PART II RULES FOR THE CONSTRUCTION AND CLASSIFICATION OF VESSELS IDENTIFIED BY THEIR MISSIONS

TITLE 26 ROLL ON – ROLL OFF PASSENGER SHIP

SECTION 1 NAVAL ARCHITECTURE

CHAPTERS

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CHAPTER A
SCOPE

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A1. APPLICATION

100. Application

101. The present Title 26 applies to roll-on roll-off passenger ships, which are multi-deck ships, with double bottom and, in some cases, with wing tanks up to the lowest deck above the full load waterline, intended for the carriage of:

a. passengers

b. vehicles which embark and disembark on their own wheels, and/or goods in or on pallets or containers which can be loaded and unloaded by means of wheeled vehicles

c. railway cars, on fixed rails, which embark and disembark on their own wheels,

as defined in Part I, Title 01, Section 1, Table T.B3.101.1.

102. Passenger ships constructed on or after 1 July 2010 having length of 120 m or more or having three or more main vertical zones shall comply with the provisions of the present Chapter K (SOLAS II-2/G/21 – "*Casualty threshold, safe return to port and safe areas*.")

103. Passenger ships constructed on or after 1 July 2010 having length of 120 m or more or having three or more main vertical zones shall comply with the provisions of Part II, Title 11, Section 3, Chapter E, E.16 (SOLAS II-2/G/22 – "*Design criteria for systems to remain operational after a fire casualty*.")

A2. DEFINITONS

100. Additional definitions to Part II, Title 11, Section 1

101. 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 motor vehicles with fuel in their tanks for their own propulsion and/or goods (packaged or in bulk, in or on rail or road cars, vehicles (including road or rail tankers), trailers, containers, pallets, demountable tanks or in similar stowage units or other receptacles, which can be loaded and unloaded normally in a horizontal direction.

102. Subdivision length (Ls) of the ship is the greatest projected moulded 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 draught.

CHAPTER B
DOCUMENTS, REGULATIONS AND STANDARDS

B1 DOCUMENTS

100. Additional plans for Ro/Ro passenger vessels

101. In addition to the documentation required by Part II, Title 11, Section 1, Chapter B, the following plans are to be submitted for approval:

a. General arrangement of vehicle decks

b. General arrangement of passenger decks

c. General arrangement and details of stern and bow ramps

d. General arrangement and details of movable decks, if fitted, including stowing arrangements for portable components

e. Arrangement and location of shell stern, bow and side doors, as applicable

CHAPTER E
CONFIGURATIONS

E1. CONFIGURATION

100. Configuration

101. The most usual configurations and the applicable requirements are shown in Table T.E1.101.1 below:

TABLE T.E1.101.1 – CONFIGURATIONS OF Ro-Ro SHIPS AND APPLICALBE REGULATIONS

Ship Type	GT ≥ 500	GT < 500
Roll on / roll off cargo ship Roll on-Roll off are multi-deck ships with double bottom and, in some cases, with wing tanks up to the lowest deck above the full load waterline, which has one or more decks closed or open not normally subdivided and generally running the entire length of the ship intended for the carriage of: a. vehicles which embark and disembark on their own wheels, and/or goods in or on pallets or containers which can be loaded and unloaded by means of wheeled vehicles b. railway cars, on fixed rails, which embark and disembark on their own wheels Class notation: **Ro/Ro cargo**	Section 1 Part II, Title 15 Section 2 Part II, Title 15 Section 3 Part II, Title 15 Section 5 Part II, Title 11 Section 6 Part II, Title 15 Section 7 Part II, Title 15	Section 1 Part II, Title 11 Section 2 Part II, Title 15 Section 3 Part II, Title 11 (as applicable) Section 5 Part II, Title 11 Section 6 Part II, Title 15 Section 7 Part II, Title 15
Roll on / roll off pure car carrier Ro/Ro cargo vessels which, however, carry exclusively cars, trucks and buses. Class notation: **Ro/Ro cargo, pure car**	Same as roll on/roll off cargo	Same as roll on/roll off cargo
Roll on / roll off container Roll-on-roll-off cargo vessels which also carry containers. Class notation: **Ro-Ro cargo, container**	Same as roll on/roll off cargo However, special consideration is to be given for the carriage of containers (See part II, Title 12).	Not applicable
Roll on / roll off dangerous goods Roll-on-roll-off cargo vessels which also carry dangerous goods Class notation: **Ro/Ro cargo, DG-P**	Same as roll on/roll off cargo Additional requirements for dangerous goods in Part II, Title 104).	Same as roll on/roll off cargo Additional requirements for dangerous goods in Part II, Title 104).
Roll on / roll off passenger / passenger and cargo Roll on-Roll off are multi-deck ships with double bottom and, in some cases, with wing tanks up to the lowest deck above the full load waterline, which has one or more decks closed or open not normally subdivided and generally running the entire length of the ship intended for the carriage of: a. passengers b. vehicles which embark and disembark on their own wheels, and/or goods in or on pallets or containers which can be loaded and unloaded by means of wheeled vehicles c. railway cars, on fixed rails, which embark and disembark on their own wheels Class notation: **Ro/Ro cargo, pax** (if passengers only, no cargo) **Ro/Ro cargo, pax, cargo** (if passengers and cargo)	Section 1 Part II, Title 26 Section 2 Part II, Title 15 Section 3 Part II, Title 26 Section 5 Part II, Title 11 Section 6 Part II, Title 26 Section 7 Part II, Title 26	Section 1 Part II, Title 11 Section 2 Part II, Title 15 Section 3 Part II, Title 11 (as applicable) Section 5 Part II, Title 11 Section 6 Part II, Title 26 Section 7 Part II, Title 11

Ship Type	GT ≥ 500	GT < 500
Ferry Boat (Short crossings) Ferry boats are multi-deck ships with double bottom and, in some cases, with wing tanks up to the lowest deck above the full load waterline, which has one or more decks closed or open not normally subdivided and generally running the entire length of the ship intended for the carriage of: a. passengers b. vehicles which embark and disembark on their own wheels Class notation: **Ferry Boat**	Section 1 Part II, Title 26 Section 2 Part II, Title 15 Section 3 Part II, Title 26 Section 5 Part II, Title 11 Section 6 Part II, Title 26 Section 7 Part II, Title 26	Section 1 Part II, Title 11 Section 2 Part II, Title 15 Section 3 Part II, Title 11 (as applicable) Section 5 Part II, Title 11 Section 6 Part II, Title 26 Section 7 Part II, Title 11

CHAPTER G
CAPACITIES AND SUBDIVISION

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G1. HULL SUBDIVISION

100. Main transverse bulkheads

101. Where there are less transverse watertight bulkheads than required by See Part II, Title 11, Section 1, or where the distance between transverse watertight bukheads is larger than the requirements above, a structural system comprised of partial bulkheads, transverse side frames and deck transverses is to be designed and fitted to provide equivalent transverse strength.

200. Passenger ships carrying goods vehicles and 4accompanying personnel [SOLAS II-1/B-2/14]

201. This regulation applies to passenger ships designed or adapted for the carriage of goods vehicles and accompanying personnel.

202. If in such a ship the total number of passengers which include personnel accompanying vehicles does not exceed

NP = 12 + Ad/25,

Where:

NP = the maximum number of passengers for which the ship is certified

Ad = total deck area (square metres) 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 regulations 13.9.1 and 13.9.2 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.

Guidance

Paragraphs SOLAS II-1/B-2/1391. And 13.9.2:

9.1 If the RBNA 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 one fifth of the breadth of the ship, as defined in regulation 2, such distance being measured at right angles to the centreline at the level of the deepest subdivision draught.

9.2 Should any such 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 RBNA.

End of guidance

202. The ship may not be certified for a higher number of passengers than assumed G1.202 a watertight door has been fitted in accordance with this regulation.

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

204. Where a double bottom is required to be fitted 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 inner bottom is not lower at any part than a plane parallel with the keel line and which is located not less than a vertical distance h measured from the keel line, as calculated by the formula:

h = B/20

However, in no case is the value of h to be less than 760 mm, and need not be taken as more than 2 000 mm.

205. Small wells constructed in the double bottom in connection with drainage arrangements of holds, etc., shall not extend downward more than necessary. 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 by the RBNA if satisfied that the arrangements give protection equivalent to that afforded by a double bottom complying with this regulation. In no case shall the vertical distance from the bottom of such a well to a plane coinciding with the keel line be less than 500 mm.

206. A double bottom need not be fitted in way of watertight tanks, including dry tanks of moderate size, provided the safety of the ship is not impaired in the event of bottom or side damage.

207. In the case of passenger ships to which the provisions of regulation 1.5 apply and which are engaged on regular service within the limits of a short national or international voyage, the RBNA may permit a double bottom to be dispensed with if satisfied that the fitting of a double bottom in that part would not be compatible with the design and proper working of the ship.

208. Any part of a passenger ship or a cargo ship that is not fitted with a double bottom shall be capable of withstanding bottom damages, as specified in G1.203 to G1.207 in that part of the ship.

209. In the case of unusual bottom arrangements in a passenger ship or a cargo ship, it shall be demonstrated that the ship is capable of withstanding bottom damages as specified G1.203 to G1.207 8

210. Compliance with paragraphs G1.208 and G1.209 above is to be achieved by demonstrating that si, when calculated in accordance with Part II, Title 21, H6.500, is not less than 1 for all service conditions when subject to a bottom damage assumed at any position along the ship's bottom and with an extent specified in subparagraph .2 below for the affected part of the ship:

a. Flooding of such spaces shall not render emergency power and lighting, internal communication, signals or other emergency devices inoperable in other parts of the ship.

b. Assumed extent of damage shall be as follows in Table T.G1.210.1 below:

TABLE T.G1.210.1 – EXTENT OF DAMAGE

	For 0.3 L from the forward perpendicular of the ship	*Any other part of the ship*
Longitudinal extent	1/3 L2/3 or 14.5 m, whichever is less	1/3 L2/3 or 14.5m, 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

c. If any damage of a lesser extent than the maximum damage specified in subparagraph .2 would result in a more severe condition, such damage should be considered.

211. In case of large lower holds in passenger ships, the RBNA may require an increased double bottom height of not more than B/10 or 3 m, whichever is less, measured from the keel line. Alternatively, bottom damages may be calculated for these areas, in accordance with paragraph 8, but assuming an increased vertical extent.

300. Integrity of the hull and superstructure, damage prevention and control on ro-ro passenger ships [SOLAS II-1/B-2/17.1]

301. All accesses that lead to spaces below the bulkhead deck shall have a lowest point which is not less than 2.5 m above the bulkhead deck.

302. Where vehicle ramps are installed to give access to spaces below the bulkhead deck, their openings is to be able to be closed weathertight to prevent ingress of water below, alarmed and indicated to the navigation bridge.

303. The RBNA may permit the fitting of particular accesses to spaces below the bulkhead deck provided they are necessary for the essential working of the ship, e.g. the movement of machinery and stores, subject to such accesses being made watertight, alarmed and indicated on the navigation bridge.

304. Indicators is to be provided on the navigation bridge for all shell doors, loading doors and other closing appliances which, if left open or not properly secured, could, in the opinion of the RBNA, lead to flooding of a special category space or ro-ro space.

a. The indicator system is to be designed on the fail-safe principle and shall show by visual alarms if the door is not fully closed or if any of the securing arrangements are not in place and fully locked and by audible alarms if such door or closing appliances become open or the securing arrangements become unsecured.

b. The indicator panel on the navigation bridge is to be equipped with a mode selection function "harbour/sea voyage" so arranged that an audible alarm is given on the navigation bridge if the ship leaves harbour with the bow doors, inner doors, stern ramp or any other side shell doors not closed or any closing device not in the correct position.

c. The power supply for the indicator system is to be independent of the power supply for operating and securing the doors.

305. Television surveillance and a water leakage detection system is to be arranged to provide an indication to the navigation bridge and to the engine control station of any leakage through inner and outer bow doors, stern doors or any other shell doors which could lead to flooding of special category spaces or ro-ro spaces.

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Special requirements for vehicle ferries, ro-ro ships and other ships of similar type

Regulation II-1/17-1 Integrity of the hull and Superstructure, damage prevention and control on ro-ro passenger ships

Interpretation

Stern, bow and side doors of large dimensions, when manual devices would not be readily accessible, are to be normally secured by means of power systems.

Alternative means of securing are also to be provided for emergency use in case of failure of the power systems.

In ro-ro passenger ships, constructed before 1 July 1997, all access doors or hatchways to spaces below the ro-ro deck, which may be used at sea, are to have sills or coamings not less than 380 mm in height above the ro-ro deck, and are to be provided with doors or covers considered weather-tight in relation to their position, refer to SOLAS regulation II-1/20-2 (94/95 Amendments).

For ro-ro passenger ships constructed on or after 1 July 1997 but before 1 January 2009, refer to SOLAS regulation II-1/20-2 (94/95 Amendments).

The ro-ro deck, referred to in the preceding paragraph is the deck above which the stern, bow or side doors are fitted, or the first deck above the load waterline.

400. Special requirements for ro-ro passenger ships [SOLAS II-1/B-4/23]

401. Special category spaces and ro-ro spaces is to be continuously patrolled or monitored by effective means, such as television surveillance, so that any movement of vehicles in adverse weather conditions and unauthorized access by passengers thereto can be detected whilst the ship is underway.

402. Documented operating procedures for closing and securing all shell doors, loading doors and other closing appliances which, if left open or not properly secured, could, in the opinion of the RBNA, lead to flooding of a special category space or ro-ro space, is to be kept on board and posted at an appropriate place.

403. All accesses from the ro-ro deck and vehicle ramps that lead to spaces below the bulkhead deck is to be closed before the ship leaves the berth on any voyage and shall remain closed until the ship is at its next berth.

404. The master shall ensure that an effective system of supervision and reporting of the closing and opening of such accesses referred to G1.305 is implemented.

405. The master shall ensure, before the ship leaves the berth on any voyage, that an entry in the log-book, as required by SOLAS regulation II-1/B-4/22.1322.13, is made of the time of the last closing of the accesses referred to in G1.503.

Guidance – SOLAS Regulation II-1/B-4/22.13

Hinged doors, portable plates, sidescuttles, gangway, cargo and bunkering 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 RBNA.

End of guidance

406. Notwithstanding the requirements of G1.503, the RBNA may permit some accesses to be opened during the voyage, but only for a period sufficient to permit through passage and, if required, for the essential working of the ship.

407. All transverse or longitudinal bulkheads which are taken into account as effective to confine the seawater accumulated on the ro-ro deck is to be in place and secured before the ship leaves the berth and remain in place and secured until the ship is at its next berth.

408. Notwithstanding the requirements of G1.307, the RBNA may permit some accesses within such bulkheads to be opened during the voyage but only for sufficient time to permit through passage and, if required, for the essential working of the ship.

409. In all ro-ro passenger ships, the master or the designated officer shall ensure that, without the expressed consent of the master or the designated officer, no passengers are allowed access to an enclosed ro-ro deck when the ship is under way.

CHAPTER H
LOADING CONDITIONS, BUOYANCY AND STABILITY

CHAPTER CONTENTS

H3. LOADING CONDITIONS

100. Configuration of loading and combination

101. The limiting or partial loading conditions are to be subjected for approval.

102. The basic conditions shall include as a minimum:

a. Light ship departure at 100%consumables and arrival at 10% consumables.

b. Fully loaded ship departure at 100%consumables and arrival at 10% consumables.

103. Intermediate conditions of loading are to be considered as necessary. In particular, the intended condition of operating with loading or unloading in a single pass, i.e. comprising cargo space empty from amidships to one end, is included. See Part II, Title 15, Section 2.

H5. STABILITY

100. Weight distribuition
– See Part II, Title 11, Section 1

200. Free Surface
– See Part II, Title 11, Section 1

300. Intact Stability for ships with GT ≥ 500
[SOLAS II-1/B-1/regulation 5]

301. Every passenger ship regardless of size and every cargo ship having a length (L) of 24 m and upwards, is to be inclined upon its completion and the elements of its stability determined. In addition to any other applicable

requirements of the present regulations, ships having a length of 24 m and upwards constructed on or after 1 July 2010 shall as a minimum comply with the requirements of part A of the 2008 IS Code.

a. The RBNAn may allow the inclining test of an individual cargo ship to be dispensed with provided basic stability data are available from the inclining test of a sister ship and it is shown to the satisfaction of the RBNA that reliable stability information for the exempted ship can be obtained from such basic data, as required by H5.301 above. A weight survey shall be carried out upon completion and the ship shall be inclined whenever in comparison with the data derived from the sister ship, a deviation from the lightship displacement exceeding 1% for ships of 160 m or more in length and 2% for ships of 50 m or less in length and as determined by linear interpolation for intermediate lengths or a deviation from the lightship longitudinal center of gravity exceeding 0.5% of Ls is found.

b. The RBNA may also allow the inclining test of an individual ship or class of ships especially designed for the carriage of liquids or ore in bulk to be dispensed with when reference to existing data for similar ships clearly indicates that due to the ship's proportions and arrangements more than sufficient metacentric height will be available in all probable loading conditions.

302. Where any alterations are made to a ship so as to materially affect the stability information supplied to the master, amended stability information is to be provided. If necessary the ship is to be re-inclined. The ship is to be re-inclined if anticipated deviations exceed one of the values specified in Part II, Title 11, Section 1.

303. At periodical intervals not exceeding five years, a lightweight survey is to be carried out on all passenger ships to verify any changes in lightship displacement and longitudinal centre of gravity. The ship is to be re-inclined whenever, in comparison with the approved stability information, a deviation from the lightship displacement exceeding 2% or a deviation of the longitudinal centre of gravity exceeding 1% of Ls (see A2.102 above is found or anticipated.

304. **Stability information supplied to the Master**
[SOLAS II-1/B-1/regulation 5-1]

The master is to be supplied with such information satisfactory to the RBNA as is necessary to enable him by rapid and simple processes to obtain accurate guidance as to the stability of the ship under varying conditions of service. A copy of the stability information is to be furnished to the RBNA. The information should include:

a. curves or tables of minimum operational metacentric height (GM) versus draught which assures compliance with the relevant intact and damage stability requirements, alternatively corresponding curves or tables of the maximum allowable vertical centre of gravity (KG) versus draught, or with the equivalents of either of these curves;

b. instructions concerning the operation of cross-flooding arrangements; and

c. all other data and aids which might be necessary to maintain the required intact stability and stability after damage.

305. The stability information shall show the influence of various trims in cases where the operational trim range exceeds +/- 0.5% of Ls.

306. For ships with AB ≥ 500, the criteria for stability of passenger ships are to meet the requirements of SOLAS Convention Chapter II-1 Part A Rule 8, IMO IS Code as ammended, Chapter 3.1.

309. **General criteria**
[IS Code 2.2. to 2.2.4]

a. The area under the righting lever curve (GZ curve) should not be less than 0.055 metre-radians up to θ = 30° angle of heel and not less than 0.09 metre-radians up to θ = 40° or the angle of downflooding θf (see note) if this angle is less than 40°. Additionally, the area under the righting lever curve (GZ curve) between the angles of heel of 30° and 40° or between 30° and θf, if this angle is less than 40°, should not be less than 0.03 metre-radians.

Note: θf is an angle of heel at which openings in the hull, superstructures or deckhouses which cannot be closed weathertight immerse. In applying this criterion, small openings through which progressive flooding cannot take place need not be considered as open.

b. The righting lever GZ should be at least 0.20 m at an angle of heel equal to or greater than 30°.

c. The maximum righting arm should occur at an angle of heel preferably exceeding 30° but not less than 25°.

d. The initial metacentric height GMo should not be less than 0.15 m.

310. **Moment due to the turning [IS Code 3.1.2]**
For passenger ships, the angle of heel on account of turning should not exceed 10° when calculated using the following formula:

$$M_R = V_0^2 * \Delta * \left(KG - \frac{d}{2}\right) * L$$

311. **Moment due to the crowding of passengers**: for passenger ships, the angle of heel on account of crowding of passengers to one side as defined in H3.102 to H3.105 should not exceed 10°.

312. Where anti-rolling devices are installed in a ship, the RBNA should be satisfied that the above criteria can be maintained when the devices are in operation.

313. A number of influences such as beam wind on ships with large windage area, icing of topsides, water trapped on deck, rolling characteristics, following seas, etc., adversely affect stability and the RBNA is advised to take these into account, so far as is deemed necessary.

314. Provisions should be made for a safe margin of stability at all stages of the voyage, regard being given to additions of weight, such as those due to absorption of water and icing (details regarding ice accretion are given in chapter 5) and to losses of weight such as those due to consumption of fuel and stores.

400. Intact Stability for ships with GT < 500

401. For passenger ships with GT <500 under the Brazilian Flag, these Rules include the compliance with the criteria contained in NORMAM 01 Chapter 7 Section V.

402. For passenger ships with GT < 500 under foreign flags, National RBNA regulations apply or, in the absence of those, IMO IS Code regulations.

H6. DAMAGE STABILITY (SHIPS WITH GT ≥ 500) [SOLAS II01/B-1/4 through B8.1]

100. General

101. The requirements of the present Subchapter H6 are to be applied to passenger ships in conjunction with the explanatory notes set out by IMO Resolution MSC281(85).
The damage stability requirements that follow shall apply to all passenger ships regardless of length.

200. Required subdivision index R

201. The subdivision of a ship is considered sufficient if the attained subdivision index A, determined in accordance with H6.300, is not less than the required subdivision index R calculated in accordance with this item H6.201 and if, in addition, the partial indices As, Ap and Al shall not less than 0.9R for passenger ships.

202. For all ships to which the damage stability requirements of this chapter apply, the degree of subdivision to be provided shall be determined by the required subdivision index R, as follows:

a. In the case of cargo ships greater than 100 m in length (Ls):

$$R = 1 - \frac{128}{Ls + 152}$$

(For the definition of Ls, see A2.118 above)

b. In the case of cargo ships not less than 80 m in length (Ls) and not greater than 100 m in length (Ls):

$$R = 1 - \left\{ \frac{1}{\left[1 + \left(\frac{Ls}{100} * \frac{Ro}{1 - Ro}\right)\right]} \right\}$$

where Ro is the value R as calculated in accordance with the formula in H6.202.a.

c. In the case of passenger ships:

$$R = 1 - \frac{5000}{Ls + 2{,}5N + 15225}$$

where

N = N1 + 2N*2
N1 = number of persons for whom lifeboats are provided
N2 = number of persons (including officers and crew) the ship is permitted to carry in excess of N1.

d. Where the conditions of service are such that compliance with N = N1 + 2N2 is impracticable and where the RBNA considers that a suitably reduced degree of hazard exists, a lesser value of N may be taken but in no case less than N = N1 + N2.

300. Attained subdivision index A

301. The attained subdivision index A is obtained by the summation of the partial indices As, Ap and Al, (weighted as shown) calculated for the draughts ds, dp and dl defined below in accordance with the following formula:

A = 0.4As + 0.4Ap + 0.2Al

where

Each partial index is a summation of contributions from all damage cases taken in consideration, using the following formula:

$A = \Sigma(Pi \cdot Si)$

where:

i represents each compartment or group of compartments under consideration;

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

Si accounts for the probability of survival after flooding the compartment or group of compartments under consideration, and includes the effect of any horizontal subdivision.

302. In the calculation of A, the level trim shall be used for the deepest subdivision draught and the partial

subdivision draught. The actual service trim shall be used for the light service draught. If in any service condition, the trim variation in comparison with the calculated trim is greater than 0.5% of Ls, one or more additional calculations of A are to be submitted for the same draughts but different trims so that, for all service conditions, the difference in trim in comparison with the reference trim used for one calculation will be less than 0.5% of Ls.

303. When determining the positive righting lever (GZ) of the residual stability curve, the displacement used should be that of the intact condition. That is, the constant displacement method of calculation should be used.

304. The summation indicated by the above formula shall be taken over the ship's subdivision length (Ls) for all cases of flooding in which a single compartment or two or more adjacent compartments are involved. In the case of unsymmetrical arrangements, the calculated A value should be the mean value obtained from calculations involving both sides. Alternatively, it should be taken as that corresponding to the side which evidently gives the least favorable result.

305. Wherever wing compartments are fitted, contribution to the summation indicated by the formula shall be taken for all cases of flooding in which wing compartments are involved. Additionally, cases of simultaneous flooding of a wing compartment or group of compartments and the adjacent inboard compartment or group of compartments, but excluding damage of transverse extent greater than one half of the ship breadth B, may be added. For the purpose of this regulation, transverse extent is measured inboard from ship's side, at right angle to the centreline at the level of the deepest subdivision draught.

306. In the flooding calculations carried out according to the regulations, only one breach of the hull and only one free surface need to be assumed. 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 of damage will give a more severe result, such extent is to be assumed.

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

306. The attained subdivision index A is not to be less than the required subdivision index R. In addition, the partial indexes As, Ap and Al are not to be less than 0,9R.

400. Calculation of the factor Pi

401. The factor Pi for a compartment or group of compartments shall be calculated below using the following notations:

j – the aftmost damage zone number involved in the damage starting with no. 1 at the stern;

n = the number of adjacent damage zones involved in the damage

k = is the number of a particular longitudinal bulkhead as barrier for transverse penetration in a damage zone counted from shell towards the centre line. The shell has k = 0;

x1 = the distance from the aft terminal of Ls to the aft end of the zone in question;

x2 = the distance from the aft terminal of Ls to the forward end of the zone in question;

b = the mean transverse distance in metres measured at right angles to the centreline at the deepest subdivision loadline between the shell and an assumed vertical plane extended between the longitudinal limits used in calculating the factor pi and which is a tangent to, or common with, all or part of the outermost portion of the longitudinal bulkhead under consideration. This vertical plane shall be so orientated that the mean transverse distance to the shell is a maximum, but not more than twice the least distance between the plane and the shell. If the upper part of a longitudinal bulkhead is below the deepest subdivision loadline the vertical plane used for determination of b is assumed to extend upwards to the deepest subdivision waterline. In any case, b is not to be taken greater than B/2.

If the damage involves a single zone only:

pi = p(x1j,x2j)*[r(xlj,x2j,bk) – r(x1j, x2j, bk-1)]

If the damage involves two adjacent zones:

pi = p (x1j,x2j+1)*[r(x1j,x2j+1,bk) - r(x1j,x2j+1,bk-1)]
- p (x1j,x2j* [r(x1j,x2j,bk) - r(x1j,x2j,bk-1)]
- p (x1j,x2j)* [r(x1j,x2j,bk) - r(x1j,x2j,bk-1)]
+p*(x1j+1,x2j+1*[r(x1j+1,x2j+1,bk)-
r(x1j+1,x2j+1,bk-1)]

and where r(x1, x2, b0) = 0

The factor p(x1, x2) is to be calculated according to the following formulae:

Overall normalized max damage length: Jmax = 10/33

Knuckle point in the distribution: Jkn = 5/33

Cumulative probability at Jkn: pk = 11/12

Maximum absolute damage length: lmax = 60 m

Length where normalized distribution ends: L* = 260 m

Probability density at J = 0:

$$b_0 = 2\left(\frac{p_k}{J_{kn}} - \frac{1-p_k}{J_{max} - J_{kn}}\right)$$

When $L_s \geq L^*$:

$$J_m = \min\left\{J_{max}, \frac{l_{max}}{L_s}\right\}$$

$$J_k = \frac{J_m}{2} + \frac{1 - \sqrt{1 + (1-2p_k)b_0 J_m + \frac{1}{4}b_0^2 J_m^2}}{b_0}$$

$$b_{12} = b_0$$

When $L_s > L^*$:

$$J_m^* = \min\left\{J_{max}, \frac{l_{max}}{L^*}\right\}$$

$$J_k^* = \frac{J_m^*}{2} + \frac{1 - \sqrt{1 + (1-2p_k)b_0 J_m^* + \frac{1}{4}b_0^2 J_m^{*2}}}{b_0}$$

$$J_m = \frac{J_m^* \cdot L^*}{L_s}$$

$$J_k = \frac{J_k^* \cdot L^*}{L_s}$$

$$b_{12} = 2\left(\frac{p_k}{J_k} - \frac{1-p_k}{J_m - J_k}\right)$$

$$b_{11} = 4\frac{1-p_k}{(J_m - J_k)J_k} - 2\frac{p_k}{J_k^2}$$

$$b_{21} = -2\frac{1-p_k}{(J_m - J_k)^2}$$

$$b_{22} = -b_{21}J_m$$

The non-dimensional damage length:

$$J = \frac{(x2 - x1)}{L_s}$$

The normalized length of a compartment or group of compartments:

Jn is to be taken as the lesser of J and Jm

J < Jk:
$p(x1, x2) = p1 = 1/6\ J^2\ (b11J + 3b12)$

J > Jk:

402. Where neither limits of the compartment or group of compartments under consideration coincides with the aft or forward terminals:

$$p(x1, x2) = p_2 = -\frac{1}{3}b_{11}J_k^3 + \frac{1}{2}(b_{11}J - b_{12})J_k^2 + b_{12}JJ_k - \frac{1}{3}b_{21}(J_n^3 - J_k^3) + \frac{1}{2}(b_{21}J - b_{22})(J_n^2 - J_k^2) + b_{22}J(J_n - J_k)$$

402. Where the aft limit of the compartment or group of compartments under consideration coincides with the aft terminal or the forward limit of the compartment or group of compartments under consideration coincides with the forward terminal:

$J \leq J_k$:

$$p(x1, x2) = \frac{1}{2}(p_1 + J)$$

$J > J_k$:

$$p(x1, x2) = \frac{1}{2}(p_2 + J)$$

403. Where the compartment or groups of compartments considered extends over the entire subdivision length (Ls):
p(x1, x2) = 1

404. The factor r(x1, x2, b) shall be determined by the following formulae:

$$r(x1, x2, b) = 1 - (1 - C)\cdot\left[1 - \frac{G}{p(x1, x2)}\right]$$

where

$$C = 12 \cdot J_b \cdot (-45 \cdot J_b + 4)$$

where

$$J_b = \frac{b}{15B}$$

405. Where the compartment or groups of compartments considered extends over the entire subdivision length (L_s):

$$G = G_1 = \frac{1}{2}b_{11}J_b^2 + b_{12}J_b$$

406. Where neither limits of the compartment or group of compartments under consideration coincides with the aft or forward terminals:

$$G = G_2 = -\frac{1}{3}b_{11}J_0^{\ 3} + \frac{1}{2}(b_{11}J - b_{12})J_0^{\ 2} + b_{12}JJ_0$$

where

$$J_0 = \min(J, J_b)$$

407. Where the aft limit of the compartment or group of compartments under consideration coincides with the aft terminal or the forward limit of the compartment or group of compartments under consideration coincides with the forward terminal:

$$G = \frac{1}{2}(G_2 + G_1 J)$$

500. Calculation of factor si

501. The factor si shall be determined for each case of assumed flooding, involving a compartment or group of compartments, in accordance with the following notations and the provisions in this regulation.

θe is the equilibrium heel angle in any stage of flooding, in degrees;

θv is the angle, in any stage of flooding, where the righting lever becomes negative, or the angle at which an opening incapable of being closed weathertight becomes submerged;

GZ max is the maximum positive righting lever, in metres, up to the angle θv;¨

Range is the range of positive righting levers, in degrees, measured from the angle θe. The positive range is to be taken up to the angle θv;

Flooding stage is any discrete step during the flooding process, including the stage before equalization (if any) until final equilibrium has been reached.

502. The factor si, for any damage case at any initial loading condition, di, shall be obtained from the formula:

si = minimum {sintermediate,i or sfinal,i· smom,i}

where:

sintermediate,i is the probability to survive all intermediate flooding stages until the final equilibrium stage, and is calculated in accordance with H6.503;

sfinal,i is the probability to survive in the final equilibrium stage of flooding. It is calculated in accordance with H6.504

smom,i is the probability to survive heeling moments, and is calculated in accordance with paragraph H6.505.

503. **Calculation of s intermediate**

The factor sintermediate,i is applicable only to passenger ships (for cargo ships sintermediate,i should be taken as unity) and shall be taken as the least of the s-factors obtained from all flooding stages including the stage before equalization, if any, and is to be calculated as follows:

$$s_{intermediate,1} = \left[\frac{GZ_{max}}{0.05} \cdot \frac{Range}{7}\right]^{\frac{1}{4}}$$

Where GZmax is not to be taken as more than 0.05 m and Range as not more than 7°. Sintermediate = 0, if the intermediate heel angle exceeds 15°. Where cross-flooding fittings are required, the time for equalization shall not exceed 10 min.

504. **Calculation of s final**

The factor sfinal,i shall be obtained from the formula:

$$S_{final,i} = K \cdot \left[\frac{GZ_{max}}{0.12} \cdot \frac{Range}{16}\right]^{\frac{1}{4}}$$

Where:

K = 1 if $\theta_e \leq \theta_{min}$
K = 0 if $\theta_e \geq \theta_{max}$

$$K = \sqrt{\frac{\theta_{max} - \theta_e}{\theta_{max} - \theta_{min}}}$$

Where:
θ_{min} is 7° for passenger ships and 25° for cargo ships;
and
θ_{max} is 15° for passenger ships and 30° for cargo ships.

505. **Calculation of s moment**

The factor $s_{mom,i}$ is applicable only to passenger ships (for cargo ships $s_{mom,i}$ shall be taken as unity) and shall be calculated at the final equilibrium from the formula:

$$s_{mom,i} = \frac{(GZ_{max} - 0.04) \cdot \text{Displacement}}{M_{heel}}$$

where:

Displacement is the intact displacement at the subdivision draught;

M_{heel} is the maximum assumed heeling moment as calculated in accordance with subparagraph H6.505.a; and

$s_{mom,i} \leq 1$

a. The heeling moment M_{heel} is to be calculated as follows:

M_{heel} = maximum {$M_{passenger}$ or M_{wind} or $M_{Survivalcraft}$}

i. **Calculation of M passenger**: $M_{passenger}$ is the maximum assumed heeling moment resulting from movement of passengers, and is to be obtained as follows:

$M_{passenger} = (0.075 \times N_p) \times (0.45 \times B)$ (tm)

Where:

N_p is the maximum number of passengers permitted to be on board in the service condition corresponding to the deepest subdivision draught under consideration; and

B is the beam of the ship.

Alternatively, the heeling moment may be calculated assuming the passengers are distributed with 4 persons per square metre 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. In doing so, a weight of 75 kg per passenger is to be assumed.

ii. **Calculation of M wind**: M_{wind} is the maximum assumed wind force acting in a damage situation:

$M_{wind} = (P \times A \times Z) / 9{,}806$ (tm)

Where:

P = 120 N/m^2;

A = projected lateral area above waterline;

Z = distance from centre of lateral projected area above waterline to T/2; and

T = ship's draught, d_i.

iii. **Calculation of M survival craft**: $M_{Survivalcraft}$ is the maximum assumed heeling moment due to the launching of all fully loaded davit-launched survival craft on one side of the ship. It shall be calculated using the following assumptions:

- all lifeboats and rescue boats fitted on the side to which the ship has heeled after having sustained damage shall be assumed to be swung out fully loaded and ready for lowering;

- for lifeboats which are arranged to be launched fully loaded from the stowed position, the maximum heeling moment during launching shall be taken;

- a fully loaded davit-launched liferaft attached to each davit on the side to which the ship has heeled after having sustained damage shall be assumed to be swung out ready for lowering;

- persons not in the life-saving appliances which are swung out shall not provide either additional heeling or righting moment; and

- life-saving appliances on the side of the ship opposite to the side to which the ship has heeled shall be assumed to be in a stowed position.

506. **Equalization arrangements**

a. Unsymmetrical flooding is to be kept to a minimum consistent with the efficient arrangements. Where it is necessary to correct large angles of heel, the means adopted shall, where practicable, be self-acting, but in any case where controls to equalization devices are provided they shall be operable from above the bulkhead deck. These fittings together with their controls shall be acceptable to the RBNA. Suitable information concerning the use of equalization devices shall be supplied to the master of the ship

b. Reference is made to the Recommendation on a standard method for establishing compliance with the requirements for cross-flooding arrangements in passengers ships, adopted by the Organization by resolution A.266(VIII), as may be amended.

c. Tanks and compartments taking part in such equalization shall be fitted with air pipes or equivalent means of sufficient cross-section to ensure that the flow of water into the equalization compartments is not delayed.

507. **Cases where si is equal to zero**

a. In all cases, si is to be taken as zero in those cases where the final waterline, taking into account sinkage, heel and trim, immerses:

i. the lower edge of openings through which progressive flooding may take place and such flooding is not accounted for in the calculation of factor si. Such openings shall include air-pipes, ventilators and openings which are closed by means of weathertight doors or hatch covers; and

i. any part of the bulkhead deck in passenger ships considered a horizontal evacuation route for compliance with SOLAS chapter II-2.

b. The factor si is to be taken as zero if, taking into account sinkage, heel and trim, any of the following occur in any intermediate stage or in the final stage of flooding:

i. immersion of any vertical escape hatch in the bulkhead deck intended for compliance with the SOLAS chapter II-2;

ii. any controls intended for the operation of watertight doors, equalization devices, valves on piping or on ventilation ducts intended to maintain the integrity of watertight bulkheads from above the bulkhead deck become inaccessible or inoperable;

iii. Immersion of any part of piping or ventilation ducts carried through a watertight boundary that is located within any compartment included in damage cases contributing to the attained index A, if not fitted with watertight means of closure at each boundary.

508. However, where compartments assumed flooded due to progressive flooding are taken into account in the damage stability calculations multiple values of $s_{intermediate,i}$ may be calculated assuming equalization in additional flooding phases.

509. Except as provided in H6.507.b, openings closed by means of watertight manhole covers and flush scuttles, small watertight hatch covers, remotely operated sliding watertight doors, side scuttles of the non-opening type as well as watertight access doors and hatch covers required to be kept closed at sea need not be considered.

600. Calculation of the factor v_m

601. The factor vm shall be obtained from the formula:

vm = v(Hj, n, m, d) - v(Hj, n, m-1, d)

Where:
Hj, n, m is the least height above the baseline, in metres, within the longitudinal range of x1(j)...x2(j+n-1) of the m_{th} horizontal boundary which is assumed to limit the vertical extent of flooding for the damaged compartments under consideration;

Hj, n, m-1 is the least height above the baseline, in metres, within the longitudinal range of x1(j)...x2(j+n-1) of the (m-1)th horizontal boundary which is assumed to limit the vertical extent of flooding for the damaged compartments under consideration;

j signifies the aft terminal of the damaged compartments under consideration;

m represents each horizontal boundary counted upwards from the waterline under consideration;

d is the draught in question as defined H6.301; and

x1 and x2 represent the terminals of the compartment or group of compartments considered H6.400.

a. The factors v(Hj, n, m,d) and v(Hj, n, m-1,d) shall be obtained from the formulae:

$$v(H,d) = 0.8\frac{(H-d)}{7.8}$$

if (H_m-d) is less than, or equal to, 7.8 m;

$$v(H,d) = 0.8 + 0.2\left[\frac{(H-d)-7.8}{4.7}\right]$$

in all other cases

where:

v(Hj, n, m, d) is to be taken as 1, if Hm coincides with the uppermost watertight boundary of the ship within the range (x1(j)...x2(j+n-1)), and

v(Hj, n, 0, d) is to be taken as 0.

In no case is vm to be taken as less than zero or more than 1.

602. In general, each contribution dA to the index A in the case of horizontal subdivisions is obtained from the formula:

dA = pi [v1 Smin 1 + (v2 - v1)Smin 2 + ..+ (1-vm-1)Smin m]

Where:

vm= the v-value calculated in accordance with H6.601;

smin = the least s-factor for all combinations of damages obtained when the assumed damage extends from the assumed damage height Hm downwards.

700. Permeability

701. For the purpose of the subdivision and damage stability calculations of the regulations, the permeability of each general compartment or part of a compartment shall be as follows:

TABLE T.H6.701.1 PEREMABILITY OF A GENERAL COMPARTMENT

Spaces	Permeability
Appropriated to stores	0.60
Occupied by accommodation	0.95
Occupied by machinery	0.85
Void spaces	0.95
Intended for liquids	0 or 0.95*

* Whichever results in the more severe requirement.

702. For the purpose of the subdivision and damage stability calculations of the regulations, the permeability of each cargo compartment or part of a compartment shall be as follows:

TABLE T.H6.702.1 PERMEABILITY OF A CARGO COMPARTMENT

Spaces	Permeability at draught ds	Permeability at draught dp	Permeability at draught dl
Dry cargo spaces	0.70	0.80	0.95
Container spaces	0.70	0.80	0.95
Ro-ro spaces	0.90	0.90	0.95
Cargo liquids	0.70	0.80	0.95

703. Other figures for permeability may be used if substantiated by calculations.

800. Special requirements concerning passenger ship stability [Rule 8 of Chapter II-1 Part A of the SOLAS Convention]

801. A passenger ship intended to carry 400 or more persons shall have watertight subdivision abaft the collision bulkhead so that si = 1 for the three loading conditions on which is based the calculation of the subdivision index and for a damage involving all the compartments within 0.08L measured from the forward perpendicular.

802. A passenger ship intended to carry 36 or more persons is to be capable of withstanding damage along the side shell to an extent specified below. Compliance with this regulation is to be achieved by demonstrating that si, as defined in h6.500, is not less than 0.9 for the three loading conditions on which is based the calculation of the subdivision index.

803. The damage extent to be assumed when demonstrating compliance with the deepest subdivision draught (d_s) (see A2.104.a), is to be dependent on both N as defined in H6.200, and Ls as defined in A2.118, such that:

a. the vertical extent of damage is to extend from the ship's moulded baseline to a position up to 12.5 m above the position of the deepest subdivision draught unless a lesser vertical extent of damage were to give a lower value of si, in which case this reduced extent is to be used;

b. where 400 or more persons are to be carried, a damage length of 0.03Ls but not less than 3 m is to be assumed at any position along the side shell, in conjunction with a penetration inboard of 0.1B but not less than 0.75 m measured inboard from the ship side, at right angle to the centreline at the level of the deepest subdivision draught;

c. where less than 400 persons are carried, damage length is to be assumed at any position along the shell side between transverse watertight bulkheads provided that the distance between two adjacent transverse watertight bulkheads is not less than the assumed damage length. If the distance between adjacent transverse watertight bulkheads is less than the assumed damage length, only one of these bulkheads shall be considered effective for the purpose of demonstrating compliance with H6.802 above.

d. where 36 persons are carried, a damage length of 0.015Ls but not less than 3 m is to be assumed, in conjunction with a penetration inboard of 0.05B but not less than 0.75 m; and

e. where more than 36, but fewer than 400 persons are carried the values of damage length and penetration inboard, used in the determination of the assumed extent of damage, are to be obtained by linear interpolation between the values of damage length and penetration which apply for ships carrying 36 persons and 400 persons as specified in H6.892.d and H6.802.b.

900. Additional requirements of stability for ships with fixed fire-fighting equipment of high pressure spraying in Ro/Ro cargo compartments

101. In Ro/Ro cargo compartments (intended for the carriage of motor vehicles with fuel for its self-propelling) equipped with firefighting systems spray fire fighting, the devices of drainage are to be arranged in such a way as to prevent the formation of free surface. If this could not be possible, the adverse effect on the stability of the ship caused by the weight added by water of the spray system and the consequent free surface is o be taken into account in the calculation of the stability.

102. The stability booklet of ro-ro passenger ships should contain information concerning the importance of securing and maintaining all closures watertight due to the rapid loss of stability which may result when water enters the vehicle deck and the fact that capsize can rapidly follow.

H7. INTEGRITY OF THE HULL, HULL OPENINGS AND MEANS OF CLOSURE

100. Openings in watertight bulkheads below the bulkhead deck [SOLAS II-1/B2/13]

101. The number of openings in watertight bulkheads is to be reduced to the minimum compatible with the design and proper operation of the ship, satisfactory means of closure are to be provided for these openings.

102. Pipes, scuppers, electric cables, etc. carried through watertight bulkheads

a. Where pipes, scuppers, electric cables, etc., are carried through watertight bulkheads, arrangements are to be made to ensure the watertight integrity of the bulkheads.

b. Valves not forming part of a piping system shall not be permitted in watertight bulkheads.

c. Lead or other heat sensitive materials shall not be used in systems which penetrate watertight bulkheads, where deterioration of such systems in the event of fire would impair the watertight integrity of the bulkheads.

103. No doors, manholes, or access openings are permitted in watertight transverse bulkheads dividing a cargo space from an adjoining cargo space.

104. Not more than one door, apart from the doors to shaft tunnels, may be fitted in each watertight bulkhead within spaces containing the main and auxiliary propulsion machinery including boilers serving the needs of propulsion. 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.

105. Watertight doors, except as provided in Part II, Title 26 (passenger ships designed or adapted for the carriage of goods vehicles and accompanying personnel), are to be power-operated sliding doors 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.

106. The means of operation whether by power or by hand of any power-operated sliding watertight door shall be capable of closing the door with the ship listed to 15° either way. Consideration shall 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.

107. Watertight door controls, including hydraulic piping and electric cables, are to be kept as close as practicable to the bulkhead in which the doors are fitted, in order to minimize the likelihood of being affected by 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 draught, the operation of the watertight doors clear of the damaged portion of the ship is not impaired.

108. **Power operated sliding watertight doors**: all power-operated sliding watertight doors are to be provided with means of indication which will indicate at all remote operating positions whether the doors are open or closed. Remote operating positions shall only be at the navigation bridge and at the location where hand operation above the bulkhead deck is required by paragraph H6.507.

109. Each power-operated sliding watertight door:

a. shall have a vertical or horizontal motion;

b. is to be normally limited to a maximum clear opening width of 1.2 m. The RBNA may permit larger doors only to the extent considered necessary for the effective operation of the ship provided that other safety measures, including the following, are taken into consideration:

i. special consideration is to be given to the strength of the door and its closing appliances in order to prevent leakages; and

ii. the door is to be located inboard the damage zone B/5;

iii. is to be fitted with the necessary equipment to open and close the door using electric power, hydraulic power, or any other form of power that is acceptable to the RBNA;

iv. 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 movement providing the same degree of safety acceptable to the RBNA. 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, shall not exceed 90 s with the ship in the upright position;

v. 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;

vi. 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 shall sound for at least 5 s but no more than 10 s before the door begins to move and shall 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 RBNA may require the audible alarm to be supplemented by an intermittent visual signal at the door; and

vii. 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 shall in no case be less than 20 s or more than 40 s with the ship in the upright position.

110. 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 is 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 in the event of failure of either the main or emergency source of electrical power.

111. Power-operated sliding watertight doors shall have either:

a. 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 is to be situated on the central operating console at the navigation bridge; or

b. 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 is to be provided at the central operating console on the navigation bridge. Loss of stored energy indication at each local operating position shall also be provided; or

c. 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 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°.

112. For the systems specified above, provision should be made as follows:

a. Power systems for power-operated watertight sliding doors is to be separate from any other power system.

b. A single failure in the electric or hydraulic power-operated systems excluding the hydraulic actuator shall not prevent the hand operation of any door.

113. Control handles is to be provided at each side of the bulkhead at a minimum height of 1.6 m above the floor and is 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.

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

116. The enclosures of electrical components necessarily situated below the bulkhead deck shall provide suitable protection against the ingress of water.

Guidance

Refer to the publication IEC 60 (2003)

i. electrical motors, associated circuits and control components; protected to IPX 7 standard;

ii. door position indicators and associated circuit components; protected to IPX 8 standard; and

iii. door movement warning signals; protected to IPX 6 standard.

iv. Other arrangements for the enclosures of electrical components may be fitted provided the RBNA is satisfied that an equivalent protection is achieved. The water pressure IPX 8 is to be based on the pressure that may occur at the location of the component during flooding for a period of 36 h.

End of guidance

117. Electric power, control, indication and alarm circuits is 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 shall not result in a loss of power operation of that door. Arrangements is to be such that leakage of water into the electrical equipment located below the bulkhead deck will not cause the door to open.

118. A single electrical failure in the power operating or control system of a power-operated sliding watertight door shall not result in a closed door opening. Availability of the power supply should be continuously monitored at a point in the electrical circuit as near as practicable to each of the motors. Loss of any such power supply should activate an audible and visual alarm at the central operating console at the navigation bridge.

119. Central operating console at the navigation bridge

a. The central operating console at the navigation bridge shall have a "master mode" switch with two modes of control:

i. a "local control" mode which shall allow any door to be locally opened and locally closed after use without automatic closure, and

ii. a "doors closed" mode which shall automatically close any door that is open. The "doors closed" mode shall automatically close any door that is open. The "doors closed" mode shall permit doors to be opened locally and shall automatically re-close the doors upon release of the local control mechanism.

iii. The "master mode" switch shall normally be in the "local control" mode. The "doors closed" mode shall only be used in an emergency or for testing purposes. Special consideration is to be given to the reliability of the "master mode" switch.

b. 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 shall indicate a door is fully open and a green light shall indicate a door is fully closed. When the door is closed remotely the red light shall indicate the intermediate position by flashing. The indicating circuit is to be independent of the control circuit for each door.

c. It shall not be possible to remotely open any door from the central operating console.

119. If the RBNA 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 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 draught.

120. Should any such 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 RBNA

121. Portable plates on bulkheads shall not be permitted except in machinery spaces. The RBNA may permit not more than one power-operated sliding watertight door in each watertight bulkhead larger than those specified in H7.119.b above to be substituted for these portable plates, provided these doors are intended to remain closed during navigation except in case of urgent necessity at the discretion of the master. These doors need not meet the requirements of H7.119.b.iv above regarding complete closure by hand-operated gear in 90 s.

110. Trunks and tunnels

a. Where trunk ways or tunnels for access from crew accommodation to the stokehold, for piping, or for any other purpose are carried through watertight bulkheads, they is to be watertight and in accordance with the requirements of H7.200. The access to at least one end of each such tunnel or trunk way, if used as a passage at sea, is to be through a trunk extending watertight to a height sufficient to permit access above the bulkhead deck. The access to the other end of the trunk way or tunnel may be through a watertight door of the type required by its location in the ship. Such trunk ways or tunnels shall not extend through the first subdivision bulkhead abaft the collision bulkhead.

b. Where it is proposed to fit tunnels piercing watertight bulkheads, these shall receive the special consideration of the RBNA.

c. Where trunk ways 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 is to be operated by power and be capable of being closed from a central position situated above the bulkhead deck.

200. Internal watertight integrity above the bulkhead deck [SOLAS II-1/B-2/17]

201. Measures shall 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 watertight bulkheads, they shall 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 shall be made effectively watertight. Where openings, pipes, scuppers, electric cables etc. are carried through the partial watertight bulkheads or

decks within the immersed part of the bulkhead deck, arrangements shall be made to ensure the watertight integrity of the structure above the bulkhead deck.

202. 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 weather tight. Freeing ports, open rails and scuppers shall be fitted as necessary for rapidly clearing the weather deck of water under all weather conditions.

203. The open end of air pipes terminating within a superstructure shall 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. The provisions of this paragraph are without prejudice to the provisions of the International Convention on Load Lines in force.

204. Sidescuttles, gangway, cargo and fuelling ports and other means for closing openings in the shell plating above the bulkhead deck 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 draught.

205. Doors are to be opened and closed locally on both sides with the ship heeled 15 ˚ to each side. If the ship is allowed to heel up to 20 ˚, during the intermediate stages of flooding, so the doors are to be capable of operating by hand with the ship heeled 20 ˚.

206. Position indicators is to be provided in the bridge as well as locally on both sides of the doors to indicate whether the doors are open or closed and fasteners are fully fitted.

300. Integrity of the hull and superstructure, damage prevention and control on ro-ro passenger ships

301. Subject to the provisions of H7.302 and H7.303 below, all accesses that lead to spaces below the bulkhead deck shall have a lowest point which is not less than 2.5 m above the bulkhead deck.

302. Where vehicle ramps are installed to give access to spaces below the bulkhead deck, their openings shall be able to be closed weathertight to prevent ingress of water below, alarmed and indicated to the navigation bridge.

303. The RBNA may permit the fitting of particular accesses to spaces below the bulkhead deck provided they are necessary for the essential working of the ship, e.g. the movement of machinery and stores, subject to such accesses being made watertight, alarmed and indicated on the navigation bridge.

304. Indicators shall be provided on the navigation bridge for all shell doors, loading doors and other closing appliances which, if left open or not properly secured, could, in the opinion of the RBNA, lead to flooding of a special category space or ro-ro space. The indicator system shall be designed on the fail-safe principle and shall show by visual alarms if the door is not fully closed or if any of the securing arrangements are not in place and fully locked and by audible alarms if such door or closing appliances become open or the securing arrangements become unsecured. The indicator panel on the navigation bridge shall be equipped with a mode selection function "harbour/sea voyage" so arranged that an audible alarm is given on the navigation bridge if the ship leaves harbour with the bow doors, inner doors, stern ramp or any other side shell doors not closed or any closing device not in the correct position. The power supply for the indicator system shall be independent of the power supply for operating and securing the doors.

305. Television surveillance and a water leakage detection system shall be arranged to provide an indication to the navigation bridge and to the engine control station of any leakage through inner and outer bow doors, stern doors or any other shell doors which could lead to flooding of special category spaces or ro-ro spaces.

400. Doors in watertight bulkheads of cargo ships and passenger ships [IACS Unified Interpretation SC156]

401. This Chapter covers doors located in way of the internal watertight subdivision boundaries and the external watertight boundaries necessary to ensure compliance with the relevant subdivision and damage stability regulations.

402. Doors in watertight bulkheads of small cargo ships not subject to any statutory subdivision and damage stability requirements may be hinged quick acting doors arranged to open out of the major space protected. They shall be constructed in accordance with the requirements of the RBNA and have notices affixed to each side stating "To be kept closed at sea". This Chapter shall not apply to HSCs pending completion of revision of the HSC Code by IMO and consideration of same by the applicable IACS WPs.
This Chapter does not apply to doors located in external boundaries above equilibrium or intermediate waterplanes.

403. The design and testing requirements for watertight doors vary according to their location relative to the equilibrium waterplane or intermediate waterplane at any stage of assumed flooding.

404. This context shall not be limited to watertight doors covered by SOLAS. Watertight doors required by other statutory damage stability requirements, e.g. MARPOL, the IBC and IGC Codes are covered as well. Small cargo vessels not subject to damage stability requirements are not required to comply with the full scheme.

405. Definitions: See A2.101

406. **Structural Design**: doors shall be of approved design and substantial construction in accordance with the requirements of the classing society and shall be of a

strength equivalent to that of the subdivision bulkheads in which they are fitted.

407. **Operation Mode, Location and Outfitting**: doors shall be fitted in accordance with all requirements regarding their operation mode, location and outfitting, i.e. provision of controls, means of indication, etc., as shown in Table T.H6.307.1 below. This table is to be read in conjunction with the following general notes:

a. For passenger ships the watertight doors and their controls are to be located in compliance with H7.101 and H7.109.b.ii above.

b. Frequency of Use whilst at sea

i. *Normally Closed*: Kept closed at sea but may be used if authorised. To be closed again after use.

ii. *Permanently Closed*: 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 such doors be accessible during the voyage, they shall be fitted with a device to prevent unauthorised opening.

iii. *Normally Open:* May be left open provided it is always ready to be immediately closed.

iv. *Used:* In regular use, may be left open provided it is ready to be immediately closed.

c. Type:

(*) Rolling doors are technically identical to sliding doors.

d. Control

i. Local: All doors, except those which are to be permanently closed at sea, are to be capable of being opened and closed by hand, (and by power, where applicable locally, from both sides of the doors, with the ship listed to either side. Arrangements for passenger ships shall be in accordance with H7.109.b.iv above.

ii. For passenger ships, the angle of list at which operation by hand is to be possible is 15° or 20° if the ship is allowed to heel up to 20° during intermediate stages of flooding.

iii. For cargo ships, the angle of list at which operation by hand is to be possible is 30°.

e. **Remote**: Where indicated in Table T.H6.307.1 below, doors are to be capable of being remotely closed by power from the bridge. Where it is necessary to start the power unit for operation of the watertight door, means to start the power unit is also to be provided at remote control stations. The operation of such remote control is to be in accordance with H7.119. Arrangements for passenger ships shall be in accordance with H7.109.b.v above.

f. **Indication**: where shown in Table T.H6.307.1 below, position indicators are to be provided at all remote operating positions as well as locally, on both sides of the door, to show whether the doors are open or closed and, if applicable, with all dogs/cleats fully and properly engaged. Indication at all remote control positions.

i. The door position indicating system is to be of self-monitoring type and the means for testing of the indicating system are to be provided at the position where the indicators are fitted.

ii. An indication (i.e. red light) should be placed locally showing that the door is in remote control mode ("doors closed mode"). Special care should be taken in order to avoid potential danger when passing through the door. Signboard/instructions should be placed in way of the door advising how to act when the door is in "doors closed" mode.

g. **Alarms**: doors which are to be capable of being remotely closed are to be provided with an audible alarm, distinct from any other alarm in the area, which will sound whenever such a door is remotely closed. For passenger ships the alarm shall sound for at least 5 s but not more than 10 s before the door begins to move and shall continue sounding until the door is completely closed. In the case of remote closure by hand operation, an alarm is required to sound only while the door is actually moving. In passenger areas and areas of high ambient noise, the audible alarms are to be supplemented by visual signals at both sides of the doors.

TABLE T.H7.407-TYPES OF THE WETHERTIGHT DOORS

Power operated, sliding or rolling *	POS
Power operated,hinged	POH
Sliding or Rolling	S
Hinged	H

h. **Notices**: as shown in Table T.H6.407.1., doors which are normally closed at sea but not provided with means of remote closure, are to have notices fixed to both sides of the doors stating, "To be kept closed at sea". Doors which are to be permanently closed at sea are to have notices fixed to both sides stating, "Not to be opened at sea".

408. **Fire Doors**: watertight doors may also serve as fire doors but need not be fire-tested when intended for use below the bulkhead deck.

a. Where such doors are used at locations above the bulkhead deck they shall, in addition to complying with

the provisions applicable to fire doors at the same locations, also comply with means of escape provisions of Part II, Title 11, Section 3, E.12.

b. Where a watertight door is located adjacent to a fire door, both doors shall be capable of independent operation, remotely if required by H7.119 and from both sides of the each door.

TABLE T.H6.407.1. INTERNAL DOORS IN WATERTIGHT BULKHEADS IN CARGO SHIPS AND PASSENGER SHIPS

Position relative to equilibrium or intermediate waterplane	1. Frequency of use whilst at sea	2. Type	3. Remote Control*6	4. Indication locally and on Bridge *6	5. Audible Alarm *6
I. Passenger Ships					
A. At or below	Norm. Closed	POS	Yes	Yes	Yes
	Perm. Closed	S, H	No	No	No
B. Above	Norm.Open	POS, POH	Yes	Yes	Yes
	Norm. Closed	S, H	No	Yes	No
		S, H	No	Yes	No
II. Cargo Ships					
A. At or below	Used	POS	Yes	Yes	Yes
	Norm. Closed	S, H	No	Yes	No
	Perm. Closed	S, H	No	No	No
B. Above	Used	POS	Yes	Yes	Yes
	Norm. Closed	S, H	No	Yes	No

Position relative to equilibrium or intermediate waterplane	6. Notice	7. Comments	8. Regulation
I. Passenger Ships			
A. At or below	No	Certain doors may be left open, see SOLAS II-1/15.9.3	SOLAS II-1/15.9.1, 2 & 3
	Yes	See Notes 1 + 4	SOLAS II-1/15.10.1 & 2
B. Above	No		SOLAS II-1/15.9.3 SOLAS II-1/20.1 MSC/Circ.541 B. Above
	Yes	See Note 2	
	Yes	Doors giving access to Ro-Ro Deck	SOLAS II-1/20-2
II. Cargo Ships			
A. At or below	No		SOLAS II-1/25-9.2
	Yes	See Notes 2 + 3 + 5	SOLAS II-1/25-9.3
	Yes	See Notes 1 + 4	SOLAS II-1/25-9.4 SOLAS II-1/25-10
B. Above	No		SOLAS II-1/25-9.2
	Yes	See Notes 2 + 5	SOLAS II-1/25-9.3 SOLAS II-1/25-10

Notes:

1. Doors in watertight bulkheads subdividing cargo spaces.
2. If hinged, this door shall be of quick acting or single action type
3. "ICLL66 + A.320" or "1988 Protocol to ICLL66", MARPOL, IGC and IBC-Codes require remotely operated watertight doors to be sliding doors
4. The time of opening such doors in port and closing them before the ship leaves port shall be entered in the logbook.
5. The use of such doors shall be authorised by the officer of the watch.
6.Cables for control and power systems to power operated watertight doors and their status indication should comply with the requirements of Part II, Title 11, Section 3, Chapter E, E5.400.

408. Normally closed doors at sea: the doors that are not necessary for frequent access at sea are to be kept normally closed and may be of any type. Hinged or sliding doors normally kept closed are to be operated locally from both sides and are to be fitted with plates on both sides with the sign: "Keep this door closed while at sea."

409. Doors normally open at sea: Where there are public spaces for the passage of passengers and crew, the doors may usually be kept at sea, both sliding and/or hinged. In addition:

a. Doors maintained normally open at sea are to be provided with motor operation from the both sides of the door and remote closing from the bridge. The operation of these ports should be similar to the following:

i. Doors must be of the self-closing type and can be closed with a tilt angle opposite to lock of up to 3.5 s

ii. The approximate time of closing of hinged doors shall not be greater than 40 seconds and not less than 10 seconds.

iii. The ports except these of emergency, are to be provided with remote release from the control station manned permanently, individually or in groups, and individual release from both sides of the door. The release keys are to be provided with a function to prevent automatic re-setting of the system.

iv. Retaining hooks not subjected to the control of the central station are prohibited.

v. A door remotely closed from the control station are to be provided with means for re-opening from both sides by local control. After the activation of this local control, the door are to be self closed automatically.

vi. There must be an indication of closed door in the control station.

vii. The automatic shutdown system must be designed so that in case of failure of the system the doors are closed automatically.

viii. Local accumulators for doors provided with energized system of opening and closing are to be able to open and close the doors for 10 minutes after the fall of power of the control system.

ix. The failure of a local or central system of a door shall not impair the operating of other doors.

x. Sliding doors or with the energized system of opening is to be provided with alarm that sounds at least 5 seconds before, but not more than 10 seconds, after the door is been released from the control station and before the door starts its movement, and continue to sound until the total closing of the door.

xi. Double-leaf doors equipped with latch necessary for their fire shall have a latch that is automatically activated by the operation of the doors when released by the control system.

xii. The doors with energized opening and closing mechanism are to be provided with approved system that should be able to operate in case of fire and that complies with the FTC (Fire Testing Code) of the IMO.

b. doors usually kept open at sea should be equipped with audible alarms, distinct from any other alarm in the area, which should trigger whenever the doors are closed remotely. The alarms are to sound for at least 5 s, but not more than 10 seconds before the doors start to move up and keep ringing until the doors are fully closed. In passenger areas and areas of high ambient noise, alarms are to be supplemented by visual signals on both sides of the doors.

[**SOLAS CHAPTER II-1/B-2/9 Regulation 9**]

500. Double bottoms in passenger ships and cargo ships other than tankers

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

502. Where a double bottom is required to be fitted 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 inner bottom is not lower at any part than a plane parallel with the keel line and which is located not less than a vertical distance h measured from the keel line, as calculated by the formula:

h = B/20

a. However, in no case is the value of h to be less than 760 mm, and need not be taken as more than 2 000 mm.

503. Small wells constructed in the double bottom in connection with drainage arrangements of holds, etc., shall not extend downward more than necessary. 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 by the RBNA if satisfied that the arrangements give protection equivalent to that afforded by a double bottom complying with this regulation. In no case shall the vertical distance from the bottom of such a well to a plane coinciding with the keel line be less than 500 mm.

504. A double bottom need not be fitted in way of watertight tanks, including dry tanks of moderate size, provided the safety of the ship is not impaired in the event of bottom or side damage.

505. In the case of passenger ships which are employed in special trades for the carriage of large numbers of special trade passengers, such as the pilgrim trade, the RBNA of the State whose flag such ships are entitled to fly, if satisfied that it is impracticable to enforce compliance with the requirements of this chapter, may exempt such ships from those requirements, provided that they comply fully with the provisions of:

a. the rules annexed to the Special Trade Passenger Ships Agreement, 1971; and

b. the rules annexed to the Protocol on Space Requirements for Special Trade Passenger Ships, 1973.

and which are engaged on regular service within the limits of a short international voyage, the RBNA may permit a double bottom to be dispensed with if satisfied that the fitting of a double bottom in that part would not be compatible with the design and proper working of the ship.

506. Any part of a passenger ship or a cargo ship that is not fitted with a double bottom in accordance with H7.401, H7404 or H7.405 shall be capable of withstanding bottom damages in that part of the ship.

507. In the case of unusual bottom arrangements in a passenger ship or a cargo ship, it shall be demonstrated that the ship is capable of withstanding bottom damages as specified in H7.408.

508. Compliance with H7.406 or H7.407 is to be achieved by demonstrating that s_i, when calculated in accordance with H6.500 above, is not less than 1 for all service conditions when subject to a bottom damage assumed at any position along the ship's bottom and with an extent specified in item b below for the affected part of the ship:

a. Flooding of such spaces shall not render emergency power and lighting, internal communication, signals or other emergency devices inoperable in other parts of the ship.

b. Assumed extent of damage shall be as follows:

TABLE T.H7508.1 – ASSUMED EXTENT OF DAMAGE

	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 $L^{2/3}$ or 14.5m, 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

c. If any damage of a lesser extent than the maximum damage specified in subparagraph .2 would result in a more severe condition, such damage should be considered.

509. In case of large lower holds in passenger ships, the RBNA may require an increased double bottom height of not more than B/10 or 3 m, whichever is less, measured from the keel line. Alternatively, bottom damages may be calculated for these areas, in accordance with paragraph 8, m but assuming an increased vertical extent.

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