far as possible.
2.3.6 Installation of anchor lights
(1) Where only one anchor light is provided, it is to be in a position easily to see;
(2) Where two anchor lights are provided, the forward anchor light is to be placed in the forepart of ship while the after anchor light is in or near the after of ship, and the forward anchor light is to be not less than 4.5 m higher than the after anchor light. On a ship of 50 m in length and above, the forward anchor light is to be placed at a height of not less than 6 m above the hull.
2.3.7 Installation of lights onboard a not under command: Two all-round red lights are to be placed on the same vertical line, and their space and height are to be in compliance with the requirement of 2.3.1(3) of this Chapter.
2.3.8 Installation of lights onboard a towboat or pushing vessel: Two or three masthead lights are to be placed on the same vertical line and in compliance with the requirement of 2.3.1(3) of this

Chapter, one of the masthead lights is to be placed in the same position as either the forward masthead light or the after masthead light; provided that, if fitted on the aftermost, the lowest after masthead light is to be at least 4.5 m vertically higher than the forward masthead light.

2.3.9 Installation of towing lights: The towing lights are to be placed on the same vertical line of sternlights, the upper being yellow and the lower white, their space is to be in compliance with the requirement 2.3.1(3) of this Chapter.

2.3.10 Installation of lights onboard a pilot vessel: Two all-round lights are to be placed on the same vertical line, the upper being white and the lower red, in or near the top of mast, and their space and height are to be in compliance with the requirement of 2.3.1(3) of this Chapter.

2.3.11 Installation of lights onboard ships with the restricted manoeuvring ability: Three all-round lights are to be place on the same vertical line, the upper being red, middle white and lower red, and they are to be installed in accordance with the requirements of 2.3.1(3) and (4) of this Chapter.

2.3.12 Installation of lights onboard ships with restricted draught:

Lights for ship constrained by her draught: three all-round red lights are to be on the identical vertical line and in compliance with the requirements of 2.3.1(3) and (4) of this Chapter.

2.3.13 Direction-indication lights for dredger and ship engaged on underwater operations: two all-round red lights in a vertical line to indicate the side on which the obstruction exists; two all-round green lights in a vertical line to indicate the side on which another ship may pass; these lights are to be placed at a maximum horizontal distance, as far as possible, from the lights specified in 2.3.11 of this Chapter, not less than 2 m. The light at the highest place could not be higher than the lowest one specified in 2.3.11 of this Chapter. The lights are to be so installed to be in compliance with the requirements of 2.3.1(3) and (4) of this Chapter.

2.3.14 Lights for ship engaged in mine-clearance operation: one all-round green light is to be placed near the top of fore masthead, and the other two are to be placed at both ends of fore yard, respectively.

3 Flashing lights

3.1 Technical requirements

3.1.1 The main characteristics such as type, purpose, range of visibility and color of light for flashing lights are to be listed in Table 3.1.1.

Technical Requirements of Flashing Lights **Table 3.1.1**

No.	Type	Purpose	Range of visibility (n mile)	Color of light	Transmitting direction
1	Portable daytime communication flashing light	communication	2	White	Directional
2	Mast	Air cushion ship	3	Yellow	All-round
			2		
3	Mast	Manoeuvring	5	White	All-round

3.1.2 The all-round yellow flashing lights for air cushion ship are to flash at regular intervals at a frequency of 120 flashes or more per minute.

3.1.3 The duration of each flash is to be about one second, the interval between flashes is to be about one second, and the interval between successive signals is to be not less than ten seconds.

3.1.4 The horizontal intensity of light I_f for flashing light is not to be less than the value calculated by the following equation:

$$I_f = \frac{0.2 + t}{t} I$$

where: t — duration of flash, in s;

I — intensity of light according to the provision of 2.1.3, in cd.

3.1.5 The structure of flashing light is to be in compliance with the following requirements:

(1) The nameplate and product certificate are meet the provision of 2.1.11(4) of this Chapter.

(2) The requirements of color of light, ambient temperature, electrical installation and material, operational reliability for flashing lights are to be identical to those for the lights.

3.2 Provision

3.2.1 Ships of 150 gross tonnage and above are to be provided with one daytime communication flashing light and two standby bulbs. The non-power-driven ships are unnecessary to provide.

3.2.2 The operating signal given by whistle could be supplemented by lights for manoeuving required in No.3 in Table 3.1.1.

3.2.3 In addition to the provisions of 2.2 of this Chapter, when the air cushion ships are navigating under non-displacement condition, flashing lights are to be provided in accordance with Table 3.2.3.

Provision of Flashing Lights for Air Cushion Ships **Table 3.2.3**

No.	Type	Range of visibility (n mile)	Length of ship (m)	
			≥ 50	< 50
1	Mast (all-round yellow light)	3	1	
2	Mast (all-round yellow light)	2		1

3.2.4 In addition to the lights specified in No.1 to No.4 in Table 2.2.2, when the wing-in-ground craft is only taking off, launching and flying near the ground, one all-round red flashing light with high intensity is to be exhibited.

3.3 Installation

3.3.1 The daytime communication flashing light is to be placed in a dedicated box provided by the manufacturer, the box is to be permanently placed in an accessible position in bridge room, but not to impede the operation and passage, generally at the left or light fore corner in bridge room. The power supply socket is to be placed adjacent to the box, and the associated flexible cable is to be so provided that the length are to be longer than the distance from this socket to any side, for this purpose, two power supply sockets are to be provided.

3.3.2 The flashing lights for wing-in-ground craft are to be placed in a position easily to see.

3.3.3 The manoeuvring light is to be placed at the identical fore and aft vertical planes of one or more masthead lights, if it is feasible, the manoeuvring light is to be 2 m higher than the fore masthead light vertically, however, such light is to be placed not less than 2 m higher or lower than after masthead light vertically. Where only one masthead light is provided onboard the ship, the manoeuvring light, if fitted, is to be placed in a place easily to see and not less than 2 m distanced from masthead light.

4 Shapes

4.1 Technical requirements

4.1.1 The shapes are to be black and the specification is to meet the requirements in Table 4.1.1.

Specification of Shapes **Table 4.1.1**

No.	Name of shape	Required diameter (mm)	Recommended diameter (mm)
1	Big ball	≥ 600	610±10
2	Big cone	≥ 600	610±10
3	Big rhomboid	Two cones share one bottom	610±10
4	Cylinder	≥ 600 (height = diameter × 2)	610±10
5	Small ball	≥ 400	410±10
6	Small cone	≥ 400	410±10
7	Small rhomboid	Two cones share one bottom	410±10

4.1.2 Shapes are to be made of durable, light and non-fading materials.

4.1.3 The vertical distance between shapes is not to be less than 1.5m, and the vertical distance between shapes with small size may be correspondingly reduced.

4.2 Provision

4.2.1 Shapes are to be provided in accordance with Table 4.2.1.

One cylinder shape is to be provided for the ship restricted in her draught.

Whenever the size of a ship engaged on diving operations makes it impracticable to exhibit shapes identical to those for the dredger and ship engaged on underwater operations, a rigid replica of the International Code flag "A" not less than 1 m in height is to be provided and measures are to be taken to ensure its all-round visibility.

Provision of Shapes **Table 4.2.1**

No.	Ship's type / Number / Name of shape	Towing boat, towed ship (or towed objects)	Ship restricted in her ability to manoeuvre	Other power-driven vessels
	Name of shape	≥ 20	≥ 20	≥ 20
1	Big ball	3	3②	3
2	Big rhomboid	1①	1③	

Notes: ① Such shape is to be provided for the towing boat and towed ship with the towing length more than 200 m. Such shape is also to be provided for imperceptible and partly immersed towed ship or object, or their combination, two shapes are to be provided when the towing length exceeds 200 m.

② Four shapes are to be provided for a dredger or ship engaged on underwater operations.

③ Three shapes are to be provided for a dredger or ship engaged on underwater operations. Two shapes are to be provided for a power-driven ship with the towing length more than 200 m and engaged on a towing operation such as severely restricts the towing boat and her tow in their ability to deviate from their courses.

5 Sound signaling appliances

5.1 Technical requirements

5.1.1 The sound signaling appliances are categorized in accordance with the Table 5.1.1.

Technical Requirements of Sound Signaling Appliances **Table 5.1.1**

No.	Name	Basic frequency range (Hz) or diameter (mm)	Sound pressure level (dB)	Range of audibility (n mile)
1	Super whistle	70~200	143	2
2	Large whistle	130~350	138	1.5
3	Middle whistle	250~700	130	1
4	Small whistle	250~700	120	0.5
5	Large bell	Diameter ≥ 300	110②	—
6	Small bell	Diameter ≥ 200	110②	—
7	Gong	Diameter ≥ 400①	110②	—

Notes: ① It is the recommended value.

② Measured from a distance of 1 m.

The range of audibility in the table above is for information and is approximately the range at which a whistle may be heard on its forward axis with 90 per cent probability in conditions of still air on board a vessel having average background noise level at the listening posts (taken to be 68 dB in the octave band centred on 250 Hz and 63 dB in the octave band centred on 500 Hz).

5.1.2 The basic frequency of whistle is to meet the requirement of Table 5.1.1, if it is a combined whistle system which sounds simultaneously, the frequency of any one whistle is to differ from those of the others by at least 10 Hz.

A whistle fitted in a ship is to provide, in the direction of maximum intensity of the whistle and at a distance of 1 m from it, a sound pressure level in at least one-third octave band within the range of frequencies 180 to 700 Hz (±1 per cent) of not less than the requirement in Table 5.1.1. The sound pressure level is to be measured in that one-third octave band which determines the audibility range.

5.1.3 For whistles having directional properties, the sound pressure level on the axis is not to be less than the requirements in Table 5.1.1. The sound pressure level of a directional whistle is to be not more than 4 dB below the specified sound pressure level on the axis at any direction in the horizontal plane within +45 degrees of the axis. The sound pressure level at any other direction in the horizontal plane is to be not more than 10 dB below the specified sound pressure level on the axis, so that the range in any direction will be at least half the range on the forward axis. The sound pressure level is to be measured in that one-third octave band which determines the

audibility range.

5.1.4 The whistles are to be capable of giving a prolonged blast with duration of 4 ~ 6 seconds and a short blast with duration of 1 second, the sound given by a whistle is to be without chattering and fluctuating and the each sound experience is to be clearly identifiable.

5.1.5 The dynamic system of a power whistle is to be so safety and reliable as to be capable of normally operating when the ship is navigating, and the electrical whistle is to be capable of reliably operating when the power source voltage changes +6% ~ −10%of rated value and the frequency changes ±5%of the rated value.

5.1.6 Where an automatic fog control device is provided for whistle, one sound at interval of not more than 2 minutes or sound at intervals of not more than 2 minutes two prolonged blasts in succession with an interval of about 2 seconds between them, and fog alarm is to be capable of being stopped immediately, at meanwhile, manual device is to be provided.

5.1.7 The diameters and sound pressure levels of gongs and bells are to meet the requirements of Table 5.1.1. The sound pressure level is to be measured in accordance with that of whistle. The gongs and bells are to be made of corrosion-resistant materials, and are to be so designed to be capable of giving a clear tone. A rod is to be provided for gong, and a striker more than 3% of the mass of the bell is to be provided for bell. If practicable, a power-driven bell striker is recommended to ensure constant force but manual operation is to be possible.

5.2 Provision

5.2.1 Sound signaling appliances are to be provided in accordance with Table 5.2.1.

The bell or gong or both may be replaced by other equipment having the same respective sound characteristics, provided that manual sounding of the specified signals are to be always possible.

Provision of Sound Signaling Appliances **Table 5.2.1**

Length of ship (m) / Number (piece) / Name	$L \geq 200$	$100 < L < 200$	$75 \leq L < 100$	$20 \leq L < 75$
Super whistle	1			
Large whistle		1	1	
Middle whistle				1
Small whistle				
Large bell	1	1	1	1
Small bell				
Gong	1	1		

5.3 Installation and storage

5.3.1 The whistle is to be installed with its maximum intensity directed straight ahead and placed as high as practicable on a ship so as to reduce interception of the emitted sound by obstructions

5.3.2 The sound pressure level of the ship's own signal at bridge room is not to exceed 110 dB(A) and so far as practicable not exceed 100 dB(A). If it is a combined whistle system consisting of two whistles as a group, such sound pressure level is to be measured when the two whistles sound simultaneously.

5.3.3 The whistles of a combined system are to be located at a distance apart of not more than 100 m and arranged to be sounded simultaneously. If the horizontal space of whistles is more than 100m, arrangement is to be so made that they do not sound simultaneously.

5.3.4 For ships of 100 m in length or above, the bells are to be located in the fore part of the ships; for ships less than 100 m in length, such bells could be located in any position where is benefit for sound emitting provided that they are not used as a contact tool during anchoring operations.

5.3.5 The gongs and rods are to be placed in an accessible position at the after part of ship, and one device for hanging gong is to be provided near the stern.

Appendix 1 Comparison of Range of Visibility and Luminous Intensity for Lights

Range of visibility (luminous range) of light D (n mile)	Luminous intensity of light in candelas for K=0.8 I (cd)
1	0.9
2	4.3
3	12
4	27
5	52
6	94

Appendix 2 Chromaticity of Lights (Diagram)

