

RESOLUTION A.265 (VIII) adopted on 20 November 1973
REGULATIONS ON SUBDIVISION AND STABILITY OF PASSENGER SHIPS AS EQUIVALENT TO PART B OF
CHAPTER II OF THE INTERNATIONAL CONVENTION FOR THE SAFETY OF LIFE AT SEA, 1960

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**REGULATIONS ON SUBDIVISION AND STABILITY OF
PASSENGER SHIPS AS EQUIVALENT TO PART B OF
CHAPTER II OF THE INTERNATIONAL CONVENTION
FOR THE SAFETY OF LIFE AT SEA, 1960**

THE ASSEMBLY,

NOTING Article 16(i) of the Convention on the Inter-Governmental Maritime Consultative Organization concerning the functions of the Assembly,

NOTING ALSO Recommendation 6 of the International Conference on Safety of Life at Sea, 1960,

BEARING IN MIND Regulation 5 of Chapter I of the International Convention for the Safety of Life at Sea, 1960,

HAVING CONSIDERED the Recommendation of the Maritime Safety Committee at its twenty-seventh session on the adoption of Regulations on Subdivision and Stability of Passenger Ships as an equivalent to Part B of Chapter II of that Convention and consequential changes to other Parts of that Chapter, as well as explanatory notes to the aforementioned Regulations prepared by the Sub-Committee on Subdivision and Stability, which have been circulated to governments in MSC/Circ.153 for guidance and information,

RECOMMENDS that governments concerned accept the total application of the Regulations on Subdivision and Stability of Passenger Ships set out in the Annex to this Resolution as being equivalent to and a total alternative to the provisions of Part B of Chapter II of the International Convention for the Safety of Life at Sea, 1960,

INVITES governments, through the Organization, to exchange information on the action taken in this respect,

RECOMMENDS that governments, through the Organization, should exchange experience gained as a result of using these Regulations, particularly in regard to the use of such relaxations which are permitted by Regulation 2(d),

REQUESTS the Maritime Safety Committee to consider comments submitted as a result of the application of these Regulations with a view to practical evaluation of the Regulations and determining their suitability and related necessary changes to Chapter II of that Convention, as amendments to that Chapter.

ANNEX

**REGULATIONS ON SUBDIVISION AND STABILITY OF
PASSENGER SHIPS AS AN EQUIVALENT TO PART B OF
CHAPTER II OF THE INTERNATIONAL CONVENTION
FOR THE SAFETY OF LIFE AT SEA, 1960**

1. The Regulations hereunder constitute an equivalent to and a total alternative to the requirements of Part B of Chapter II of the International Convention for the Safety of Life at Sea, 1960 for passenger ships.

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2. In applying these equivalent Regulations the following should be observed for other Parts of Chapter II of that Convention :

Part A Regulation 1(d) and Regulation 2 are not applicable.

Parts C, F and H

In Regulations 25(a), 37(b), 68(a), 94(1), 96(b), 99(a), (b) and (c) and 108 the term "bulkhead deck" is to be replaced by the term "relevant bulkhead deck" as defined in Regulation 1(e) of the equivalent Regulations.

3. The following references to Regulations relate solely to the Regulations of this Equivalent.

Regulation 1 – Definitions

For the purpose of these Regulations, unless expressly provided otherwise:

- (a) (i) A "subdivision loadline" is a waterline used in determining the subdivision of the ship; and
 - (ii) the "deepest subdivision loadline" is the waterline which corresponds to the greatest draught permitted by the subdivision requirements which are applicable.
- (b) the "subdivision length of the ship" (L_s) is the extreme moulded length of that part of the ship below the immersion limit line.
- (c) "midlength" is the midpoint of the subdivision length of the ship (L_s).
- (d) (i) the "breadth" (B_1) is the extreme moulded breadth of the ship at midlength at or below the deepest subdivision loadline;
 - (ii) the "breadth" (B_2) is the extreme moulded breadth of the ship at midlength at the relevant bulkhead deck.
- (e) The "relevant bulkhead deck" is the uppermost deck which, together with the watertight bulkheads bounding the extent of flooding under consideration and the shell of the ship, defines the limit of watertight integrity in the flooded condition.
- (f) The "immersion limit line" at any point in L_s is defined by the highest relevant bulkhead deck at side at that point.
- (g) The "draught" (d_i) is the vertical distance from the moulded base line at midlength to the waterline in question.
 - (i) The "subdivision draught" (d_s) is the draught up to the subdivision loadline in question.
 - (ii) The "lightest service draught" (d_o) is the service draught corresponding to the lightest anticipated loading and associated tankage, including, however, such ballast as may be necessary for stability and/or immersion.
 - (iii) Intermediate draughts between d_s and d_o are:

$$d_1 = d_s - \frac{2}{3}(d_s - d_o)$$

$$d_2 = d_s - \frac{1}{3}(d_s - d_o)$$

$$d_3 = d_s - \frac{1}{6}(d_s - d_o)$$
- (h) The "effective mean damage freeboard" (F_1) is equal to the projected area of that part of the ship taken in the upright position between the relevant bulkhead deck and the damage waterline and between $\frac{1}{3}L_s$ forward and abaft the midlength divided by $\frac{2}{3}L_s$. In making this calculation no part of the area which is more than $0.2B_2$ above the damage waterline shall be included. However, if there are stairways or other openings in the bulkhead deck through which serious downflooding could occur F_1 shall be taken as not more than $\frac{1}{3}(B_2 \tan \theta_f)$, where θ_f is the angle at which such openings would be immersed.
- (i) The "permeability" (μ) of a space is the proportion of the immersed volume of that space which can be occupied by water.

Regulation 2 – Subdivision Index

- (a) To provide for buoyancy and stability after collision or other damage, ships shall have sufficient intact stability and be as efficiently subdivided as is possible having regard to the nature of the service for which they are intended.
- (b) The subdivision of a ship is considered sufficient if:
- (i) the stability of the ship in damaged condition meets the requirements of Regulation 5; and
 - (ii) the attained Subdivision Index A according to Regulations 6 and 7 is not less than the required Subdivision Index R calculated in accordance with paragraph (c) of this Regulation.
- (c) The degree of subdivision is determined by the required Subdivision Index R, as follows:

$$R = 1 - \frac{1000}{1.22L_s + N + 1500} \quad (\text{in feet}) \quad \dots\dots\dots (I)$$

$$R = 1 - \frac{1000}{4L_s + N + 1500} \quad (\text{in metres})$$

Where:

$$N = N_1 + 2N_2$$

N_1 = number of persons for whom life-boats are provided.

N_2 = number of persons (including officers and crew) that the ship is permitted to carry in excess of N_1 .

- (d) Where the conditions of service are such that compliance with paragraph (b) of this Regulation on the basis of $N = N_1 + 2N_2$ is impracticable and where the Administration considers that a suitably reduced degree of hazard exists, a lesser value of N may be taken but in no case less than $N = N_1 + N_2$.

Regulation 3 – Special Rules concerning Subdivision

- (a) In ships 330 feet (or 100 metres) in length and upwards the watertight transverse bulkhead next abaft the forepeak bulkhead shall be located so that the s-value, as defined in Regulation 6(a), for a combination of the forepeak and adjacent compartment, calculated by formulae (VIII) and (IX) shall not be less than 1.0. However, in no case shall the distance between the forepeak bulkhead and the next bulkhead be less than the longitudinal extent of damage specified in Regulation 5(b)(i).
- (b) A watertight 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 of $0.2B_1$ from the ship's side, and measured at right angles to the centreline at the level of the subdivision loadline. Any part of a recess which lies outside these limits shall be dealt with as a step, as provided in Regulation 5(b)(i).

Regulation 4 – Permeability

- (a) For the purpose of the subdivision and damage stability calculations of Regulations 5, 6 and 7 the permeability of each space or part of a space subject to flooding either during any intermediate stage or in the final stage of flooding shall be as follows:

<i>Spaces</i>	<i>Permeability (μ)</i>
Appropriated as accommodation for passengers and crew, or other spaces not specifically herein designated	0.95
Appropriated for machinery	0.85
Normally occupied by stores	0.60
Intended for consumable liquids	0.00 or 0.95*

* whichever results in the more severe requirement.

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(b) The permeability μ of any space appropriated for cargo shall be assumed to vary with the draught before damage in such a way that for any initial draught d_i the permeability μ_i of any cargo space shall be taken as:

$$\mu_i = 1.000 - \frac{1.2(d_i - d_o)}{d_s} - \frac{0.05(d_s - d_i)}{(d_s - d_o)}$$

but not more than 0.95 nor less than 0.60.

(c) If the ship's arrangement or service are such that the use of other permeabilities resulting in more severe requirements is logical the use of other permeabilities may be required by the Administration.

Regulation 5 – Subdivision and Damage Stability

(a) Sufficient intact stability shall be provided in all service conditions so as to enable the ship to comply with the provisions of this Regulation. Before certification of the ship the Administration shall be satisfied that the required intact stability can practicably be obtained in service.

- (b) (i) All ships shall be so designed as to comply with the provisions of this Regulation in the event of flooding due to one side damage with a penetration of $0.2B_1$ from the ship's side at right angles to the centreline at the level of the subdivision loadline and a longitudinal extent of 9.8 feet (3.00 metres) + $0.03L_s$, or 36 feet (11 metres) whichever is the less, occurring anywhere in the ship's length, but not including a transverse bulkhead. However, where a bulkhead is stepped it shall be assumed as subject to damage.
- (ii) Ships for which N is more than 600 shall additionally be able to comply with this Regulation in the event of flooding, due to side damage including transverse bulkheads occurring anywhere within a length equal to $(\frac{N}{600} - 1.00)L_s$, measured from the forward terminal of L_s , where N is as defined in Regulation 2(c) and (d). The value of $(\frac{N}{600} - 1.00)$ shall not be more than one.
- (iii) In any calculation required under this paragraph the damage shall be assumed to extend from the base line upwards without limit. However, if flooding due to a lesser extent of damage either vertically, transversely or longitudinally results in a higher necessary intact metacentric height, such a lesser extent of damage shall be assumed. In all cases, however, only one breach in the hull and only one free surface need be assumed. For the purpose of assessing heel prior to equalization the bulkheads and deck bounding refrigerated spaces and other decks or inner divisions which in the opinion of the Administration are likely to remain sufficiently watertight after damage, shall be regarded as limiting flooding. Otherwise, flooding shall be assumed as limited only by undamaged watertight structural divisions.
- (c) (i) In the final stage of flooding:
- (1) there shall be a positive metacentric height, GM , calculated by the constant displacement method and for the ship in upright condition, of at least

$$GM = 0.003 \frac{B_2^2(N_1 + N_2)}{\Delta F_1} \quad \text{or}$$

$$GM = 0.049 \frac{B_2}{F_1} \quad (\text{in feet})$$

$$GM = 0.015 \frac{B_2}{F_1} \quad (\text{in metres}) \quad \text{or}$$

$GM = 2$ inches (0.05 m) whichever is the greater

Where: Δ = displacement of the ship in the undamaged condition (in long tons or metric tons respectively);

- (2) the angle of heel in the case of one compartment flooding shall not exceed 7 degrees. For the simultaneous flooding of two or more adjacent compartments a heel of 12 degrees may be permitted unless the Administration considers a lesser heel necessary to ensure an adequate amount and range of residual stability;

- (3) except in way of the flooded compartment or compartments no part of the relevant bulkhead deck at side shall be immersed.
- (ii) Unsymmetrical flooding shall be kept to a minimum consistent with efficient arrangements. If any equalizing arrangements are necessary to ensure that the angle of heel in the final stage of flooding does not exceed the limits specified in sub-paragraphs (i)(2) and (3) of this paragraph, these arrangements shall, where practicable, be self-acting. However, if controls are necessary, they shall be operable from above the highest relevant bulkhead deck. All such arrangements shall be acceptable to the Administration.
- (iii) The Administration shall be satisfied that stability prior to equalization is sufficient. However, in no case shall the maximum heel before equalization exceed 20 degrees nor shall it result in progressive flooding. Additionally, the time for equalization of cross-connected spaces to at least the limits specified in sub-paragraphs (i)(2) and (3) of this paragraph shall not exceed ten minutes.
- (iv) The Administration shall be satisfied that the residual stability is sufficient during intermediate flooding and that progressive flooding will not take place. Calculations relative thereto shall be in accordance with the provisions of sub-paragraph (b)(iii) of this Regulation, respecting the assumed extent of damage and resulting extent of flooding. Heel during intermediate flooding due either to negative metacentric height alone or in combination with unsymmetrical flooding shall not exceed 20 degrees.
- (d) Damage stability calculations performed in compliance with this Regulation shall be such as to take account of the form and the design characteristics of the ship and the arrangements, configuration and probable contents of the compartments considered to be flooded. In making calculations for heel prior to equalization and for equalization time, the flooding of that portion of the ship opened to the sea shall be assumed to be completed prior to commencement of equalization. For each initial draught condition the ship shall be at the most unfavourable intact service trim anticipated at that draught having regard to the influence of the trim on the freeboard in the flooded condition.
- (e) The intact metacentric height, and corresponding vertical centre of gravity, necessary to provide compliance with the requirements specified in paragraphs (b) and (c) of this Regulation shall be determined for the operating range of draughts between d_s and d_o . If $(d_s - d_o)$ does not exceed $0.1 d_s$, damage stability calculations may be made only for d_s and d_o , and the intermediate values may be obtained by linear interpolation. If $(d_s - d_o)$ exceeds $0.1 d_s$, damage stability calculations shall also be made for at least one additional intermediate draught. However, in all cases where there are vertical discontinuities in permeabilities or in free surfaces which may result in discontinuities in the necessary intact metacentric height, damage stability calculations shall be made for the corresponding draughts in order to define such discontinuities.

Regulation 6 – Attained Subdivision Index A

- (a) (i) In addition to complying with Regulation 5 the attained Subdivision Index A shall be determined for the ship by formula (II):

$$A = \sum a p s \dots\dots\dots (II)$$

Where:

“a” accounts for the probability of damage as related to the position of the compartment in the ship’s length,

“p” evaluates the effect of the variation in longitudinal extent of damage on the probability that only the compartment or group of compartments under consideration may be flooded, and

“s” evaluates the effect of freeboard, stability and heel in the final flooded condition for the compartment or group of compartments under consideration.

- (ii) The summation indicated by formula (II) is taken over the ship’s length for each compartment taken singly. To the extent that the related buoyancy and stability in the final condition of flooding are such that “s” is more than zero, the summation is also taken for all possible pairs of adjacent compartments, and may be taken for all possible groups of a higher number of adjacent compartments if it is found that such inclusion contributes to the value of the attained Subdivision Index A.
- (iii) Wherever wing compartments are fitted and where the assumed damage used in the damage stability calculations according to Regulation 5 forming the basis for the “s” calculation does not result in flooding of the associated inboard spaces, “p” shall be multiplied by “r” as determined in Regulation 7(b).

(b) The factor "a" in formula (II) shall be determined for each compartment and for each group of compartments by formula (III):

$$a = 0.4 \left[1 + \xi_1 + \xi_2 + \xi_{12} \right] \dots\dots\dots (III)$$

Where:

$$\xi_1 = \frac{X_1}{L_s} \text{ if } X_1 \text{ is equal to or less than } 0.5L_s$$

and otherwise

$$\xi_1 = 0.5$$

$$\xi_2 = \frac{X_2}{L_s} \text{ if } X_2 \text{ is equal to or less than } 0.5L_s$$

and otherwise

$$\xi_2 = 0.5$$

$$\xi_{12} = \frac{X_1 + X_2}{L_s} \text{ if } X_1 + X_2 \text{ is equal to or less than } L_s$$

and otherwise

$$\xi_{12} = 1.0$$

and where:

X_1 = the distance from the aft terminal of L_s to the aft end of the considered compartment or group of adjacent compartments;

X_2 = the distance from the aft terminal of L_s to the forward end of the considered compartment or group of adjacent compartments.

For purposes of this paragraph and of paragraph (c) of this Regulation, with respect to the length of any compartment or groups of compartments under consideration, where one or both of the limiting bulkheads have steps, the forward and after ends of the considered compartment or group of compartments shall be taken at the portions of the bulkheads which are nearest to each other.

(c) The factor "p" in formula (II) shall be determined for each compartment and for each group of compartments by formulae (IV) – (VII).

(i) In general, "p" shall be:

$$\begin{aligned} p &= W \left[4.46 \left(\frac{\ell}{\lambda} \right)^2 - 6.20 \left(\frac{\ell}{\lambda} \right)^3 \right] \text{ for } \frac{\ell}{\lambda} \text{ equal to } \left. \begin{array}{l} 0.24 \text{ or less} \end{array} \right\} \\ &\text{and otherwise,} \left. \begin{array}{l} \\ \\ \end{array} \right\} \\ p &= W \left[1.072 \frac{\ell}{\lambda} - 0.086 \right] \end{aligned} \quad (IV)$$

Where:

ℓ = the length of compartment or group of compartments as defined in paragraph (b) of this Regulation

$W = 1.0$ and $\lambda = L_s$ for $L_s = 655$ feet (200 metres) or less

and otherwise,

$$W = \frac{602.5}{L_s - 52.5} \text{ and } \lambda = 655 \text{ (for } L_s \text{ in feet)}$$

$$W = \frac{184}{L_s - 16} \text{ and } \lambda = 200 \text{ (for } L_s \text{ in metres).}$$

- (ii) To evaluate "p" for compartments taken singly, formulae (IV) are applied directly.
- (iii) To evaluate the "p" values attributable to groups of compartments, the following supplementary nomenclature and formulae apply:

$\ell_1, \ell_2, \ell_3, \ell_4$, etc. are the lengths of compartments taken singly
 $\ell_{12}, \ell_{23}, \ell_{34}$, etc. are the lengths of pairs of adjacent compartments
 ℓ_{123}, ℓ_{234} , etc. are the lengths of groups of three adjacent compartments
 ℓ_{1234} , etc. is the length of a group of four adjacent compartments
 p_1, p_2, p_3, p_4 , etc. are p calculated by formulae (IV) using $\ell_1, \ell_2, \ell_3, \ell_4$, etc. as ℓ .
 p_{12}, p_{23}, p_{34} , etc. are p calculated using $\ell_{12}, \ell_{23}, \ell_{34}$, etc. as ℓ .
 p_{123}, p_{234} , etc. are p calculated using ℓ_{123}, ℓ_{234} , etc. as ℓ .
 p_{1234} , etc. is p calculated using ℓ_{1234} , etc. as ℓ .

For compartments taken by pairs,

$$\left. \begin{aligned} p &= p_{12} - p_1 - p_2 \text{ or} \\ p &= p_{23} - p_2 - p_3, \text{ etc.} \end{aligned} \right\} \dots\dots\dots (V)$$

For compartments taken by groups of three,

$$\left. \begin{aligned} p &= p_{123} - p_{12} - p_{23} + p_2, \text{ or} \\ p &= p_{234} - p_{23} - p_{34} + p_3, \text{ etc.} \end{aligned} \right\} \dots\dots\dots (VI)$$

For compartments taken by groups of four,

$$p = p_{1234} - p_{123} - p_{234} + p_{23}, \text{ etc.} \dots\dots\dots (VII)$$

- (d) The factor "s" in formula (II) shall be determined for the final stage of flooding for each compartment and for each group of compartments by formulae (VIII) and (IX).

- (i) In general, for any condition of flooding from any initial draught d_i , s_i shall be:

$$\left. \begin{aligned} s_i &= 2.70 \left[\left(\frac{F_1}{B_2} - \frac{\tan \theta}{2} \right) (GM_R - MM_S) \right]^{\frac{1}{2}} \quad (\text{in feet}) \\ s_i &= 4.9 \left[\left(\frac{F_1}{B_2} - \frac{\tan \theta}{2} \right) (GM_R - MM_S) \right]^{\frac{1}{2}} \quad (\text{in metres}) \end{aligned} \right\} \dots\dots\dots (VIII)$$

but not more than 1.0

Where:

θ = the angle of heel due to unsymmetrical flooding in the final condition after cross-flooding, if any;
 GM_R = the highest required intact metacentric height at the relative draught, as determined in Regulation 5(e) or if a higher metacentric height is to be specified in the instructions to the Master, that value may be used;
 MM_S = the reduction in the height of the metacentre as a result of flooding, calculated for the ship in the upright position in the final stage of flooding.

- (ii) For each compartment and for each group of compartments, "s" is taken as:

$$s = 0.45s_1 + 0.33s_2 + 0.22s_3 \dots\dots\dots (IX)$$

Where:

$s_1 = s_i$ calculated for the ship at initial draught d_1
 $s_2 = s_i$ " " " " " " " " d_2
 $s_3 = s_i$ " " " " " " " " d_3

d_1, d_2 and d_3 as defined in Regulation 1(g)(iii).

Values of GM_R for the draughts d_1, d_2 and d_3 are determined from the plot of GM_R versus draught to be furnished to the Master of the ship in accordance with Regulation 8. Values of

MM_S , θ and F_1 for these draughts are determined from plots of damaged condition vertical metacentre, trim, draught and heel versus undamaged draught, determined in accordance with Regulation 5(e).

- (iii) Provided a positive contribution to the attained Subdivision Index A is obtained thereby, the flooding of combinations of adjacent compartments in excess of those required for compliance with Regulation 5(b)(i) and (ii) may be included in the calculations. However, s_i shall be taken as zero for any case of flooding which results
 - (1) during intermediate flooding or prior to equalization in an angle of heel in excess of 20 degrees or which immerses any opening through which downflooding might take place, or
 - (2) for the final stage of flooding, except in way of the flooded compartment or compartments, in immersion of the relevant bulkhead deck at side, or heel in excess of 12 degrees, or $(GM_R - MM_S)$ less than 2 inches (0.05 metre).

Regulation 7 – Combined Longitudinal and Transverse Subdivision

- (a) Regulation 6 is predicated upon the condition that transverse bulkheads ordinarily extend from side to side. However, an Administration may also accept a combination of transverse and longitudinal watertight bulkheads wherein some of the transverse watertight bulkheads extend inboard only to longitudinal watertight bulkheads, provided that:
 - (i) A horizontal watertight division located not less than $0.1B_1$ above the base line is fitted in the centre space between the longitudinal bulkheads, and the space below the horizontal division is subdivided by watertight bulkheads in line with the watertight transverse bulkheads in the wings or by equivalent means.
 - (ii) Compliance with the provisions of Regulation 5 is demonstrated.
 - (iii) The Subdivision Index A, calculated according to paragraphs (b) and (c) of this Regulation is not less than the required Subdivision Index R.
- (b) To calculate the contribution of the wing compartments to the attained Subdivision Index A:
 - (i) “a” is calculated as in Regulation 6(b) using the distances from the aft terminal of L_s to the transverse bulkheads bounding the considered wing compartment or group of compartments.
 - (ii) “p” is obtained by multiplying the values obtained by application of formulae (IV) of Regulation 6(c) by the reduction factor “r” according to formulae (X), which represents the probability that the inboard spaces will not be flooded.
 - (1) Where ℓ/L_s is equal to or more than $0.2 b/B_1$:

$$r = \frac{b}{B_1} \left[2.8 + 0.08/(\ell/L_s + 0.02) \right] \quad \left. \begin{array}{l} \\ \\ \end{array} \right\} \quad \text{(X)}$$

if b/B_1 is equal to or less than 0.2, and

$r = 0.016/(\ell/L_s + 0.02) + b/B_1 + 0.36$

if b/B_1 is greater than 0.2.

}
 - (2) Where ℓ/L_s is less than $0.2 b/B_1$, r shall be determined by linear interpolation between 1.0 for $\ell/L_s = 0$ and the r-value calculated by formulae (X) for $\ell/L_s = 0.2 b/B_1$.

In formulae (X) the terms have the following meaning:

ℓ = the distance between the longitudinal limits used for the calculation of “a” and “p” as defined in Regulation 6(b) and (c).

b = the mean transverse distance measured at right angles to the centreline at the subdivision loadline 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 “a”.

- (iii) “s” is calculated as in Regulation 6(d), treating the inboard spaces as not floodable, i.e. $\mu = 0$.

(c) If the attained Subdivision Index A obtained by application of the procedures in paragraph (b) of this Regulation is less than the required Subdivision Index R, the additional contribution to the attained Subdivision Index A attributable to flooding of spaces inboard of the longitudinal bulkheads together with the outboard spaces may be included. For the purposes of this contribution:

- (i) "a" is calculated as in sub-paragraph (b)(i) of this Regulation except that the distances from the aft terminal of L_s are taken to each transverse bulkhead bounding either a wing or an inboard compartment or group thereof.
- (ii) "p" is obtained by multiplying the values obtained by application of formulae (IV) through (VII) of Regulation 6(c) by $(1 - r)$.
- (iii) "s" is calculated as in Regulation 6(d). In so doing, the assumed extent of flooding of both wing and inboard spaces shall be that which would result from an assumed longitudinal extent of damage coincidental with the longitudinal limits used in calculating "a" and "p" and extending in to the ship's centreline.

Regulation 8 – Stability Information

- (a) (i) Every passenger ship shall be inclined upon its completion and the elements of its stability determined.
- (ii) Where any alterations are made to a ship so as to materially affect the stability information supplied to the Master, amended stability information shall be provided. If necessary the ship shall be re-inclined.
- (b) The Master of the ship shall 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 which information shall include:
 - (i) a curve of minimum operational metacentric height versus draught which assures compliance with the requirements of Regulations 5, 6 and 7, as well as a corresponding curve of the maximum allowable vertical centre of gravity versus draught, or with the tabular equivalents of these curves;
 - (ii) tables containing draught limits and their corresponding trim limits within which the requirements of Regulations 5, 6 and 7 can be met;
 - (iii) instructions concerning the operation of cross-flooding arrangements; and
 - (iv) all other data and aids which might be necessary to maintain the required stability after damage.
- (c) There shall 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 shall be made available to the officers of the ship.
- (d) All information called for by this Regulation shall be subject to approval by the Administration.

Regulation 9 – Ballasting

When ballasting with water is necessary, the water ballast should not 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 separator equipment to the satisfaction of the Administration shall be fitted, or other alternative means acceptable to the Administration shall be provided for disposing of the oily-water ballast.

Regulation 10 – Peak and Machinery Space Bulkheads, Shaft Tunnels, etc.

- (a) (i) A ship shall have a forepeak or collision bulkhead, which shall be watertight up to the relevant bulkhead deck. This bulkhead shall be fitted not less than $0.05L_s$ and not more than 9.8 feet (or 3.0 metres) + $0.05L_s$ abaft the forward terminal of the deepest subdivision loadline.
- (ii) If a ship has a long forward superstructure and the residual freeboard at the forward terminal of L_s after flooding of the foremost compartment is less than the summer freeboard required amidships according to the International Convention on Load Lines, 1966 the collision bulkhead shall be extended weathertight to the deck next above the relevant bulkhead deck. The extension need not be fitted directly over the bulkhead below, provided it is at least $0.05L_s$ abaft the forward terminal of the deepest subdivision loadline and the part of the relevant bulkhead deck which forms the step is made effectively weathertight.
- (b) An afterpeak bulkhead and bulkheads dividing the machinery space from the cargo and passenger spaces forward and aft shall also be fitted and made watertight up to the relevant bulkhead deck. The afterpeak bulkhead may, however, be stepped below the relevant bulkhead deck, provided the degree of safety of the ship as regards subdivision is not thereby diminished.

(c) In all cases stern tubes shall be enclosed in watertight spaces of moderate volume. The stern gland shall 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 relevant bulkhead deck will not be submerged.

Regulation 11 – Double Bottoms

(a) A double bottom shall be fitted extending from the forepeak bulkhead to the afterpeak bulkhead as far as this is practicable and compatible with the design and proper working of the ship.

- (i) In ships 165 feet (or 50 metres) and under 200 feet (or 61 metres) in length a double bottom shall be fitted at least from the machinery space to the forepeak bulkhead, or as near thereto as practicable.
- (ii) In ships 200 feet (or 61 metres) and under 249 feet (or 76 metres) in length a double bottom shall be fitted at least outside the machinery space, and shall extend to the fore and after peak bulkheads, or as near thereto as practicable.
- (iii) In ships 249 feet (or 76 metres) in length and upwards a double bottom shall be fitted amidships, and shall extend to the fore and after peak bulkheads, or as near thereto as practicable.

(b) Where a double bottom is required to be fitted its depth shall be to the satisfaction of the Administration and the inner bottom shall 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 degrees to the base line and cutting it at a point $0.5B_1$ from the middle line.

(c) Small wells constructed in the double bottom in connection with drainage arrangements of holds, etc., shall not extend downwards more than necessary. The depth of the well shall in no case be more than the depth less 18 inches (or 457 millimetres) of the double bottom at the centreline, nor shall the well extend below the horizontal plane referred to in paragraph (b) of this Regulation. A well extending to the outer bottom is, however, permitted at the after end of the shaft tunnel of screw ships. Other wells (e.g. for lubricating oil under main engines) may be permitted by the Administration if satisfied that the arrangements give protection equivalent to that afforded by a double bottom complying with this Regulation.

(d) 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, in the opinion of the Administration, thereby impaired.

Regulation 12 – Assigning, Marking and Recording of Subdivision Loadlines

(a) In order that the required degree of subdivision shall be maintained, a loadline corresponding to the approved subdivision draught shall 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 loadlines assigned and marked to correspond with the subdivision draughts which the Administration may approve for the alternative service conditions.

(b) The subdivision loadlines assigned and marked shall be recorded in the Passenger Ship Safety Certificate, and shall be distinguished by the notation C.1 for the principal passenger condition, and C.2, C.3, etc., for the alternative conditions.

(c) The freeboard corresponding to each of these loadlines shall be measured at the same position and from the same deck line as the freeboards determined in accordance with the International Convention on Load Lines, 1966.

(d) The freeboard corresponding to each approved subdivision loadline and the conditions of service for which it is approved, shall be clearly indicated on the Passenger Ship Safety Certificate.

(e) In no case shall any subdivision loadline mark be placed above the deepest loadline in salt water as determined by the strength of the ship and/or the International Convention on Load Lines, 1966.

(f) Whatever may be the position of the subdivision loadline marks, a ship shall in no case be loaded so as to submerge the loadline mark appropriate to the season and locality as determined in accordance with the International Convention on Load Lines, 1966.

(g) A ship shall in no case be so loaded that when she is in salt water the subdivision loadline mark appropriate to the particular voyage and condition of service is submerged.

Regulation 13 – Construction and Initial Testing of Watertight Bulkheads, etc.

- (a) Each watertight subdivision bulkhead whether transverse or longitudinal shall be constructed in such a manner that it shall 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 immersion limit line. The construction of these bulkheads shall be to the satisfaction of the Administration.
- (b)
 - (i) Steps and recesses in bulkheads shall be watertight and as strong as the bulkhead at the place where each occurs.
 - (ii) Where frames or beams pass through a watertight deck or bulkhead such deck or bulkhead shall be made structurally watertight without the use of wood or cement.
- (c) 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 shall 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 shall be carried out.
- (d) The forepeak, double bottoms (including duct keels) and inner skins shall be tested with water to a head corresponding to the requirements of paragraph (a) of this Regulation.
- (e) Tanks which are intended to hold liquids, and which form part of the subdivision of the ship, shall be tested for tightness with water to a head up to the deepest subdivision loadline or to a head corresponding to two-thirds of the depth from the top of the keel to the immersion limit line in way of the tanks, whichever is the greater; provided that in no case shall the test head be less than 3 feet (or 0.92 metre) above the top of the tank.
- (f) The tests referred to in paragraphs (d) and (e) of this Regulation 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.

Regulation 14 – Openings in Watertight Bulkheads

- (a) The number of openings in watertight bulkheads shall be reduced to the minimum compatible with the design and proper working of the ship; satisfactory means shall be provided for closing these openings.
- (b)
 - (i) Where pipes, scuppers, electric cables, etc. are carried through watertight subdivision bulkheads, arrangements shall be made to ensure the integrity of the watertightness of the bulkheads.
 - (ii) Valves and cocks not forming part of a piping system shall not be permitted in watertight subdivision bulkheads.
 - (iii) Lead or other heat sensitive materials shall not 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.
- (c)
 - (i) No doors, manholes, or access openings are permitted:
 - (1) in the collision bulkhead below the relevant bulkhead deck;
 - (2) in watertight transverse bulkheads dividing a cargo space from an adjoining cargo space, except as provided in paragraph (k) of this Regulation.
 - (ii) Except as provided in sub-paragraph (iii) of this paragraph, the collision bulkhead may be pierced below the relevant bulkhead deck by not more than one pipe for dealing with fluid in the forepeak tank, provided that the pipe is fitted with a screwdown valve capable of being operated from above the immersion limit line, the valve chest being secured inside the forepeak to the collision bulkhead.
 - (iii) If the forepeak is divided to hold two different kinds of liquids the Administration may allow the collision bulkhead to be pierced below the relevant bulkhead deck by two pipes, each of which is fitted as required by sub-paragraph (ii) of this paragraph, provided the Administration is satisfied 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.
- (d) Within spaces containing the main and auxiliary propelling machinery including boilers serving the needs of propulsion not more than one door apart from the doors to shaft tunnels may be fitted in each main transverse bulkhead. Where two or more shafts are fitted the tunnels shall be connected by an intercommunicating passage. There shall 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 shall be of the sliding type and shall be

located so as to have their sills as high as practicable. The hand gear for operating these doors shall be situated above the immersion limit line and outside the spaces containing the machinery if this is consistent with a satisfactory arrangement of the necessary gearing.

- (e) (i) Watertight doors shall be sliding doors or hinged doors or doors of an equivalent type. Plate doors secured only by bolts and doors required to be closed by dropping or by the action of a dropping weight are not permitted.
- (ii) Sliding doors may be either:
 - hand operated only, or power operated as well as hand operated.
- (iii) Authorized watertight doors may therefore be divided into three Classes:
 - Class 1 – hinged doors;
 - Class 2 – hand operated sliding doors;
 - Class 3 – sliding doors which are power operated as well as hand operated.
- (iv) The means of operation of any watertight door whether power operated or not shall be capable of closing the door with the ship listed to 15 degrees either way.
- (v) In all classes of watertight doors indicators shall be fitted which show, at all operating stations from which the doors are not visible, whether the doors are open or closed. If any of the watertight doors, of whatever Class, is not fitted so as to enable it to be closed from a central control station, it shall be provided with a mechanical, electrical, telephonic, or any other suitable direct means of communication, enabling the officer of the watch promptly to contact the person who is responsible for closing the door in question, under previous orders.
- (f) Hinged doors (Class 1) shall be fitted with quick action closing devices, such as catches, workable from each side of the bulkhead.
- (g) Hand operated sliding doors (Class 2) may have a horizontal or vertical motion. It shall be possible to operate the mechanism at the door itself from either side, and in addition, from an accessible position above the immersion limit line, with an all round crank motion, or some other movement providing the same guarantee of safety and of an approved type. Departures from the requirement of operation on both sides may be allowed, if this requirement is impossible owing to the layout of the spaces. When operating a hand gear, the time necessary for the complete closure of the door with the ship upright shall not exceed 90 seconds.
- (h) (i) Power operated sliding doors (Class 3) may have a vertical or horizontal motion. If a door is required to be power operated from a central control, the gearing shall be so arranged that the door can be operated by power also at the door itself from both sides. The arrangement shall be such that the door will close automatically if opened by local control after being closed from the central control, and also such that any door can be kept closed by local systems which will prevent the door from being opened from the upper control. Local control handles in connection with the power gear shall be provided each side of the bulkhead and shall 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 closing mechanism in operation accidentally. Power operated sliding doors shall be provided with hand gear workable at the door itself on either side and from an accessible position above the immersion limit line, with an all round crank motion or some other movement providing the same guarantee of safety and of an approved type. Provision shall be made to give warnings by sound signal that the door has begun to close and will continue to move until it is completely closed. The door shall take a sufficient time to close to ensure safety.
- (ii) There shall be at least two independent power sources capable of opening and closing all the doors under control, each of them capable of operating all the doors simultaneously. The two power sources shall be controlled from the central station on the bridge provided with all the necessary indicators for checking that each of the two power sources is capable of giving the required service satisfactorily.
- (iii) In the case of hydraulic operation, each power source shall consist of a pump capable of closing all doors in not more than 60 seconds. In addition, there shall be for the whole installation hydraulic accumulators of sufficient capacity to operate all the doors at least three times, i.e. closed–open–closed. The fluid used shall be one which does not freeze at any of the temperatures liable to be encountered by the ship during its service.
- (i) (i) Hinged watertight doors (Class 1) in passenger, crew and working spaces are only permitted above a deck the underside of which, at its lowest point at side, is at least 7 feet (or 2.13 metres) above the deepest subdivision loadline.

- (ii) Watertight doors, the sills of which are above the deepest subdivision loadline and below the line specified in sub-paragraph (i) of this paragraph shall be sliding doors and may be hand operated (Class 2), except in ships where N is 1200 or more in which all such doors shall be power operated. When trunkways in connection with refrigerated cargo and ventilation or forced draught ducts are carried through more than one main watertight subdivision bulkhead, the doors at such openings shall be operated by power.
- (j) Watertight doors which may sometimes be opened at sea, and the sills of which are below the deepest subdivision loadline, shall be sliding doors. The following rules shall apply:
 - (1) when the number of such doors (excluding doors at entrances to shaft tunnels) exceeds five, all of these doors and those at the entrance to shaft tunnels or ventilation or forced draught ducts, shall be power operated (Class 3) and shall be capable of being simultaneously closed from a central station situated on the bridge;
 - (2) when the number of such doors (excluding doors at entrances to shaft tunnels) is greater than one, but does not exceed five,
 - (a) where the ship has no passenger spaces below the immersion limit line, all the above-mentioned doors may be hand operated (Class 2);
 - (b) where the ship has passenger spaces below the immersion limit line all the above-mentioned doors shall be power operated (Class 3) and shall be capable of being simultaneously closed from a central station situated on the bridge;
 - (3) in any ship where there are only two such watertight doors and they are into or within the space containing machinery, the Administration may allow these two doors to be hand operated only (Class 2).
- (k) (i) If the Administration is satisfied that such doors are essential, watertight doors of satisfactory construction may be fitted in watertight bulkheads dividing cargo between deck spaces. Such doors may be hinged, rolling or sliding doors but shall not be remotely controlled. They shall be fitted at the highest level and as far from the shell plating as practicable, but in no case shall the outboard vertical edges be situated at a distance from the shell plating which is less than $0.2B_1$, such distance being measured at right angles to the centreline of the ship at the level of the deepest subdivision loadline.
- (ii) Such doors shall be closed before the voyage commences and shall be kept closed during navigation, and the time of opening such doors in port and of closing them before the ship leaves port shall be entered in the log book. Should any of the doors be accessible during the voyage, they shall be fitted with a device which prevents unauthorized opening. When it is proposed to fit such doors, the number and arrangements shall receive the special consideration of the Administration.
- (l) Portable plates on bulkheads shall not be permitted except in machinery spaces. Such plates shall always be in place before the ship leaves port, and shall not be removed during navigation except in case of urgent necessity. The necessary precautions shall be taken in replacing them to ensure that the joints shall be watertight.
- (m) All watertight doors shall be kept closed during navigation except when necessarily opened for the working of the ship, and shall always be ready to be immediately closed.
- (n) (i) Where trunkways or tunnels for piping, or for any other purpose are carried through main transverse watertight bulkheads, they shall be watertight and in accordance with the requirements of Regulation 17. The access to at least one end of each such tunnel or trunkway, if used as a passage at sea, shall be through a trunk extending watertight to a height sufficient to permit access above the relevant bulkhead deck. 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 shall not extend through the first subdivision bulkhead abaft the collision bulkhead.
- (ii) Where it is proposed to fit tunnels or trunkways for forced draught, piercing main transverse watertight bulkheads, these shall receive the special consideration of the Administration.

Regulation 15 – Openings in the Shell Plating below the Immersion Limit Line

- (a) The number of openings in the shell plating shall be reduced to the minimum compatible with the design and proper working of the ship.
- (b) The arrangement and efficiency of the means for closing any opening in the shell plating shall be consistent with its intended purpose and the position in which it is fitted and generally to the satisfaction of the Administration.

- (c) (i) If in a between deck the sills of any sidescuttles are below a line drawn parallel to the immersion limit line at side and having its lowest point $0.025B_1$ above the deepest subdivision loadline, all sidescuttles in that between deck shall be of the non-opening type.
- (ii) All sidescuttles, the sills of which are below the immersion limit line, other than those required to be of a non-opening type by sub-paragraph (i) of this paragraph, shall be of such construction as will effectively prevent any person opening them without the consent of the Master of the ship.
- (iii) (1) Where in a between deck the sills of any of the sidescuttles referred to in sub-paragraph (ii) of this paragraph are below a line drawn parallel to the immersion limit line, and having its lowest point $4\frac{1}{2}$ feet (or 1.37 metres) + $0.025B_1$ above the water when the ship departs from any port, all the sidescuttles in that between deck shall be closed watertight and locked before the ship leaves port, and they shall not be opened before the ship arrives at the next port. In the application of this sub-paragraph the appropriate allowance for fresh water may be made when applicable.
- (2) The time of opening such sidescuttles in port and of closing and locking them before the ship leaves port shall be entered in such log book as may be prescribed by the Administration.
- (d) Efficient hinged inside deadlights arranged so that they can be easily and effectively closed and secured watertight shall be fitted to all sidescuttles except that abaft $0.125L_s$ from the forward terminal of L_s and above a line drawn parallel to the immersion limit line and having its lowest point at a height of 12 feet (or 3.66 metres) + $0.025B_1$ above the deepest subdivision loadline the deadlights may be portable in passenger accommodation other than that for steerage passengers, unless the deadlights are required by the International Convention on Load Lines, 1966 to be permanently attached in their proper positions. Such portable deadlights shall be stowed adjacent to the sidescuttles they serve.
- (e) Sidescuttles and their deadlights, which will not be accessible during navigation, shall be closed and secured before the ship leaves port.
- (f) (i) No sidescuttles shall be fitted in any spaces which are appropriated exclusively to the carriage of cargo.
- (ii) Sidescuttles may, however, be fitted in spaces appropriated alternatively to the carriage of cargo or passengers, but they shall be of such construction as will effectively prevent any person opening them or their deadlights without the consent of the Master of the ship.
- (iii) If cargo is carried in such spaces, the sidescuttles and their deadlights shall be closed watertight and locked before the cargo is shipped and such closing and locking shall be recorded in such log book as may be prescribed by the Administration.
- (g) Automatic ventilating sidescuttles shall not be fitted in the shell plating below the immersion limit line without the special sanction of the Administration.
- (h) The number of scuppers, sanitary discharges and other similar openings in the shell plating shall 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.
- (i) (i) All inlets and discharges in the shell plating shall be fitted with efficient and accessible arrangements for preventing the accidental admission of water into the ship. Lead or other heat sensitive materials shall not be used for pipes fitted outboard of shell valves in inlets or discharges, or any other application where the deterioration of such pipes in the event of fire would give rise to danger of flooding.
- (ii) (1) Except as provided in sub-paragraph (iii) of this paragraph, each separate discharge led through the shell plating from spaces below the immersion limit line shall be provided either with one automatic non-return valve fitted with a positive means of closing it from above the immersion limit line or, alternatively, with two automatic non-return valves without such means, the upper of which is so situated above the deepest subdivision loadline as to be always accessible for examination under service conditions, and is of a type which is normally closed.
- (2) Where a valve with positive means of closing is fitted, the operating position above the immersion limit line shall always be readily accessible, and means shall be provided for indicating whether the valve is open or closed.
- (iii) Main and auxiliary sea inlets and discharges in connection with machinery shall be fitted with readily accessible cocks or valves between the pipes and shell plating or between the pipes and fabricated boxes attached to the shell plating.

- (j) (i) Gangway, cargo and bunkering station ports fitted below the immersion limit line shall be of sufficient strength. They shall be effectively closed and secured watertight before the ship leaves port, and shall be kept closed during navigation.
- (ii) Such ports shall be in no case fitted so as to have their lowest point below the deepest subdivision loadline.
- (k) (i) The inboard opening of each rubbish-shoot, etc., shall be fitted with an efficient cover.
- (ii) If the inboard opening is situated below the immersion limit line the cover shall be watertight, and in addition an automatic non-return valve shall be fitted in the shoot in an easily accessible position above the deepest subdivision loadline. When the shoot is not in use both the cover and the valve shall be kept closed and secured.

Regulation 16 – Construction and Initial Tests of Watertight Doors, Sidescuttles, etc.

- (a) (i) The design, materials and construction of all watertight doors, sidescuttles, gangway, cargo and other ports, valves, pipes, and rubbish-shoots referred to in these Regulations shall be to the satisfaction of the Administration.
 - (ii) The frames of vertical watertight doors shall have no groove at the bottom in which dirt might lodge and prevent the door closing properly.
 - (iii) All cocks and valves for sea inlets and discharges below the immersion limit line and all fittings outboard of such cocks and valves shall be made of steel, bronze or other approved ductile material. Ordinary cast iron or similar materials shall not be used.
- (b) Each watertight door shall be tested by water pressure to a head up to the immersion limit line. The test shall be made before the ship is put in service, either before or after the door is fitted.

Regulation 17 – Construction and Initial Tests of Watertight Decks, Trunks, etc.

- (a) Watertight decks, trunks, tunnels, duct keels and ventilators shall 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, shall be to the satisfaction of the Administration. Watertight ventilators and trunks shall be carried at least up to the immersion limit line.
- (b) After completion, a hose or flooding test shall be applied to watertight decks and a hose test to watertight trunks, tunnels and ventilators.

Regulation 18 – Watertight Integrity above the relevant Bulkhead Deck

- (a) The Administration may require that all reasonable and practicable measures shall be taken to limit the entry and spread of water above the relevant bulkhead deck. Such measures may include partial bulkheads or webs. When partial watertight bulkheads and webs are fitted on the relevant bulkhead deck, above or in the immediate vicinity of main subdivision bulkheads, they shall have watertight shell and relevant 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 relevant bulkhead deck between shall be made effectively watertight.
- (b) The deck at the immersion limit line or a deck above it shall be weathertight in the sense that in ordinary sea conditions water will not penetrate in a downward direction. All openings in the exposed weather deck shall have coamings of ample height and strength and shall be provided with efficient means for expeditiously closing them weathertight. Freeing ports, open rails and/or scuppers shall be fitted as necessary for rapidly clearing the weather deck of water under all weather conditions.
- (c) Sidescuttles, gangway, cargo and other ports and other means for closing openings in the shell plating above the immersion limit line shall 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 loadline.
- (d) Efficient inside deadlights, arranged so that they can be easily and effectively closed and secured watertight, shall be provided for all sidescuttles to spaces below the first deck above the immersion limit line.

Regulation 19 – Bilge Pumping Arrangements

- (a) Ships shall be provided with an efficient bilge pumping plant capable of pumping from and draining any watertight compartment which is neither a permanent oil compartment nor a permanent water compartment under all practicable conditions after a casualty whether the ship is upright or listed. For this purpose wing

suctions will generally be necessary except in narrow compartments at the ends of the ship, where one suction may be sufficient. In compartments of unusual form, additional suctions may be required. Arrangements shall be made whereby water in the compartment may find its way to the suction pipes. Where in relation to particular compartments the Administration is satisfied that the provision of drainage may be undesirable, it may allow such provision to be dispensed with if calculations made in accordance with the conditions laid down in Regulation 5 and assumed for the purposes of Regulations 6 and 7 show that the safety of the ship will not be impaired. Efficient means shall be provided for draining water from insulated holds.

- (b) (i) Ships shall have at least three power pumps connected to the bilge main, one of which may be attached to the propelling unit. Where R is more than 0.50, one additional independent power pump shall be provided.
- (ii) The requirements are summarized in the following table:

Required Subdivision Index R	Less than 0.50	and over 0.50
Main engine pump (may be replaced by one independent pump)	1	1
Independent pumps	2	3

- (iii) 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.
- (c) Where practicable, the power bilge pumps shall be placed in separate watertight compartments so arranged or situated that these compartments will not readily be flooded by the same damage. If the engines and boilers are in two or more watertight compartments, the pumps available for bilge service shall be distributed throughout these compartments as far as is possible.
- (d) On ships 330 feet (or 100 metres) or more in length or having R more than 0.50, the arrangements shall be such that at least one power pump shall be available for use in all ordinary circumstances in which a ship may be flooded at sea. This requirement will be satisfied if:
 - (i) one of the required pumps is an emergency pump of a reliable submersible type having a source of power situated above the relevant bulkhead deck; or
 - (ii) the pumps and their sources of power are so disposed throughout the length of the ship that under any condition of flooding which the ship is required to withstand, at least one pump in an undamaged compartment will be available.
- (e) With the exception of additional pumps which may be provided for peak compartments only, each required bilge pump shall be arranged to draw water from any space required to be drained by paragraph (a) of this Regulation.
- (f) Each power bilge pump shall be capable of giving a speed of water through the required main bilge pipe of not less than 400 feet (or 122 metres) per minute. Independent power bilge pumps situated in machinery spaces shall have direct suctions from these spaces, except that not more than two such suctions shall be required in any one space. Where two or more such suctions are provided there shall be at least one on the port side and one on the starboard side. The Administration may require independent power bilge pumps situated in other spaces to have separate direct suctions. Direct suctions shall be suitably arranged and those in a machinery space shall be of a diameter not less than that required for the bilge main.
- (g) (i) In addition to the direct bilge suction or suctions required by paragraph (f) of this Regulation there shall be in the machinery space a direct suction from the main circulating pump leading to the drainage level of the machinery space and fitted with a non-return valve. The diameter of this direct suction pipe shall 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 motorships.
- (ii) Where in the opinion of the Administration the main circulating pump is not suitable for this purpose, a direct emergency bilge suction shall be led from the largest available independent power driven pump to the drainage level of the machinery space; the suction shall be of the same diameter as the main inlet of the pump used. The capacity of the pump so connected shall exceed that of a required bilge pump by an amount satisfactory to the Administration.

- (iii) The spindles of the sea inlet and direct suction valves shall extend well above the engine room platform.
- (h) (i) All pipes from the pumps which are required for draining cargo or machinery spaces shall be entirely distinct from pipes which may be used for filling or emptying spaces where water or oil is carried.
- (ii) 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, shall be of steel or other approved material.
- (i) The diameter of the bilge main shall be calculated according to the following formulae provided that the actual internal diameter of the bilge main may be of the nearest standard size acceptable to the Administration.

$$d \text{ (in inches)} = \sqrt{\frac{L_s(B_1 + D_s)}{2,500}} + 1$$

or

$$d \text{ (in millimetres)} = 1.68 \sqrt{L_s(B_1 + D_s)} + 25$$

where d = internal diameter of the bilge main (in inches or in millimetres respectively)

L_s and B_1 in feet or metres respectively

D_s = moulded depth of ship to immersion limit line at midlength
 (in feet or metres respectively).

The diameter of the bilge branch pipes shall be determined by rules to be made by the Administration.

- (j) The arrangement of the bilge and ballast pumping system shall 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. Special provision shall be made to prevent any deep tank having bilge and ballast connections being inadvertently run up from the sea when containing cargo, or pumped out through a bilge pipe when containing water ballast.
- (k) Provision shall 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 $0.2B_1$ (measured at right angles to the centreline at the level of the deepest subdivision loadline), or in a duct keel, a non-return valve shall be fitted to the pipe in the compartment containing the open end.
- (l) All the distribution boxes, cocks and valves in connection with the bilge pumping arrangements shall be in positions which are accessible at all times under ordinary circumstances. They shall 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 $0.2B_1$, shall not put the bilge system out of action. If there is only one system of pipes common to all the pumps, the necessary cocks or valves for controlling the bilge suctions must be capable of being operated from above the immersion limit line. Where in addition to the main bilge pumping system an emergency bilge pumping system is provided, it shall be independent of the main system and so arranged that a pump is capable of operating on any compartment under flooding conditions; in that case only the cocks and valves necessary for the operation of the emergency system need be capable of being operated from above the immersion limit line.
- (m) All cocks and valves mentioned in paragraph (1) of this Regulation which can be operated from above the immersion limit line shall have their controls at their place of operation clearly marked and provided with means to indicate whether they are open or closed.

Regulation 20 – Marking, Periodical Operation and Inspection of Watertight Doors, etc.

- (a) Drills for the operating of watertight doors, sidescuttles, valves and closing mechanisms of scuppers, and rubbish-shoots shall take place weekly. In ships in which the voyage exceeds one week in duration a complete drill shall be held before leaving port, and others thereafter at least once a week during the voyage. In all ships all watertight power doors and hinged doors, in main transverse bulkheads, in use at sea, shall be operated daily.
- (b) (i) The watertight doors and all mechanisms and indicators connected therewith, all valves the closing of which is necessary to make a compartment watertight, and all valves the operation of which is necessary for damage control cross connections, shall be periodically inspected at sea at least once a week.

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- (ii) Such valves, doors and mechanisms shall be suitably marked to ensure that they may be properly used to provide maximum safety.

Regulation 21 – Entries in Log

- (a) Hinged doors, portable plates, sidescuttles, gangway, cargo and other ports and other openings, which are required by these Regulations to be kept closed during navigation, shall be closed before the ship leaves port. The time of closing and the time of opening (if permissible under these Regulations) shall be recorded in such log book as may be prescribed by the Administration.
 - (b) A record of all drills and inspections required by Regulation 20 shall be entered in the log book with an explicit record of any defects which may be disclosed.
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