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

TITLE 11 SHIPS IN GENERAL

SECTION 1 NAVAL ARCHITECTURE

CHAPTERS

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CHAPTER A
APPROACH

CHAPTER CONTENTS

A1. APPROACH

100. Application

101. The present Part II, Title 11, Section 1 is applicable to all vessels.

102. The load line requirements for vessels under 500 GT or having GT equal to or greater than 500 are given in the application of each Chapter.

A2. DEFINITIONS

100. Terms

101. **2008 IS Code** means the International Code on Intact Stability, 2008, consisting of an introduction, part A (the provisions of which shall be treated as mandatory) and part B (the provisions of which shall be treated as recommendatory), as adopted by resolution MSC.267(85), provided that:

a. amendments to the introduction and part A of the Code are adopted, brought into force and take effect in accordance with the provisions of article VIII of the SOLAS Convention concerning the amendment procedures applicable to the Annex other than chapter I thereof; and

b. amendments to part B of the Code are adopted by the Maritime Safety Committee in accordance with its Rules of Procedure.

102. **Amidship**: distance centred at half of the length L, with extension of de 0,4 × L.

103. **Pontoon:** Vessel type A (see definition above) without self propulsion, with or without a trunk deck.

104. **Barge***:* B-type vessel or closed deck vessel for cargo on deck without self propulsion, with or without double shell or double bottom, which meets the following relations, according to the NORMAN:

a. Breadth / draft> 6

b. Breadth / depth> 3.

105. **Bilge system**: piping system designed to pump out the flooding and/or bilge water from the ship's compartments.

106. **IACS UR S2.2 Block coefficient Cb** the block coefficient Cb is the moulded block coefficient at draught d corresponding to summer load waterline, based on rule length L and moulded breadth B:

$$C_b = \Delta * d/ (L*B*d)$$

where:

C_b is the moulded block coefficient at draught ***d*** corresponding to summer load waterline, based on rules length Land moulded breadth B

Δ = Moulded Displacement (m^3) is the moulded displacement of the vessel in cubic metes, excluding appendages, taken at the summer load line (draught ***d***)

L = length of ***L*** is the distance, in metres, on the summer load waterline from the fore side of the stem to the after side of the rudder post, or the centre of the rudder stock if there is no rudder post. ***L*** is not to be less than 96%, and need not be greater than 97%, of the extreme length on the summer load waterline. In ships with unusual stern and bow arrangement the length L will be specially considered.(**ILL Reg 3**)

B is the breadth of the vessel as defined below.

d is the vessel's draught at the summer load load line.

107. **Breadth B:** largest moulded breadth of the ship measured at the broadest transverse section of the hull, in meters.

108. **Closed deck:** ship with strong deck all along the length and breadth to carry load on the deck or liquid cargoes inside the hull, with or without a trunk.

109. **Common watertight bulkhead (AEC):** bulkhead of watertight construction built as part of the hull structure for purpose of subdivision of the hull into watertight compartments, restricting the effect of flooding. See Part II, Title 11, Section 2 of the Rules.

110. **Deckhouse:** construction other than a superstructure, located on the freeboard deck or above, which does not fit as a superstructure with deck.

111. **Design pressure:** means the hydrostatic pressure for which each structure or appliance assumed to be watertight in the intact and damage stability calculations is designed to withstand.

112. **Freeboard Deck** (according to ILLC): the freeboard deck is the uppermost complete deck exposed to weather and sea, which has permanent means of closing all openings in the weather part thereof, and below which all openings in the sides of the ship are fitted with permanent means of watertight closing.

Guidance

***IACS UI LL 48 Discontinuous Freeboard Deck, Stepped Freeboard Deck: interpretation**.*

a. Where a step exists in the freeboard deck, creating a discontinuity extending over the full breadth of the ship, and this step is in excess of one metre in length, the lowest line of the exposed deck and the continuation of that line parallel to the upper part of the deck is taken as the freeboard deck. (Fig F.A2.101.1). A step one metre or less in length shall be treated as a recess in accordance with paragraph b.

b. Where a recess is arranged in the freeboard deck, and this recess does not extend to the side of the ship, the freeboard calculated without regard to the recess is to be corrected for the consequent loss of buoyancy. The correction would be equal to the value obtained by dividing the volume of the recess by the waterplane area of the ship at 85% of the least moulded depth. (Fig. F.A2.101. 2).

i. The correction would be a straight addition to the freeboard obtained after all other corrections have been applied, except bow height correction.

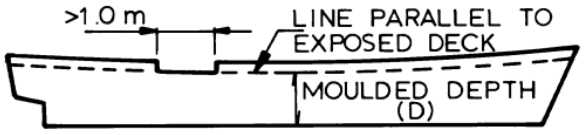
ii. the freeboard, corrected for lost buoyancy as above, is greater than the minimum geometric freeboard determined on the basis of a moulded depth measured to the bottom of the recess, the latter value may be used.

c. Recesses in a second deck, designated as the freeboard deck, may be disregarded in this Interpretation provided all openings in the weather deck are fitted with weather tight closing appliances.

d. Due regard is to be given to the drainage of exposed recesses and to free surface effects on stability.

e. This Interpretation is not intended to apply to dredgers, hopper barges or other similar types of ships with large open holds, where each case would require individual consideration.

FIGURE F.A2.112.1



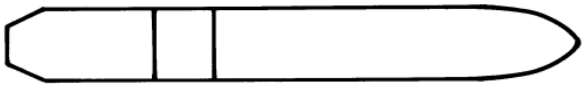


FIGURE F.A2.112.2

Correction is the addition to freeboard equal to:

$$\frac{l*b*d_r}{\text{WP area at } 0{,}85\ D}$$

End of guidance

113. **Depth moulded***:*

a. The moulded depth is the vertical distance measured from the top of the keel to the top of the freeboard deck beam at side.

b. In ships having rounded gunwales, the moulded depth shall be measured to the point of intersection of the moulded lines of deck and sides, the lines extending as though the gunwale were of angular design.

c. Where the freeboard deck is stepped and the raised part of the deck extends over the point at which the moulded depth is to be determined, the moulded depth shall be measured to a line of reference extending from the lower part of the deck along a line parallel with the raised part.

114. **Depth for freeboard** (D) (**ILL Reg. 3)**:

a. The depth for freeboard (D) is the moulded depth amidships, plus the thickness of the freeboard deck stringer plate, where fitted,plus

$$T*(L-sS)/L$$

if the exposed freeboard deck is sheathed, where

T is the mean thickness of the exposed sheathing clear of deck openings, and

S is the total length of superstructures as defined in sub-paragraph (10)(d) of this Regulation.

b. The depth for freeboard (D) in a ship having a rounded gunwale with a radius greater than 4 per cent of the breadth (B) or having topsides of unusual form is the depth for freeboard of a ship having a midship section with vertical topsides and with the same round of beam and area of topside section equal to that provided by the actual midship section

115. **DPC - Diretoria de Portos e Costas**: department of the Brazilian government, which takes care of the safety of navigation in the country and is the Brazilian Maritime Authority.

116. **Draft d:** vertical distance from the moulded baseline to the summer load line, measured amidships in meters.

117. **Draft dc**: is the draft for which the vessel is classified and the structure is calculated.

118. **Draft dP**: is the draft for which the vessel is designed. Note that when the keel is inclined the actual aft draft may have a greater value than by the definition.

119. **Draft (ds)** Deepest subdivision draft is the waterline which corresponds to the summer load line draught of the ship.

120. **DVC: Distance of visibility of the coast** is defined in NORMAM 01, Chapter 6 defines (the area of coastal navigation).

121. **Fast ships**: see the relevant Title.

122. **"Ferry boat***": vessel designed for the transportation of vehicles and passengers in crossings of rivers, channels, estuaries, bays or in coastal short crossings.

123. **Forward and aft ends**: distance of 0,1× L, measured from teach one of the forward and aft perpendiculars.

124. **Freeboard:** distance prescribed in ILLC and NORMAN 01, measured vertically downwards amidships from the upper edge of the deck line to the upper edge of the related load line which determines the maximum draft water line. It is marked on the side shell, at the middle of the length Lf, by a circle with a horizontal line in the middle. See. Part II, Title 11, Chapter H, conditions of loading.

125. **Freeboard Deck** (according to ILLC): the freeboard deck is normally the uppermost complete deck exposed to weather and sea, which has permanent means of closing all openings in the weather part thereof, and below which all openings in the sides of the ship are fitted with permanent means of watertight closing.

a. In a ship having a discontinuous freeboard deck, the lowest line of the exposed deck and the continuation of that line parallel to the upper part of the deck is taken as the freeboard deck.

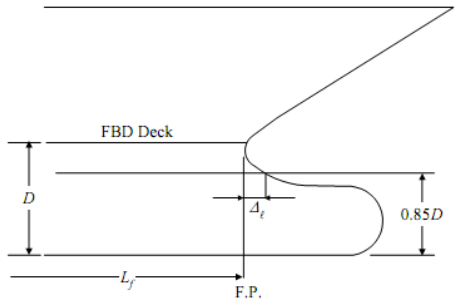
b. At the option of the owner and subject to the approval of the Administration, a lower deck may be designated as the freeboard deck provided it is a complete and permanent deck continuous in a fore and aft direction at least between the machinery space and peak bulkheads and continuous athwartships.

c. When this lower deck is stepped the lowest line of the deck and the continuation of that line parallel to the upper part of the deck is taken as the freeboard deck.

d. When a lower deck is designated as the freeboard deck, that part of the hull which extends above the freeboard deck is treated as a superstructure so far as concerns the application of the conditions of assignment and the calculation of freeboard. It is from this deck that the freeboard is calculated.

126. **Freeboard Length L_{BL}** The length (L) shall be taken as 96% of the total length on a waterline at 85% of the least moulded depth measured from the top of the keel, or as the length from the fore-side of the stem to the axis of the rudder stock on that waterline, if that be greater. Where the stem contour is concave above the waterline at 85% of the least moulded depth, both the forward terminal of the total length and the fore-side of the stem respectively shall be taken at the vertical projection to that waterline of the after most point of the stem contour (above that waterline). In ships designed with a rake of keel the waterline on which this length is measured shall be parallel to the designed waterline.See figure F.A2.126.1

FIGRE F.A2.126.1



127. **Inclining test:** The inclining test is a procedure which involves moving a series of known weights, normally in the transverse direction, and then measuring the resulting change in the equilibrium heel angle of the ship. By using this information and applying basic naval architecture principles, the ship's vertical centre of gravity (VCG or KG) is determined.

128. **"ILLC":** IMO **"**International Load Line Convention"

129. **Lightship**: The lightship is a ship complete in all respects, but with-out consumables, stores, cargo, and crew and effects, and without any liquids on board except for machinery and piping fluids, such as lubricants and hydraulics, which are at operating levels.

130. **Lightweight check**: The lightweight check is a procedure which involves auditing all items which are to be added, deducted or relocated on the ship at the time of the inclining test so that the observed condition of the ship can be adjusted to the lightship condition. The weight and longitudinal, transverse and vertical location of each item are to be accurately determined and recorded. The lightship dis-placement and longitudinal centre of gravity (LCG) can be obtained using this information, as well as the static waterline of the ship at the time of the inclining test as determined by measuring the freeboard or verified draught marks of the ship, the ship's hydrostatic data and the sea water density.

131. **Machinery spaces:** spaces of category A and other spaces containing:

a. propulsion machinery, boilers, oil fuel units, steam and internal combustion engines;

b. generators and major electrical equipment;

c. oil filling stations;

d. refrigeration , stabilizing, ventilation and air conditioning equipment; and

e. similar spaces and their trunks.

132. **Machinery spaces of category A:** are those spaces and trunks to such spaces which contain either:

a. internal combustion machinery used for main propulsion;

b. internal combustion machinery used for purposes other than main propulsion where such machinery has in the aggregate a total power output of not less than 375 kW; or

c. any oil-fired boiler or oil fuel unit, or any oil-fired equipment other than boilers, such as inert gas generators, incinerators, etc.

133. **Main Deck:** continuous deck from which the is measured the Freeboard and on which stand the superstructures

134. **Moulded depth:**

a. The moulded depth is the vertical distance measured from the top of the keel to the top of the freeboard deck beam at side. In wood and composite ships the distance is measured from the lower edge of the keel rabbet. Where the form at the lower part of the midship section is of a hollow character, or where thick garboards are fitted, the distance is measured from the point where the line of the flat of the bottom continued inwards cuts the side of the keel.

b. In ships having rounded gunwales, the moulded depth shall be measured to the point of intersection of the moulded lines of deck and sides, the lines extending as though the gunwale were of angular design.

c. Where the freeboard deck is stepped and the raised part of the deck extends over the point at which the moulded depth is to be determined, the moulded depth shall be measured to a line of reference extending from the lower part of the deck along a line parallel with the raised part.

135. **Navigation zone:** area defined in accordance with the environmental conditions of navigation. See NORMAM 01 chapter 2 and Part I, Title 1, Section 01 of the present Rules.

136. **Open deck:** resistant open deck (with or without hatch cover or similar)

137. **Open sea:** areas of sea and ocean navigation according to NORMAM 01 Chapter 2.

138. **O1, O2:** areas of sea and ocean navigation as defined in Part I, Title 1, Section 1 of the present Rules, where O1 is defined as coastal navigation (DVC) and O2 is defined as ocean navigation.

139. **MARPOL:** IMO “International Convention for the Prevention of Pollution from Ships".

140. **Perpendiculars:** vertical lines at the extremities and in the diddle of the length L, named “forward perpendicular” and “aft perpendicular”.

141. **Perpendicular amidships:** vertical line at the end of length L.

142. **Aft perpendicular:** vertical line at the aft end of length L.

143. **Forward perpendicular:** vertical line at the forward end of length L.

Guidance

ILL Regulation 3: Perpendiculars. The forward and after perpendiculars shall be taken at the forward and after ends of the length (L). The forward perpendicular shall coincide with the foreside of the stem on the waterline on which the length is measured.

End of guidance

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

*Guidance **[IACS UI SC 225]***

IACS Unified Interpretation SC 225(Sept 2008)

The occupied volume by flooded water of a flooded space in the SOLAS Chapter II-1(Regulation 2(14)) also issued as SOLAS Interpretations as approved by IMO 01-06-2010 (Technical background excepted) Interpretation

In determining the permeability of a space, the volume of a space is to be taken as the moulded volume, i.e. the immersed volume of a space shall be the underwater moulded volume of that space multiplied by the permeability.

Technical Background for this IACS UI Sept 2008):

With regard to whether net capacity (i.e. capacity with reduction of volume of inside structural members) or

moulded capacity shall be used to determine the volume of flooded water in the damage stability calculation under Regulation 2(14) (the definition of permeability) of SOLAS II-1 as contained in resolution MSC.194(80), IACS members reached the agreement that moulded capacity shall be the basis for calculating the flooded water volume, i.e., the immersed volume of a space shall be the underwater moulded volume of that space multiplied by the permeability. In order to uniformly implement the inherent requirement of the definition of permeability, a UI has been developed to give a common ground on this issue.

Identical interpretations have been set out in MSC.1/Circ.1362 of 2010-05-26, Unified interpretation of SOLAS Chapter II-1.

End of guidance

145. **Positions 1 and 2** for vessels with GT ≥ 500: For the purpose of The present Rules, two positions of hatchways, doorways and ventilators are defined as follows:

a. **Position 1** - Upon exposed freeboard and raised quarter decks, and upon exposed superstructure decks situated forward of a point located a quarter of the ship' s length from the forward perpendicular.

b. **Position** 2 - Upon exposed superstructure decks situated abaft a quarter of the ship' s length from the forward perpendicular and located at least one standard height of superstructure above the freeboard deck.

c. Upon exposed superstructure decks situated forward of a point located a quarter of the ship' s length from the forward perpendicular and located at least two standard heights of superstructure above the freeboard deck.

146. **Rules:** for application in all Chapters, Rules means henceforth the classification and technical standards issued by the RBNA, i.e., Rules for the Construction and Classification of Sea Going Vessels.

147. **Regulations:** laws, regulations, circulars, etc issued by the official National or International Organizations which contain their specific set of requirements and procedures.

148. **IACS UR S2 Scantling Length L**: horizontal distance in meters, parallel to the design line of flotation, measured at the waterline corresponding to the maximum draft, from the meeting point of this line with the outer face of the stem, which determines the forward perpendicular, to the external face of rudder stem or until the centre of the rudder stock, which determines the aft perpendicular and shall not be less than 96% nor needing to be greater than 97% of the length of the waterline. In the event of vessels without rudder stock the same applies as to the length of the flotation line. In the case of ferry and barge this value is adopted as the length between the transoms.

149. **SOLAS:** IMO "International Convention for the Safety of Life At Sea".

149. **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.

150. **Superstructure:** a superstructure is a decked structure on the freeboard deck, extending from side to side of the ship or with the side plating not being inboard of the shell plating more than 4% of the breadth (B).

a. **Enclosed superstructure** is a superstructure with:

a.1. enclosing bulkheads of efficient construction;

a.2. access openings, if any, in these bulkheads fitted with doors complying with the requirements of regulation 12 of the ILLC – International Load Line Convention, Annex 1, and NORMAM 01.chapter 07.

a.3. all other openings in sides or ends of the superstructure fitted with efficient weather tight means of closing.

a.4. a bridge or poop shall not be regarded as enclosed unless access is provided for the crew starting from any point on the uppermost complete exposed deck or higher to reach machinery and other working spaces inside these superstructures by alternative means which are available at all times when bulkhead openings are closed. [**IACS UI LL3]**

b. **Bridge**. A bridge is a superstructure which does not extend to either the forward or after perpendicular.

c. **Poop**. A poop is a superstructure which extends from the after perpendicular forward to a point which is aft of the forward perpendicular. The poop may originate from a point aft of the aft perpendicular.

d. **Forecastle**. A forecastle is a superstructure which extends from the forward perpendicular aft to a point which is forward of the after perpendicular. The forecastle may originate from a point forward of the forward perpendicular.

e. **Full superstructure**. A full superstructure is a superstructure which, as a minimum, extends from the forward to the after perpendicular.

f. **Raised quarterdeck**. A raised quarterdeck is a superstructure which extends forward from the after perpendicular, generally has a height less than a normal superstructure, and has an intact front bulkhead (sides cuttles of the non-opening type fitted with efficient deadlights and bolted man hole covers). Where the forward bulkhead is not intact

due to doors and access openings, the superstructure is then to be considered as a poop.

151. **Superstructure deck**. A superstructure deck is a deck forming the upper boundary of a superstructure.

152. **Tank bulkhead (ATQ**): bulkhead of watertight construction built as part of the structure or not, for the purpose of delimiting tanks continuously subjected to hydrostatic pressure. See Part II, Title 11, Section 2 of the Rules.

153. **Weathertight** means that in any sea conditions water will not penetrate into the ship.

157. **Watertight** means having scantlings and arrangements capable of preventing the passage of water in any direction under the head of water likely to occur in intact and damaged conditions. In the damaged condition, the head of water is to be considered in the worst situation at equilibrium, including intermediate stages of flooding.

CHAPTER B
DOCUMENTS, REGULATIONS AND STANDARDS

CHAPTER CONTENTS

B1. NAVAL ARCHITECTURE STANDARDS

100. Documents for classification

101. The plans or documents to be submitted to the Society for approval or for information are listed in item B1.200 below under IACS UR L2 “Stability – a matter of Class”.

200. Statutory documents for approval

201. The plans required by the National Regulations are to be submitted to the RBNA for approval. Such plans may include:

a. General Arrangement

b. Lines Plan

c. Capacity Plan

d. Hydrostatic and Isocline Curves or Tables

e. Loading Manual, where required.

f. Loading and unloading arrangement to be included in the ILO Register

g. Cargo securing manual, where required.

h. Tonnage calculation notes;

i. Inclining experiment report;

j. Deadweight and draft experiment (when the inclination experiment can be substituted);

k. Stability and Trim booklet (for the several conditions of loading); and

l. Load line calculations.

300. Construction documents

301. The construction documents are to be part of the ship’s files to be assembled during construction and to be submitted to the surveyor. Those documents are part of RBNA final report for new buildings. See Part I, Title 01, Section 2, C5.700.

B2 REGULATION

100. Regulations of the National Administration

101. For Brazilian Flag ships under 500 GT, the NORMAM 01 regulations emitted by DPC are comprehended by the present Rules and, in some cases, with additional details

103. The level of intact stability for ships of all sizes in any case shall not be less than that provided by IMO IS Code as amended.

200. Emissions of other National Administrations

201. The regulation emitted by National Organizations is is to be submitted to RBNA for assessment. See B2.102 above.

202. For foreign flag ships, the National Regulations are applicable or, in absence of those, the regulations required in B2.102 below apply.

300. International regulation

301. For vessels under 500 GT destined to international voyages or under foreign flags, the present Classification Rules apply for construction and classification. Eventual points of discrepancy in regard to National Regulations applicable to the vessel are to be submitted for RBNA analysis.

102. For ships having GT equal to or larger than 500, the IMO ILLC and IS-Code regulations are applicable.

400. IACS requirements

401. The present Rules comprehend the IACS Unified Requirements (UR), and Recommendations (Rec) where applicable, as well as CSR rules for bulkers and tankers.

402. In vessels where the RBNA has received delegation to carry out statutory certification, the IACS Unified Interpretations are of mandatory use for ships having GT ≥ 500.

403. Where relevant, the present Rules comprehend the IACS Procedural Requirements (PR).

B3. TECHNICAL STANDARDS

100. Industrial Standards

101. The present Rules follow industrial standards where applicable to materials and equipment destined to be installed on board vessels classified by RBNA or other societies. Where this is the case, the applicable standards are indicated in the relevant Chapters of the Rules.

CHAPTER C
NAVIGATION ENVIRONMENT

CHAPTER CONTENTS

C1. NAVIGATION ZONES

100. Scope

101. The navigation zones for which specific requirements apply are referred to the class notation of the vessel (see part I, Title 1, Section 1, Chapter B).

102. The designation of the navigation zones for Brazilian Flag vessels is given in NORMAM 01, chapter 2.

C2. SHIP MOVEMENTS

100. Induced forces

101. The effect of induction of forces by the action of movement of the ship must be determined for foundations and supports of elements in the higher parts or of masts, as well as for container fittings.

102. The structural connections and supports are to be checked for induced forces and moments from the rolling motions presented in this Section 1.

[IACS CSR Ch. 4]

103. Reference coordinate system

a. The ship’s geometry, motions, accelerations and loads are defined with respect to the following right-hand coordinate system (see Figure F.B3.103.1):

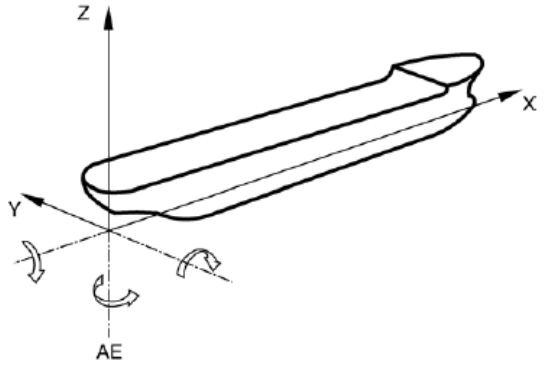
a.1. Point of origin: at the intersection among the longitudinal plane of symmetry of ship, the aft end of L and the baseline

a.2. *X* axis: longitudinal axis, positive forwards

a.3. *Y* axis: transverse axis, positive towards portside

a.4. *Z* axis: vertical axis, positive upwards.

FIGURE F.C2.103.1 - REFERENCE COORDINATE SYSTEM



b. Rotations are positive when oriented in anti-clockwise direction about the *X*, *Y* and *Z* axes.

104**.** **Ship motions** are defined by the six degrees of freedom that a ship, boat or any other craft can experience.

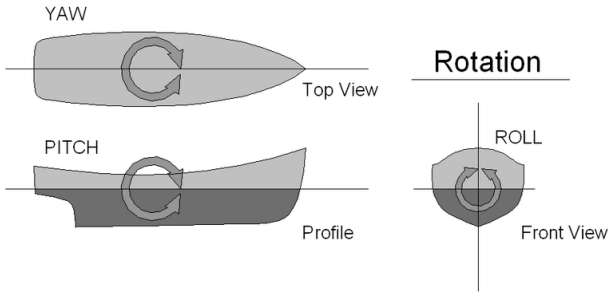
a. Rotation motions

a.1. *Roll*: is when the vessel rotates about the longitudinal (front/back) axle

a.2. *Pitch*: is when the vessel rotates about the transverse (side-to-side) axle

a.3. *Yaw*: is when the vessel rotates about the vertical (up-down) axle

FIGURE F.C2.104.1.A - SHIP'S MOVEMENTS



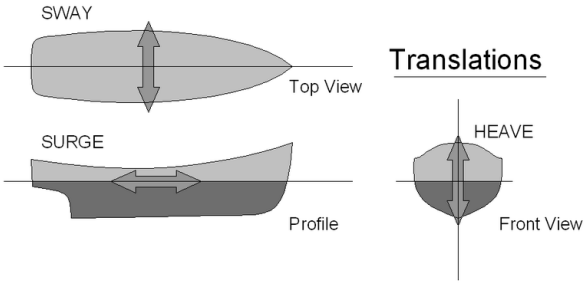
b. Translation

a.1. *Heave*: is the linear vertical (up/down) motion

a.2. *Sway*: is the linear lateral (side-to-side) motion

a.3. *Surge*: is the linear longitudinal (front/back) motion

FIGURE F.C2.104.1.B - SHIP'S MOVEMENTS



200. Symbols used in Subchapter C2

201. Primary symbols

Symbol	Meaning	Units
A	Area	m^2
	Sectional area of ordinary stiffeners and primary members	cm^2
B	Moulded breadth of ship (see [2])	m
C	Coefficient	-
D	Depth of ship (see [2])	m
E	Young's modulus	N/mm^2
F	Force and concentrated loads	kN
I	Hull girder inertia	m^4
	Inertia of ordinary stiffeners and primary members	cm^4
L	Length of ship (see [2])	m
M	Bending moment	kN.m
Q	Shear force	kN
S	Spacing of primary supporting members	
T	Draught of ship (see [2])	m
V	Ship's speed	knot
Z	Hull girder section modulus	m^3
a	Acceleration	m/s^2
b	Width of attached plating	m
	Width of face plate of ordinary stiffeners and primary members	mm
g	Gravity acceleration (see [2])	m/s^2
h	Height	m
	Web height of ordinary stiffeners and primary members	mm
k	Material factor (see [2])	-
ℓ	Length / Span of ordinary stiffeners and primary supporting members	m
m	Mass	t
n	Number of items	-
p	Pressure	kN/m^2
r	Radius	mm
	Radius of curvature of plating or bilge radius	m
s	Spacing of ordinary stiffeners	m
t	Thickness	mm
w	Section modulus of ordinary stiffeners and primary supporting members	cm^3
x	X coordinate along longitudinal axis (see [4])	m
y	Y coordinate along transverse axis (see [4])	m
z	Z coordinate along vertical axis (see [4])	m

Symbol	Meaning	Units
γ	Safety factor	-
δ	Deflection / Displacement	mm
θ	Angle	deg
ξ	Weibull shape parameter	-
ρ	Density	t/m^3
σ	Bending stress	N/mm^2
τ	Shear stress	N/mm^2

202. Symbols for Loads

g : Gravity acceleration, taken equal to 9.81 m/s^2

ρ: Sea water density, taken equal to 1.025 t/m^3

ρ_L : Density, in t/m3, of the liquid carried

ρ_C : Density, in t/m3, of the dry bulk cargo carried

C : Wave parameter, taken equal to:

$$C = 10.75 - \left(\frac{300 - L}{100}\right)^{1,5} \quad \text{for } 90 \le L < 300\text{m}$$

$$C = 10.75 \quad \text{for } 300 \le L < 350\text{m}$$

h : Height, in m, of a tank, to be taken as the vertical distance from the bottom to the top of the tank, excluding any small hatchways

z_{TOP} : Vertical distance, in m, of the highest point of the tank from the baseline. For ballast holds, z_{TOP} is the vertical distance, in m, of the top of the hatch coaming from the baseline

l_H : Length, in m, of the compartment

M_{SW} : Design still water bending moment, in kN.m, at the hull transverse section considered:

$M_{SW} = M_{SW,H}$ in hogging conditions

$M_{SW} = M\, M_{SW,S}$ in sagging conditions

M_{WV} : Vertical wave bending moment, in kN.m, at the hull transverse section considered:

$M_{WV} = M_{WV,H}$ in hogging conditions

$M_{WV} = M_{WV,S}$ in sagging conditions

M_{WH} : Horizontal wave bending moment, in kN.m, at the hull transverse section considered,

Q_{SW} : Design still water shear force, in kN, at the hull transverse section considered

Q_{WV} : Vertical wave shear force, in kN, at the hull transverse section considered

p_S : Still water pressure, in kN/m^2

p_W : Wave pressure or dynamic pressures, in kN/m^2

p_{SF}, p_{WF} : Still water and wave pressure, in kN/m^2, in flooded conditions

σ_X : Hull girder normal stress, in N/mm^2

σ_X , a_X, a_Y, a_Z : Accelerations, in m/s^2, along X, Y and Z directions, respectively

T_R : Roll period, in s

Θ: Roll single amplitude, in deg

T_P : Pitch period, in s

ϕ: Single pitch amplitude, in deg

k_r : Roll radius of gyration, in m

GM : Metacentric height, in m

λ: Wave length, in m

203. Symbols for Parameters of Ship motions and accelerations.

204. For symbols not defined in this Subchapter C2, refer to Subchapter A2.

a_0 : Acceleration parameter, taken equal to:

$$a_0 = f_p\left(1.58 - 0.47C_B\right)\left(\frac{2.4}{\sqrt{L}} + \frac{34}{L} - \frac{600}{L^2}\right)$$

T_R : Roll period, in s, defined in [2.1.1]

Θ: Single roll amplitude, in deg, defined in [2.1.1]

T_P : Pitch period, in s, defined in [2.2.1]

ϕ: Single pitch amplitude, in deg, defined in [2.2.1]

f_p : Coefficient corresponding to the probability level, taken equal to:

f_p = 1.0 for strength assessments corresponding to the probability level of 10-8

f_p = 0.5 for strength assessments corresponding to the probability level of 10-4

300. Ship's motions and accelerations: General

301. Ship motions and accelerations are assumed to be periodic. The motion amplitudes, defined by the formulae in this Section, are half of the crest to trough amplitudes.

302. As an alternative to the formulae in this Section, the RBNA may accept the values of ship motions and accelerations derived from direct calculations or obtained from model tests, when justified on the basis of the ship's characteristics and intended service. In general, the values of ship motions and accelerations to be determined are those which can be reached with a probability level of 10-8 or 10-4.
303. In any case, the model tests or the calculations, including the assumed sea scatter diagrams and spectra, are to be submitted to the RBNA for approval.

400. Ship absolute motions and accelerations

401. **Roll**: The roll period *TR*, in s, and the single roll amplitude θ, in deg, are given by:

$$T_R = \frac{2.3k_r}{\sqrt{GM}}$$

$$\theta = \frac{9000(1.25 - 0.025T_R)f_p k_b}{(B+75)\pi}$$

where:

k_b : Coefficient taken equal to:

k_b = 1.2 for ships without bilge keel

k_b = 1.0 for ships with bilge keel

k_r : Roll radius of gyration, in m, in the considered loading condition. When k_r is not known, the values indicated in Tab 1 may be assumed.

GM : Metacentric height, in m, in the considered loading condition. When *GM* is not known, the values indicated in Table T.C2.501.1 may be assumed.

Table T.C2.501.1: Values of k_r and *GM*

Loading conditions	k_r	GM
Full load condition (alternate or homogeneous loading)	0,35B	0,12B
Normal ballast condition	0,45B	0,33B
Heavy ballast condition	0,40B	0,25B

402. **Pitch:** The pitch period T_P, in s, and the single pitch amplitude ϕ, in deg, are given by:

$$T_P = \sqrt{\frac{2\pi\lambda}{g}}$$

$$\Phi = f_p \frac{960}{L}\sqrt[4]{\frac{V}{C_B}}$$

where:

$$\lambda = 0.6\left(1 + \frac{T_{LC}}{T_S}\right)L$$

where:

$$\lambda = 0.6\left(1 + \frac{T_{LC}}{T_S}\right)L$$

403. **Heave :** The vertical acceleration due to heave, in m/s2, is given by:

$a_{heave} = a_0 g$

404. **Sway:** The transverse acceleration due to sway, in m/s2, is given by:

$a_{sway} = 0.3a_0 g$

405. **Surge:** The longitudinal acceleration due to surge, in m/s2, is given by:

$a_{surge} = 0.2a_0 * g$

$\boldsymbol{a_0}$ **:** Acceleration parameter, taken equal to (see C2.204 above):

$$a_0 = f_p(1.58 - 0.47C_B)\left(\frac{2.4}{\sqrt{L}} + \frac{34}{L} - \frac{600}{L^2}\right)$$

500. Ship relative accelerations

501. **General:** At any point, the accelerations in *X*, *Y* and *Z* directions are the acceleration components which result from the ship absolute motions and accelerations defined in item C2.502 below.

502. **Accelerations:** The reference values of the longitudinal, transverse and vertical accelerations at any point are obtained from the following formulae:

a. In longitudinal direction:

$$a_X = C_{XG} g \sin\Phi + C_{XS} a_{surge} + C_{XP} a_{pitch\,x}$$

b. In transverse direction:

$$a_Y = C_{YG} g \sin\theta + C_{YS} a_{sway} + C_{YR} a_{roll\,y}$$

c. In a vertical direction:

$$a_Z = C_{ZH} a_{heave} + C_{ZR} a_{roll\,z} + C_{ZP} a_{pitch\,z}$$

where:

CXG, *CXS*, *CXP*, *CYG*, *CYS*, *CYR*, *CZH*, *CZR* and *CZP* : Load combination factors defined in Ch 4, Sec 4, [2.2]

$a_{pitch\,x}$: Longitudinal acceleration due to pitch, in m/s2

$$a_{pitch\,x} = \Phi\frac{\pi}{180}\left(\frac{2\pi}{T_P}\right)^2 R$$

$a_{roll\,y}$: Transverse acceleration due to roll, in m/s2

$$a_{roll\,y} = \theta \frac{\pi}{180}\left(\frac{2\pi}{T_R}\right)^2 R$$

$a_{roll\,z}$: Vertical acceleration due to roll, in m/s2

$$a_{roll\,z} = \theta \frac{\pi}{180}\left(\frac{2\pi}{T_R}\right)^2 y$$

$a_{pitch\,z}$: Vertical acceleration due to pitch, in m/s2

$$a_{pitch\,z} = \Phi \frac{\pi}{180}\left(\frac{2\pi}{T_P}\right)^2 \left|(x - 0.45L)\right|$$

where $\left|(x - 0.45L)\right|$ is to be taken not less than $0.2L$

$$R = z - \min\left(\frac{D}{4} + \frac{T_{LC}}{2}, \frac{D}{2}\right)$$

x, y, z : X, Y and Z co-ordinates, in m, of any point considered with respect to the reference co-ordinate system defined in Ch 1, Sec 4

C3. ENVIRONMENT PRESERVATION

100. Compliance to Environmental Regulations

101. For vessels under the Brazilian Flag and with GT < 400, the regulatory prescriptions for environment protection (Agency for Sanitary Regulation – ANVISA, law 9966 amended by Resolution RDC Nº 217, 21 of November 2001 are to be complied with.

102. For vessels under foreign flags with GT < 400, National Regulations are to be complied with. In the absence of such regulations, MARPOL regulations apply.

103. For vessels with GT ≥ 400, under Brazilian or foreign flags, the requirements of

CHAPTER D
ACTIVITIES AND SERVICES

CHAPTER CONTENTS

D1. TYPES OF ACTIVITIES AND SERVICES

100. Types of vessels in the present Rules

101. The Activities / services of the vessels covered by the present Rules are classed in categories hereafter designated as Titles (see definition in Part I, Title 01 Section 2, Chapter D, sub-chapter D3).

102. The prescriptions for assigning a Class according to a Title are given in Part II of the present Rules. Each Title is subdivided into Sections, as follows:

a. Section 1 – Naval Architecture

b. Section 2 – Hull Structure

c. Section 3 – Hull Equipment

d. Section 4 – Accommodation

e. Section 5 – Machinery

f. Section 7 – Electricity

g. Section 8 – Nautical and Electronics

Each Section is subdivided into Chapters, Subchapters and topics according to the ship's nature and mission.

200. Statutory surveys

201. For the purpose of statutory certification, vessels under the Brazilian flag are to be in accordance with the definitions of activities and services given in NORMAM 01, Chapter 2, Section I, item 0216.

202. For vessels with GT < 500 under foreign flag the definition of activities and services are to be in conformity with the relevant National Regulations or, in absence of such regulations, in conformity with the SOLAS regulations and/or with the relevant IMO Codes.

202. For vessels with GT ≥ 500, under Brazilian or foreign flags the definition of activities and services are to be in conformity with the relevant SOLAS Chapters and/or with the relevant IMO Codes

D2. OPERATION AND MAINTENANCE OF SHIPS

100. Adequate crew

101. The application of the present Rules is based on the principle that the vessels are going to be loaded, operated and maintained adequately by competent and qualified crew or operating personnel, according to the environmental, loading, operating and other criteria on which classification is based. In particular, it will be assumed that the ship will not exceed the draught of the assigned freeboard, or the maximum allowed by Classification.

102. The RBNA interventions and the relevant reports reflect the condition of the ship at the moment of the intervention. It is the responsibility of the interested parties to ensure proper maintenance until the next survey required by the Rules.

103. The Interested Party has the duty of to inform the Surveyor whenever circumstances occur that might affect the ship's class.

CHAPTER E
CONFIGURATIONS

CHAPTER CONTENTS

E1. HULL COMPATIBILITY

100. Sailing characteristics

101. The present Rules are based on the assumption that the hull shape and arrangement are compatible with the navigation zone of the vessel.

200. Navigation aids

201. The present Rules are based upon the assumption that instruments and information such as nautical charts, echo-sounder, etc. sufficient for the control of the navigating conditions as well as environmental control are available and are adequate for the navigation zone and applicable Regulations.

E2. BASIC GENERAL ARRANGEMENT

100. Location of cargo spaces

101. In cargo or passenger vessels, the cargo spaces may be located inside the hull or over the hull, giving due consideration to the buoyancy and water tightness conditions as per load line and stability regulations. See Chapter G and H below.

102. The general arrangement of tankers must be in accordance with the ships covered under the Group 30 of the present Rules.

103. For passenger vessel, see Part II, Title 21, Section 1.

104. For roll-on roll off cargo vessels, see Part II, Title 15, Section 1. For roll on roll off passenger or cargo and passenger vessels, see Part II, Title 26, Section 1.

200. Engine Room location

201. In general, the engine Room may be located amidships or aft.

202. In special type vessels, the Engine Room may be located forward or over the deck, or else the ship may be fitted with two Engine Rooms such as in dredgers and oil tankers, one of them generally for main services and/or pumps.

203. Catamaran type vessels (double hull) may have separate Engine Rooms, one in each hull.

300. Accommodation location

301. Accommodation space may be under or over the deck under the conditions of:

a. For vessels under 500 GT, the National Administration regulations, which in Brazilian Flag ships are those of NORMAM 01;

b. For vessels with GT equal to 500 GT and over, and for vessels which have no National Administration regulations, the IMO regulations.

302. For Class certification, the requirements of the present Chapter are applicable, and additional regulations are to be found in the relevant Titles according to the mission of the vessel.

303. See also Part II, Title 11, Section 4 of Rules.

CHAPTER F
HULL SHAPE AND DIMENSIONS

CHAPTER CONTENTS

F1. DIMENSIONS

100. Hull dimensions and proportions

101. The hull forms and dimensions for the design speed and mission are to be within the boundaries imposed by the Class Notation restrictions related to the navigation zone as defined in Part I, Title 01, Section 1 of the Rules, in conjunction with the prescriptions of Part II, Title 11, Section 2 of the present Rules.

F2. HULL FORMS

100. Focus on hull shape

101. The present Rules apply to the safety of navigation of the vessels, and not specifically to the performance of the hull.

CHAPTER G
SUBDIVISION

CHAPTER CONTENTS

G1. CAPACITIES

100. Volumes and volume centres

101. The capacity of the cargo holds, tanks, etc. are to be submitted in plans and tables (including sounding tables), indicating the geometry, location and volumes, the centres of gravity as well as the free surface of the tanks at several levels.

G2. HULL SUBDIVISION

100. Compartments, tanks and empty spaces

101. The subdivision of the hull by bulkheads of compartments, tanks and empty spaces will take into consideration the nature of their contents, attending specific requirements presented in the present Rules and in the Regulations.

102. As to subdivision for buoyancy, see sub-chapter H4 below.

103. The Engine Room will be restricted by bulkheads. In case the Engine Room is located aft of the vessel, the aft bulkhead of the engine Room may be the aft peak bulkhead of the vessel.

104. Where vehicles are carried inside the holds, special consideration will be given by RBNA, including double hull construction.

200. Cofferdams

201. A cofferdam is an empty space separating adjacent compartments. A cofferdam may be arranged vertically or horizontally, adequately ventilated and of sufficient dimensions to allow access for inspection.

202. Cofferdams are to be installed between:

a. Fuel oil and lubricating oil tanks;

b. Compartments destined to liquid hydrocarbons and fresh water compartments;

c. Compartments destined to liquid hydrocarbons and liquid foam for fire extinguishing.

203. **Spaces destined to carry flammable liquids**: where the accommodation or service area is located immediately over one of such cargo spaces, the requirement for a cofferdam may be exempted only in case the deck is not fitted with access openings and coated by an adequate material subject to RBNA approval.

204. Where the dimension of the cofferdams is excessive when compared to the dimensions of the adjacent tank or tanks, an exemption may be granted by RBNA upon assessment and in case the following conditions are complied with:

a. An increase of 2 mm must be added in the thickness of the plating between the tanks in relation to Part II Title 11 Section 2 item .F2.600 of the Rules for fresh water tanks and 1 mm in all other cases.

b. The sum of the welding seam thicknesses must not be less than the thickness of the bulkhead;

c. The height of a water column employed in the design structural calculations as well as the height employed at the water tightness and structural strength tests is to be increased by 1 (one) meter in relation to item Part II, Title 11, Section 2,item T6 of the Rules.

CHAPTER H
LOADING CONDITIONS, BUOYANCY AND STABILITY

CHAPTER CONTENTS

H1. LOAD LINE

100. Load line assignment

101. The conformity of the load line assignment in compliance with the existing regulations is to be verified by RBNA jointly with the analysis of the structural resistance and stability

102. The conformity of the physical conditions for compliance with the existing regulations is to be verified by RBNA.

103. For ships under the Brazilian Flag with GT < 500, the requirements for the assignment of the load line are to be in conformity with the requirements of NORMAM 01 (Norma da Autoridade Marítima Brasileira para Navegação em Mar Aberto, Chapter 7).

104. For ships under foreign Flags with GT < 500, the requirements for the assignment of the load line are to be in conformity with the requirements of the National Administration and, in the absence of such requirements, in conformity with the ILC Convention, as far as practicable. [***(IACS Rec 99 Chapter II)]***

105. For ships having GT ≥ 500 the requirements of ILLC - International Load Line Convention are to be complied with. The application of the relevant IACS Unified Interpretations (UI) is mandatory.

H2. LIGHT SHIP WEIGHT

100. Determination of the light ship weight

101. The vessel's light weight value including the equipment on board are determined and tested, together with the centre of gravity coordinates.

102. In vessels with GT > 50, this determination is made through the inclination experiment.

103. In vessels with GT ≤ 50 (except passenger or special vessels), the inclination test can be substituted by the "weights and centres estimate", under the condition that the weights and centres be checked by measurement of the drafts (see relevant item).

104. In vessels where the bending moment is calculated, the curve (or table) of weight distribution is to be determined and submitted.

H3. LOADING CONDITIONS

- See Chapter H5 below.

H4. BUOYANCY AND SUBDIVISION OF THE HULL

100. Principles

101. The integrity of the hull, responsible for the hull's floatability, i.e., the up thrust, is to be preserved by the arrangements of prevention against flooding.

102. Hatch ways and other access openings for cargo tanks or cargo holds on the main deck, giving access to the interior of the hull, must be fitted with covers or manholes as required by Part II, Section 3 of the Rules.

103. Compartments under the main deck, such as accommodations and Engine Room, having access through openings in the main deck protected by superstructure or deck houses, will not have direct access to the outside unless through an emergency opening.

104. The compartments at main deck level fitted with water tight doors will have other means of going out in such a way that the watertight doors remain closed in case of bad weather or tilting.

105. When a ship having a length less than 80 m and a tonnage of 500 GT and over is fitted with single cargo hold or cargo holds below the freeboard deck, which are not separated by at least one bulkhead made watertight up to the freeboard deck, a water ingress detection system is to be fitted.

106. **Bulk Carriers**: For ships granted with the service notation bulk carrier, bulk carrier ESP, ore carrier ESP, combination carrier/OBO ESP or combination carrier /OOC ESP, a water ingress detection system is to be fitted.

200. Subdivision bulkheads to contain flooding

201. All ships are to have at least the following transverse watertight bulkheads:

a. one collision bulkhead

b. one after peak bulkhead for passenger ships and roll on –roll off passenger ships

c. two bulkheads forming the boundaries of the machinery space in ships with machinery amidships, and a bulkhead forward of the machinery space in ships with machinery aft. In the case of ships with an electrical propulsion plant, both the generator room and the engine room are to be enclosed by watertight bulkheads.

202. Subdivision and Damage Stability: Vessels of applicable size, type and service are to have subdivision and damage stability as required by the SOLAS - International Convention for the Safety of Life as Sea, 1974/1988, as amended, as follows:

a. Passenger vessel — Regulation II-1/4 through 8-1 (Part II, Title 21)

b. Cargo vessel — Regulation II-1/4 through 7-3 (Part II, Title 11)

c. Gas carrier — IGC Code (Part II, Title 34)

d. Chemical carrier — IBC Code (Part II, Title 33).

203. Bulk carriers for which the request for class for new construction is received on or after 1 July 1998 are to meet the requirements in Appendix 3-3-A2 of the SOLAS conventions, "Subdivision and Damage Stability Requirements for Bulk Carriers".

204. All ships, shall be fitted with a collision bulkhead in conformity with NORMAM 01, chapter 7 for ships with GT < 500; and SOLAS II01, Part B-2, Regulation 12 for ships with GT ≥ 500.

205. The collision bulkhead shall be located at a Rules distance from the forward perpendicular dc, basically of the following order:

$dc \geq 0{,}05 \times L$

$dc \leq 0{,}125 \times L$

or 10 m, whichever is less.

Guidance

In case of discrepancies between the National or International regulations, the strictest parameters are to be adopted.

End of guidance

206. No doors, manholes, access openings, ventilation ducts or any other openings shall be fitted in the collision bulkhead below the bulkhead deck.

207. All ships with GT ≥ 500: where any part of the ship below the waterline extends forward of the forward perpendicular, e.g., a bulbous bow, the distances stipulated in H4.205 shall be measured from a point either:

a. at the mid-length of such extension;

b. at a distance 0.015L forward of the forward perpendicular; or

c. at a distance 3 m forward of the forward perpendicular, whichever gives the smallest measurement.

208. The bulkhead may have steps or recesses provided they are within the limits prescribed in H4.207 above.

209. All ships: An aft collision bulkhead shall be fitted at a Rules distance from the stern of the order of 0,04 a 0,08 x L. In self-propelled vessels the aft collision bulkhead may be located at the inner extremity of the stern tube. Where a special arrangement of the stern exists, this is to be submitted to RBNA for approval.

210. The Engine Room shall be limited by two bulkheads. Where the Engine Room is aft, the aft bulkhead of the Engine Room, may be the aft collision bulkhead.

211. Further to the above bulkheads, common transverse watertight bulkheads (AEC) shall be built. The spacing between two bulkheads shall not exceed 14% to 33% of the length L.

212. For vessels fitted with a single hold, double hull construction may be considered as an alternative.

213. In cases where the damage stability calculation and/or flooded length is required the spacing between the transverse watertight bulkheads is to be determined by those calculations.

Guidance

In case of discrepancies with the National or International regulations, the strictest parameters are to be adopted.

End of guidance

300. Vertical subdivision

301. Where the accommodation floor is below the maximum draft waterline, the distance between the floor and the waterline shall not exceed one meter.

400. Hull openings and means of closure

401. The upper end of the coamings, ventilation ducts, the height of the sills of access openings and the lower end of the "U" pipe in air vents, must be in conformity with the distances required in IMO ILLC – International Load Line Convention – and NORMAM 1, Chapter 6 (National Administration Requirements), where applicable.

402. The permanent watertight means of closure of the hull openings are detailed in Part II, Section 3 of the present Rules.

500. Angle of flooding

501. "**Angle of flooding**" means that angle of heel at which openings in the hull, superstructures or deckhouses that cannot be closed weather tight immerse.

Guidance

Angle of flooding *is the angle of heel at which the vessel's interior spaces are flooded by water through openings considered to be open or openings which may be open as required by operation conditions of the vessel in working position*.

End of guidance

502. The angle of flooding as defined in H5.501 above is to be adopted for the stability calculations.

600. Minimizing the flooding effects

601. For ships with GT ≥ 500, the prescriptions for bilge pumping and piping systems are to be in conformity with NORMAM 01 Chapter 7, and Part II, Section 6 of the Rules.

602. For ships with GT < 500, the prescriptions for bilge pumping and piping systems are to be in conformity with the SOLAS International Convention Chapter II-1, Part C, Rule 35-1.

603. For passenger vessels and tankers, please refer to the relevant Part II, Titles 21, 32, 33 and 34 of the Rules.

604. For cross-flooding in passenger vessels, refer to Part II, Title 21, Section 1 of the Rules.

700. Minimizing the free surface effect

701. To minimize the free surface effect, longitudinal watertight bulkheads will be built, which will be taken into account in the stability calculations.

H5. INTACT STABILITY

100. Intact Stability
[IACS REC 24 and UR L2, IMO A.749(18) amended by MSC.267(85)]

[IACS UR L2]

101. All new ships with a length of 24 m and above will be assigned class only after it has been demonstrated that their intact stability is adequate for the service intended. Adequate intact stability means compliance with standards laid down by the relevant Administration or those of the Classification Society taking into account the ship's size and type. The level of intact stability for ships of all sizes in any case shall not be less than that provided by IMO IS Code as amended.

a. The criteria according to the type of ship is given in Table T.H5.103.1.

102. **Stability check – vessels with GT < 500 subject to National Administration**: The checking of the stability is carried out by comparison with the standards of the National and International Administrations. For ships with GT <500, the present Rules follows the requirements of NORMAM 01.

103. For ships having GT ≥ 500 at least the following sets of criteria in Table T.H5.103.1or their equivalents are to be met:

Guidance

The IMO Intact Stability (IS) Code is applicable for ships built on or after 1 Januaty 2010.

*For ships built before 1 January 2010, the requirements and criteria of the IMO Resolution A.749(18) as amended are to be adopted as far as practicable. [(**IACS Rec 99 Chapter III)]***

For ships of foreign flags under 500 GT, National Administration regulations are to be assessed by RBNA or, in the absence of such regulations, the IMO IS Code or the IMO Resolution A.749 is to be adopted according to the age of the ship.

End of guidance

TABLE T.H5.103.1 – STABILITY CRITERIA ACCORDING TO THE VESSEL'S TYPE

[IMO IS Code as amended]
[IACS Rec 24]

INTACT STABILITY	
All ships ≥ 24 m in length	IS Code Part A Chapter 2
Passenger ships	IS Code Chapter 3 Part A* Chapter3 Section 3.1
Tankers of 5000 t DWT and above, type and service for which the building contract is placed on or after 1 February 1999 or, in the absence of a building contract, the keels of which are laid or which are in a similar stage of construction on or after 1 August 1999	IS Code Chapter 3 Part A* Section 3.2 Regulation 27 in Annex I of the International Convention for Prevention of Pollution from Ships, 1973/1978
Towing vessels	The intact stability requirement of IMO Res. MSC.267(85), Part A Chapter 2.2, Alternatively, if applicable: the intact stability requirement of IMO Res. MSC.267(85), Part B Chapter 2.4 Additional requirements of IACS Rec 24
Offshore supply vessels	The intact stability requirements of IMO Res. MSC.267(85), Part A Chapter 2.3 and Part B Chapter 2.4.
Special purpose ships	The intact stability requirements of IMO Res. MSC.267(85), Part A Chapter 2.3 and Part B Chapter 2.5.
Cargo ships carrying timber deck cargoes	IS Code Chapter 3 Part A* Section 3.3
Cargo ships carrying grain in bulk	IS Code Chapter 3 Part A* Section 3.4
High speed craft	IS Code Chapter 3 Part A* Section 3.5
Ice class notation ships	IS Code Part A Chapter 2 Additionally to comply with IMO MCS/Circ.1056 – Guidelines for Ships Operating in Arctic Ice Covered Waters

104. For vessels to which requirements governing subdivision and damage stability are applicable, the intact stability shall be sufficient to meet such requirements in all prescribed damage conditions.

105. Tankers for which that Regulation is not applicable are to meet the requirements in Part II, Title 32, Section 1, sub-chapter H5 item 700 "Intact Stability of Tankers During Liquid Transfer Operations."

106. Evidence of approval by the Administration concerned may be accepted by RBNA for the purpose of classification.

107. In addition to the requirements of items H5.101 to 106 above, the requirements of the MARPOL convention 73/88 Annex I, regulation 27 and 28 are to be complied with.

108. The RBNA may allow the inclining test of an individual ship as required by this sub-chapter H5 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.

109. **Stability test for pontoons**: an inclining experiment is not normally required for a pontoon, provided a conservative value of the lightship vertical centre of gravity (KG) is assumed for the stability calculations. The KG can be assumed at the level of the main deck although it is recognized that a lesser value could be acceptable if fully documented. The lightship displacement and longitudinal centre of gravity shall be determined by calculation based on draught and density readings.

200. Conditions of loading

201. The intact stability calculations are to be based on the following conditions of loading

a. All the intended cargo loading conditions are to be included in the trim and stability booklet for examination.

b. Further cases are subject to prior examination by the RBNA before the loading; alternatively, an approved loading instrument capable of performing damage stability calculations in accordance with the requirements in chapter H5 may be used.

c. For ships covered by this chapter the following loading cases are to be included in the trim and stability booklet, as applicable:

c.1. ship in the fully loaded departure condition at the summer load waterline, with cargo homogeneously distributed throughout all cargo tanks and with full stores and consumables

c.2. same condition as above, but with 10% stores and consumables

c.3. ship in the departure condition loaded with a cargo having a density in order to fill all cargo tanks, with full stores and consumables, but immersed at a draught less than the summer load waterline

c.4. same condition as above, but with 10% stores and consumables

c.5. ship in the fully loaded departure condition at the summer load waterline, with cargo tanks not entirely filled and with full stores and consumables

c.6. same condition as above, but with 10% stores and consumables

c.7. two loading conditions corresponding to different cargo segregations in order to have slack tanks with full stores and consumables

d. When it is impossible to have segregations, these conditions are to be replaced by loading conditions with the same specific gravity and with slack cargo tanks same loading condition as above, but with 10% stores and consumables

e. For oil tankers having segregated ballast tanks, the lightship condition with segregated ballast only is also to be included in the trim and stability booklet for examination.

300. Weight distribution

301. The typical calculations for weight distribution including cargo, consumables, etc. taking into considerations the stages of the loading/unloading operations.

400. Free surface
[IACS UI LL61]

401. For all loading conditions, the initial metacentric height and the righting lever curve shall be corrected for the effect of free surfaces of liquids in tanks

402. Free surface effects shall be considered whenever the filling level in a tank is less than 98% of full condition. Free surface effects need not be considered where a tank is nominally full, i.e. filling level is 98% or above. Free surface effects for small tanks may be ignored under condition specified in H5.215 of the present subchapter.

403. Nominally full cargo tanks shall be corrected for free surface effects at 98% filling level. In doing so, the correction to initial metacentric height shall be based on the inertia moment of liquid surface at 5° of the heeling angle divided by displacement, and the correction to righting lever is suggested to be on the basis of real shifting moment of cargo liquids.

404. Tanks which are taken into consideration when determining the free surface correction may be in one of two categories:

a. Tanks with filling levels fixed (e.g. liquid cargo, water ballast). The free surface correction shall be defined for the actual filling level to be used in each tank.

b. Tanks with filling levels variable (e.g. consumable liquids such as fuel oil, diesel oil and fresh water, and also liquid cargo and water ballast during liquid transfer operations). Except as permitted in H5.408 and 5.409 below, the free surface correction shall be the maximum value attainable between the filling limits envisaged for each tank, consistent with any operating instructions.

405. In calculating the free surface effects in tanks containing consumable liquids, it shall be assumed that for each type of liquid at least one transverse pair or a single centreline tank has a free surface and the tank or combination of tanks taken into account shall be those where the effect of free surfaces is the greatest.

406. Where water ballast tanks, including anti-rolling tanks and anti-heeling tanks, are to be filled or discharged during the course of a voyage, the free surface effects shall be calculated to take account of the most onerous transitory stage relating to such operations.

407. For ships engaged in liquid transfer operations, the free surface corrections at any stage of the liquid transfer operations may be determined in accordance with the filling level in each tank at that stage of the transfer operation.

408. Where water ballast tanks, including anti-rolling tanks and anti-heeling tanks, are to be filled or discharged during the course of a voyage, the free surface effects shall be calculated to take account of the most onerous transitory stage relating to such operations.

409. For ships engaged in liquid transfer operations, the free surface corrections at any stage of the liquid transfer operations may be determined in accordance with the filling level in each tank at that stage of the transfer operation.

410. The corrections to the initial metacentric height and to the righting lever curve are to be addressed separately as indicated in H5.211 and H5.212.

411. In determining the correction to the initial metacentric height, the transverse moments of inertia of the tanks are to be calculated at 0 degrees angle of heel according to the categories indicated in H5.212.

412. The righting lever curve may be corrected by any of the following methods:

a. Correction based on the actual moment of fluid transfer for each angle of heel calculated; corrections may be calculated according to the categories indicated in H5.211.

b. Correction based on the moment of inertia, calculated at 0 degrees angle of heel, modified at each angle of heel calculated; corrections may be calculated according to the categories indicated in H5.211.

c. Correction based on the summation of Mfs (free surface) values for all tanks taken into consideration

413. Whichever method is selected for correcting the righting lever curve, only that method is to be presented in the ship's trim and stability booklet. However, where an alternative method is described for use in manually calculated loading conditions, an explanation of the differences which may be found in the results, as well as an example correction for each alternative, are to be included.

414. The usual remainder of liquids in the empty tanks need not be taken into account in calculating the corrections, providing the total of such residual liquids does not constitute a significant free surface effect.

415. The values of M_{fs} for each tank may be derived from the formula:

$$M_{fs} = v \times b \times \gamma \times k \sqrt{\delta}$$

where:

M_{fs} is the free surface moment at any inclination, in m·tonnes

v is the tank total capacity, in m^3

b is the tank maximum breadth, in m

γ is the mass density of liquid in the tank, in tonnes/m^3

δ is equal to $v/(b \times l \times h)$ (the tank block coefficient)

h is the tank maximum height, in m

l is the tank maximum length, in m

k is the dimensionless coefficient to be determined from table T.H5.416.1 according to the ratio b/h. The intermediate values are determined by interpolation.

417. Small tanks which satisfy the following condition using the values of "k" corresponding to an angle of inclination of 30°, need not be included in the correction:

$$M_{fs} / \Delta_{min} < 0.01 \text{ m}$$

where:

Δ_{min} is the minimum ship displacement calculated at d_{min}, in tonnes

d_{min} is the minimum mean service draught of the ship without cargo, with 10% stores and minimum water ballast, if required, in m.

418. The usual remainder of liquids in empty tanks need not be taken into account in calculating the corrections, provided that the total of such residual liquids does not constitute a significant free surface effect.

TABLE T.H5.416.1 - VALUES FOR COEFFICIENT "K" FOR CALCULATING FREE SURFACE CORRECTIONS

$$k = \frac{\sin\theta}{12}\left(1+\frac{\tan^2\theta}{2}\right)\times b/h \qquad k = \frac{\cos\theta}{8}\left(1+\frac{\tan\theta}{b/h}\right)-\frac{\cos\theta}{12(b/h)^2}\left(1+\frac{\cot^2\theta}{2}\right)$$

Where $\cot\theta \geq$ b/h Where $\cot\theta \leq$ b/h

b/h \ θ	5°	10°	15°	20°	30°	40°	45°	50°	60°	70°	75°	80°	85°
20	0.11	0.12	0.12	0.12	0.11	0.10	0.09	0.09	0.07	0.05	0.04	0.03	0.02
10	0.07	0.11	0.12	0.12	0.11	0.10	0.10	0.09	0.07	0.05	0.04	0.03	0.02
5	0.04	0.07	0.10	0.11	0.11	0.11	0.10	0.10	0.08	0.07	0.06	0.05	0.04
3	0.02	0.04	0.07	0.09	0.11	0.11	0.11	0.10	0.09	0.09	0.07	0.06	0.05
2	0.01	0.03	0.04	0.06	0.09	0.11	0.11	0.11	0.10	0.09	0.09	0.08	0.07
1.5	0.01	0.02	0.03	0.05	0.07	0.10	0.11	0.11	0.11	0.11	0.10	0.10	0.09
1	0.01	0.01	0.02	0.03	0.05	0.07	0.09	0.10	0.12	0.13	0.13	0.13	0.13
0.75	0.01	0.01	0.02	0.02	0.04	0.05	0.07	0.08	0.12	0.15	0.16	0.16	0.16
0.5	0.00	0.01	0.01	0.02	0.02	0.04	0.04	0.05	0.09	0.16	0.18	0.21	0.23
0.3	0.00	0.00	0.01	0.01	0.01	0.02	0.03	0.03	0.05	0.11	0.19	0.27	0.34
0.2	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.02	0.04	0.07	0.13	0.27	0.45
0.1	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.04	0.06	0.14	0.53

419. Small tanks which satisfy the following condition using the values of "k" corresponding to an angle of inclination of 30°, need not be included in the correction:

$$vb\rho k\sqrt{\delta}/\Delta min < 0.01 \text{ m}$$

where

Δmin = the minimum ship displacement in tonnes.

420. The usual remainder of liquids in empty tanks need not be taken into account in calculating the corrections providing the total of such residual liquids does not constitute a significant free surface effect.

500. Stability booklet

501. Each ship shall be provided with a stability booklet, approved by the Administration, which contains sufficient information to enable the master to operate the ship in compliance with the applicable requirements contained in the Code. The Administration may have additional requirements. On a mobile offshore drilling unit, the stability booklet may be referred to as an operating manual. The stability booklet may include information on longitudinal strength. This Code addresses only the stability-related contents of the booklet. The format of the stability booklet and the information included will vary dependent on the ship type and operation. In developing the stability booklet, consideration shall be given to including the following information:

a. a general description of the ship;

b. instructions on the use of the booklet;

c. general arrangement plans showing watertight compartments, closures, vents, downflooding angles, permanent ballast, allowable deck loadings and freeboard diagrams;

d. hydrostatic curves or tables and cross curves of stability calculated on a free-trimming basis, for the ranges of displacement and trim anticipated in normal operating conditions;

e. capacity plan or tables showing capacities and centres of gravity for each cargo stowage space;

f. tank sounding tables showing capacities, centres of gravity, and free surface data for each tank;

g. information on loading restrictions, such as maximum KG or minimum GM curve or table that can be used to determine compliance with the applicable stability criteria;

h. standard operating conditions and examples for developing other acceptable loading conditions using the information contained in the stability booklet;

i. a brief description of the stability calculations done including assumptions;

j. general precautions for preventing unintentional flooding;

k. information concerning the use of any special cross-flooding fittings with descriptions of damage conditions which may require cross-flooding;

l. any other necessary guidance for the safe operation of the ship under normal and emergency conditions;

m. a table of contents and index for each booklet;

n. inclining test report for the ship, or:

n1. where the stability data is based on a sister ship, the inclining test report of that sister ship along with the lightship measurement report for the ship in question; or

n2. where lightship particulars are determined by other methods than from inclining of the ship or its sister, a summary of the method used to determine those particulars;

o. recommendation for determination of ship's stability by means of an in-service inclining test.

502. As an alternative to the stability booklet mentioned in the item H5.501 above, a simplified booklet in an approved form containing sufficient information to enable the master to operate the ship in compliance with the applicable provisions of the Code as may be provided at the discretion of the Administration concerned

503. Stability data and associated plans shall be drawn up in the working language of the ship and any other language the Classification RBNA may require. All translations of the stability booklet shall be approved

504. As a supplement to the approved stability booklet, a computer may be used to facilitate the stability calculations.

505. The computer hardware and software shall be approved for stability calculation by the Administration. The input/output format shall, as far as practicable, be easily comparable in information and format to the stability booklet so that the operators will easily gain familiarity with the stability calculations.

506. A simple and straightforward instruction manual written in the same language as the stability booklet, complying with the provisions of H5.600, shall be provided

507. In order to validate the proper functioning of the computer hardware and software, pre-defined standard loading conditions shall be run in the computer periodically, at intervals recommended by the suppliers but at least at every annual load line inspection, and the printout shall be maintained on board as check conditions for future reference

508. Ships with innovative design are to be provided with additional information in the stability booklet such as design limitations, maximum speed, worst intended weather conditions or other information regarding the handling of the craft that the Master needs to operate the ship.

600. Permanent ballast

601. If used, permanent ballast shall be located in accordance with a plan approved by the Administration and in a manner that prevents shifting of position. Permanent ballast shall not be removed from the ship or relocated within the ship without the approval of the Administration. Permanent ballast particulars shall be noted in the ship's stability booklet.

H6. DAMAGED STABILITY

100. Subdivision and Damage D Stability

101. The damage stability requirements in the present Chapter H6 [SOLA parts B-1 through B-4} shall apply to cargo ships of 80 m in length (L) and upwards and to all passenger ships regardless of length but shall exclude those cargo ships which are shown to comply with subdivision and damage stability regulations in other instruments developed by the IMO Regulations.

Reference is made to Part II, Title 21, Section 1, H6.

102. Vessels of applicable size, type and service are to have subdivision and damage stability as required by the International Convention for the Safety of Life as Sea, 1974, as amended, as follows:

TABLE T.H6.1013.1 – DAMAGED STABIITY CRITERIA

DAMAGED STABILITY	
Passenger vessel	SOLAS 74/88 Part B-1 Regulation II-1/B/4 through II-1/B1/8-1 , Chapter II of Annex 2 to resolution MSC 216(82)
Cargo vessel	SOLAS 74/88 Part B-1 Regulation II-1/B1/4 through II-1/B1/7-3
Oil tanker	Regulation 28, Annex I, MARPOL 73/78
Gas carrier	IGC Code Part II, Title 34 of the Rules
Chemical carrier	IBC Code Part II Title 33 of the Rules
Bulk carriers 150m in length constructed on or after 1 July 1999 and for cargoes of density 1,000 kg/m3 and above	SOLAS 74/88 Regulation XII/4 “Damage stability requirements applicable to bulk carriers”
Offshore supply vessel	IMO Resolution MSC.235(82)

CHAPTER I
PROPULSION PERFORMANCE

CHAPTER CONTENTS

I1. PROPULSION PERFORMANCE

100. Selection of the propulsion system

101. The selection of propulsion power and propulsion system is Owners’ convenience.

102. The present Rules cover the requirements for minimum speed for manoeuvres of the order of 6.0 knots.

I2. HIGH SPEED CRAFT

100. Definition

101. **High speed craft**, as defined by the IMO “INTERNATIONAL CODE OF SAFETY FOR HIGH SPEED CRAFT” – HSC Code - is a craft capable of a

maximum speed in metres per second (m/s) equal to or exceeding:

$$V = 3.7 \times \Delta^{0.1667}$$

where:

Δ = displacement corresponding to the design waterline (m^3).

102. The specific requirements for high speed craft are included in Part II, Title 25 of the Rules.

200. Special approach

201. High speed craft are subject to a special approach by RBNA (see Part II, Title 25 of the Rules).

CHAPTER J
ON-BOARD COMPUTERS FOR STABILITY CALCULATIONS

CHAPTER CONTENTS

J1. APPLICATION

100. Application
[IACS UR L5.1]

101. The use of onboard computers for stability calculations is not a requirement of class. However, a stability software installed onboard shall cover all stability requirements applicable to the ship.

Guidance

IACS UR are mandatory for class, and in the present case, this Chapter J is according to IACS UR L5. Although this used to be a statutory item, after IACS has considered stability to be a matter of Class, requirements for loading computers have become a Class matter as well.

End of guidance

102. This Chapter J, which requires only software approval, applies to onboard computers which are provided with software capable of performing stability calculations for the vessel.

103. Active and passive systems are defined in item J1.102. This Chapter J covers passive systems and the off-line operation mode of active systems only.

104. The requirements in this Chapter J apply to stability software on ships contracted for construction on or after 1 July 2005.

J2. GENERAL PRINCIPLES
[IACS UR L5.1]

100. General Principles

101. The scope of a stability calculation software shall be in accordance with the stability information as approved by the administration and shall at least include all information and perform all calculations or checks as necessary to ensure compliance with the applicable stability requirements.

102. Approved stability software is not a substitute for the approved stability information, and is used as a supplement to the approved stability information to facilitate stability calculations.

103. The input/output information shall be easily comparable with approved stability information so as to avoid confusion and possible misinterpretation by the operator relative to the approved stability information.

104. An operation manual is to be provided for the onboard computer stability software.

105. The language in which the stability information is displayed and printed out as well as the operation manual is written shall be the same as used in the ship's approved stability information. The RBNA may require a translation into a language considered appropriate.

106. The onboard computer software for stability calculations is ship specific and the results of the calculations are only applicable to the ship for which it has been approved.

107. In case of modifications implying changes in the main data or internal arrangement of the ship, the specific approval of any original stability calculation software is no longer valid. The software is to be modified accordingly and re-approved.

J3. CALCULATION SYSTEMS IACS UR L5.2

100. General

101. A passive system requires manual data entry, an active system replaces the manual entry with sensors reading and entering the contents of tanks, etc., and a third system, an integrated system, controls or initiates actions based on the sensor-supplied inputs and is not within the scope of this Chapter.

200. Types of Stability Software IACS UR L5.3

201. Three types of calculations performed by stability software are acceptable depending upon a vessel's stability requirements:

a. Type 1: Software calculating intact stability only (for vessels not required to meet a damage stability criterion)

b. Type 2: Software calculating intact stability and checking damage stability on basis of a limit curve (e.g. for vessels applicable to SOLAS Part B-1 damage stability calculations, etc.) or previously approved loading conditions and

c. Type 3: Software calculating intact stability and damage stability by direct application of pre-programmed damage cases for each loading condition (for some tankers etc.)

J4. FUNCTIONAL REQUIREMENTS

100. Required data [IACS UR L5.4.1]

101. The calculation program shall present relevant parameters of each loading condition in order to assist the Master in his judgement on whether the ship is loaded within the approval limits. The following parameters shall be presented for a given loading condition:

a. deadweight data;

b. lightship data;

c. trim;

d. draft at the draft marks and perpendiculars;

e. summary of loading condition displacement, VCG, LCG and, if applicable, TCG;

f. downflooding angle and corresponding downflooding opening;

g. compliance with stability criteria: Listing of all calculated stability criteria, the limit

h. values, the obtained values and the conclusions (criteria fulfilled or not fulfilled).

102. If direct damage stability calculations are performed, the relevant damage cases according to the applicable rules shall be pre-defined for automatic check of a given loading condition.

103. A clear warning shall be given on screen and in hard copy printout if any of the loading limitations are not complied with. J4.104 below. The data are to be presented on screen and in hard copy printout in a clear unambiguous manner.

104. The data are to be presented on screen and in hard copy printout in a clear unambiguous manner.

105. The date and time of a saved calculation shall be part of the screen display and hard copy printout.

106. Each hard copy printout shall contain identification of the calculation program including version number.

107. Units of measurement are to be clearly identified and used consistently within a loading calculation.

200. Acceptable Tolerances IACS UR L5.5

201. Depending on the type and scope of programs, the acceptable tolerances are to be determined differently, according to J4.205 or J4 206 below. Deviation from these tolerances shall not be accepted unless the RBNA considers that there is a satisfactory explanation for the difference and that there will be no adverse effect on the safety of the ship.

202. Examples of pre-programmed input data include the following:

a. Hydrostatic data: Displacement, LCB, LCF, VCB, KMt and MCT versus draught.

b. Stability data: KN or MS values at appropriate heel/ trim angles versus displacement, stability limits.

c. Compartment data: Volume, LCG, VCG, TCG and

d. FSM/ Grain heeling moments vs level of the compartment's contents.

203. Examples of output data include the following:

a. Hydrostatic data: Displacement, LCB, LCF, VCB, KMt and MCT versus draught as well as actual draughts, trim.

b. Stability data: FSC (free surface correction), GZ-values, KG, GM, KG/GM limits, allowable grain heeling moments, derived stability criteria, e.g. areas under the GZ curve, weather criteria.

c. Compartment data: Calculated Volume, LCG, VCG, TCG and FSM/ Grain heeling moments vs level of the compartment's contents.

204. The computational accuracy of the calculation program results shall be within the acceptable tolerances specified in J4.205 e J4.206, of the results using an independent program or the approved stability information with identical input.

205. Programs which use only pre-programmed data from the approved stability information as the basis for stability calculations, shall have zero tolerances for the printouts of input data. Output data tolerances are to be close to zero, however, small differences associated with calculation rounding or abridged input data are acceptable. Additionally differences associated with the use of hydrostatic and stability data for trims that differ from those in the approved stability information, are acceptable subject to review by the individual RBNA.

206. Programs which use hull form models as their basis for stability calculations, shall have tolerances for the printouts of basic calculated data established against either data from the approved stability information or data obtained using the approval authority's model. Acceptable tolerances shall be in accordance with Table T.J4.206.1.5.2

TABLE T.J4.206.1 – ACCEPTABLE TOLERANCES

Hull Form Dependent	
Displacement	2%
Longitudinal center of buoyancy, from AP	1% / 50 cm max
Vertical center of buoyancy	1% / 5 cm max
Transverse center of buoyancy	0.5% of B / 5 cm max
Longitudinal center of flotation, from AP	1% / 50 cm max
Moment to trim 1 cm	2%
Transverse metacentric height	1% / 5 cm max
Longitudinal metacentric height	1% / 50 cm max
Cross curves of stability	5 cm
Compartment dependent	
Volume or deadweight	2%
Longitudinal center of gravity, from AP	1% / 50 cm max
Vertical centre of gravity	1% / 5 cm max
Transverse center of gravity	0.5% of B / 5 cm max
Free surface moment	2%
Shifting moment	5%
Level of contents	2%
Trim and stability	
Draughts (forward, aft, mean)	1% / 5 cm max
GMt	1% / 5 cm max
GZ values	5% / 5 cm max
FS correction	2%
Downflooding angle	20
Equilibrium angles	10
Distance to unprotected openings or margin line from WL, if applicable	+/- 5% / 5 cm max
Areas under righting arm curve	5% or 0,0012mrad

Notes to Table T.J4.206.1

a. Deviation in % = {(base value-applicant's value)/base value} *100

b. Where the "base value" may be from the approved stability information or the RBNA's computer model.

J5. APPROVAL PROCEDURES

100. Conditions of approval of the onboard software for stability calculations

101. The onboard software used for stability calculations is subject to approval, which is to include;

a. verification of type approval, if any;

b. verification that the data used is consistent with the current condition of the ship.

c. verification and approval of the test conditions;

d. verification that the software is appropriate for the type of ship and stability calculations required.

102. The satisfactory operation of the software with the onboard computer(s) for stability calculations is to be verified by testing upon installation (see Chapter T below). A copy of the approved test conditions and the operation manual for the computer/ software are to be available on board.

200. General Approval (optional) IACS UR L5.6.1

201. Upon application to the RBNA for general approval of the calculation program, the RBNA may provide the applicant with test data consisting of two or more design data sets, each of which is to include a ship's hull form data, subdivision data, lightship characteristics and deadweight data, in sufficient detail to accurately define the ship and it's loading condition. Acceptable hull form and subdivision data may be in the form of surface coordinates for modelling the hull form and compartment boundaries, e.g.: a table of offsets, or in the form of pre-calculated tabular data, e.g.: hydrostatic tables, capacity tables, etc., depending upon the form of data used by the software being submitted for approval.

202. Alternatively, the general approval may be given based on at least two test ships agreed upon between the RBNA and the applicant.

203. In general, the software is to be tested for two types of ships for which approval is requested, with at least one design data set for each of the two types. Where approval is requested for only one type of ship, a minimum of two data sets for different hull forms of that type of ship are required to be tested. For calculation software which is based on the input of hull form data, design data sets shall be provided for three types of ships for which the software is to be approved, or a minimum of three data sets for different hull forms if approval is requested for only one type of ship. Representative ship types which require different design data sets due to their hull forms, typical arrangements, and nature of cargo include: tanker, bulk carrier, container ship, and other dry cargo and passenger ships.

204. The test data sets shall be used by the applicant to run the calculation program for the test ships. The results obtained (together with the hydrostatic data and cross-curve data developed by the program, if appropriate) shall be submitted to the RBNA for the assessment of the program's computational accuracy.

205. The RBNA shall perform parallel calculations using the same data sets and a comparison of these results will be made against the applicant's submitted program's results.

300. Specific approval
[IACS UR L5.6.2]

301. The RBNA shall verify the accuracy of the computational results and actual ship data used by the calculation program for the particular ship on which the program will be installed.

302. Upon application to the RBNA for data verification, the RBNA and the applicant shall agree on a minimum of four loading conditions, taken from the ship's approved stability information, which are to be used as the test conditions. For ships carrying liquids in bulk, at least one of the conditions shall include partially filled tanks. For ships carrying grain in bulk, one of the grain loading conditions shall include a partially filled grain compartment. Within the test conditions each compartment shall be loaded at least once. The test conditions normally are to cover the range of load draughts from the deepest envisaged loaded condition to the light ballast condition and shall include at least one departure and one arrival condition.

303. The RBNA is to verify that the following data, submitted by the applicant, is consistent with arrangements and most recently approved lightship characteristics of the ship according to current plans and documentation on file with the RBNA, subject to possible further verification on board:

a. Identification of the calculation program including version number.

b. Main dimensions, hydrostatic particulars and, if applicable, the ship profile.

c. The position of the forward and after perpendiculars, and if appropriate, the calculation method to derive the forward and after draughts at the actual position of the ship's draught marks.

d. Ship lightweight and centre of gravity derived from the most recently approved inclining experiment or light weight check.

e. Lines plan, offset tables or other suitable presentation of hull form data if necessary for the RBNA to model the ship.

f. Compartment definitions, including frame spacing, and centres of volume, together with capacity tables (sounding/ullage tables), free surface corrections, if appropriate.

g. Cargo and Consumables distribution for each loading condition.

304. Verification by the RBNA does not absolve the applicant and shipowner of responsibility for ensuring that the information programmed into the onboard computer software is consistent with the current condition of the ship.

J6. OPERATION MANUAL

100. Operation Manual
[IACS UR L5.7]

101. A simple and straightforward operation manual is to be provided, containing descriptions and instructions, as appropriate, for at least the following:

a. installation

b. function keys

c. menu displays

d. input and output data

e. required minimum hardware to operate the software

f. use of the test loading conditions

g. computer-guided dialogue steps

h. list of warnings

J7. REQUIREMENTS FOR LOADING CONDITIONS, LOADING MANUALS AND LOADING INSTRUMENTS
[IACS UR S1]

100. General

101. RBNA considers that this Requirement satisfies Regulation 10(1) of the International Convention on Load Lines, 1966.

200. Application

201. These requirements* apply to all classed sea-going ships of 65m in length and above which are contracted for construction on or after 1st July 1998, and contain minimum requirements for loading guidance information. For CSR Bulk Carriers and Oil Tankers, these requirements apply in addition to those of the Common Structural Rules.

300. Definitions

301. **Loading Manual**: a Loading Manual is a document which describes:

a. the loading conditions on which the design of the ship has been based, including permissible limits of still water bending moment and shear force

b. the results of the calculations of still water bending moments, shear forces and where applicable, limitations due to torsional and lateral loads

c. the allowable local loading for the structure (hatch covers, decks, double bottom, etc.)

Notes

a. For ships which were contracted for construction before 1st July 1998, the relevant prior revisions of this Unified Requirement as well as Members' reservations to those revisions of this Unified Requirement apply.

b. Certain additional requirements of Unified Requirement S1A also apply to bulk carriers, ore carriers and combination carriers of 150m length and above.

302. **Loading Instrument**: a loading instrument is an instrument, which is either analogue or digital, by means of which it can be easily and quickly ascertained that, at specified read-out points, the still water bending moments, shear forces, and the still water torsional moments and lateral loads, where applicable, in any load or ballast condition will not exceed the specified permissible values.

a. An operational manual is always to be provided for the loading instrument.

b. Single point loading instruments are not acceptable.

303. **Category I Ships**

a. Ships with large deck openings where combined stresses due to vertical and horizontal hull girder bending and torsional and lateral loads have to be considered;

b. Ships liable to carry non-homogeneous loadings, where the cargo and/or ballast may be unevenly distributed. Ships less than 120 metres in length, when their design takes into account uneven distribution of cargo or ballast, belong to Category II;

c. Chemical tankers and gas carriers.

304. Category II Ships

a. Ships with arrangement giving small possibilities for variation in the distribution of cargo and ballast, and ships on regular and fixed trading pattern where the Loading Manual gives sufficient guidance, and in addition the exception given under Category I.

400. Annual and Special Survey

401. At each Annual and Special Survey, it is to be checked that the approved loading guidance information is available on board.

402. The loading instrument is to be checked for accuracy at regular intervals by the ship's Master by applying test loading conditions.

403. At each Special Survey this checking is to be done in the presence of the Surveyor.

500. Loading Conditions, Loading Manuals and Loading Instruments

501. An approved loading manual is to be supplied for all ships except those of Category II with length less than 90m in which the deadweight does not exceed 30% of the displacement at the summer load line draft. In addition, an approved loading instrument is to be supplied for all ships of Category I of 100m in length and above.

600. Conditions of Approval of Loading Manuals

601. The approved Loading Manual is to be based on the final data of the ship. The Manual is to include the design loading and ballast conditions upon which the approval of the hull scantlings is based.

CHAPTER T
INSPECTIONS AND TESTS FOR NAVAL ACRHITECTURE

CHAPTER CONTENTS:

T1. TESTS DURING CONTRUCTION

100. Dfrat marks measument

101. The positions of the draft markings must be measured in the presence of a RBNA surveyor.

102. Load line markings

103. Load line markings must be measured in the presence of a RBNA surveyor.

T2. TESTS AT THE COMPLETION OF BUILDING

100. Inclining experiment

101. The measurements will be carried out in conformity with the proceedings of NORMAM 01, in the presence of a RBNA surveyor, therein included the checking of the weights by a calibrated device.

102. The proceedings are to be previously approved by RBNA and shall be comprised of:

a. Loading condition at the test;

b. Calculation of the weights to be applied in the test;

c. Indication of the estimated angle of heel;

d. Positioning of the weight during the trials; and

e. Estimated positioning of the weighs or hoses, checking that the devices have appropriate length and course so that angles of about 2 to 2.5 degrees are attained, with a course of approximately 10 cm.

103. The report of the test, containing the light weight and the measured centres, will be sent to RBNA for approval.

104. For vessels under 500 GT, the inclining experiment is to be carried out in conformity with:

For Brazilian Flag vessels with GT < 500, according to NORMAM 01 chapter 3;

For foreign Flag vessels with GT < 500, according to National Regulations or, in the absence of such regulations, in conformity with IMO regulations and IACS Rec 31.

200. Deadweight Measurement (“draft survey”)

201. For vessels under 500 GT under the Brazilian flag, and where allowed by NORMAM 01, Chapter 3 the inclining experiment may be substituted by a “Deadweight Measurement”

a. For vessels under 500 GT under foreign flags, and where allowed by the National Administration, the inclining experiment may be substituted by a “Deadweight Measurement”

202. The measurement of weights and the longitudinal and transverse position of the centre of gravity is carried out through the draft measurement, and is destined to verify conformity with the preliminary Weight and Centres Estimative. This measurement will be carried out in the presence of a RBNA surveyor.

203. The proceedings for these measurements is the same as in the inclining experiment for vessels under 500 GT, where applicable.

204. For vessels having GT≥ 500, see Part II, Title 11, Section 1, sub-chapter T.3

300. Tolerances for vessels

301. Where the draft and weight measurement is applicable, the values must not exceed the following tolerances:

For LCG : ± 1 % of L;

For TCG: ± 0,3 % of L; and

For light weight: ± 3 % of the estimated.

302. In case larger differences are observed, a full inclining experiment is required.

Guidance

303. The Brazilian National Administration adopts tolerances stricter than IMO requirements. The RBNA Rules adopt the tolerances above for all ships.

End of guidance

T3. SEA TRIALS

100. Propulsion and manoeuvring performance

101. For self-propelled vessels or for an integrated convoy behaving as one single vessel, sea trials are required to measure the following performances:

a. Speed;

b. Turning circle;

c. Zig-zag steering;

d. Distance to stop the vessel through engine reversal

e. Distance to stop the vessel without engine reversal; and

f. Tendencies of the vessel in reverse power

102. For measurement of the performance of equipments and systems of the vessel, refer to the relevant Sections.

T4. INSTALLATION TESTING FOR ON-BOARD COMPUTERS FOR STABILITY CALCULATIONS [IACS UR L5.8]

100. Installation Testing

101. To ensure correct working of the computer after the final or updated software has been installed, it is the responsibility of the ship's Master to have test calculations carried out according to the following pattern in the presence of a RBNA surveyor:

102. From the approved test conditions at least one load case (other than light ship) shall be calculated. Note: Actual loading condition results are not suitable for checking the correct working of the computer.

103. Normally, the test conditions are permanently stored in the computer.

104. Steps to be performed:

a. Retrieve the test load case and start a calculation run; compare the stability results with those in the documentation.

b. Change several items of deadweight (tank weights and the cargo weight) sufficiently to change the draught or displacement by at least 10%. The results are to be reviewed to ensure that they differ in a logical way from those of the approved test condition.

c. Revise the above modified load condition to restore the initial test condition and compare the results. The relevant input and output data of the approved test condition are to been replicated.

d. Alternatively, one or more test conditions shall be selected and the test calculation performed by entering all deadweight data for each selected test condition into the program as if it were a proposed loading. The results shall be verified as identical to the results in the approved copy of the test conditions.

200. Periodical Testing

201. It is the responsibility of the ship's master to check the accuracy of the onboard computer for stability calculations at each Annual Survey by applying at least one approved test condition.

202. If a RBNA surveyor is not present for the computer check, a copy of the test condition results obtained by the computer check is to be retained on board as documentation of satisfactory testing for the surveyor's verification.

203. At each Special Survey this checking for all approved test loading conditions is to be done in presence of the surveyor.

204. The testing procedure shall be carried out in accordance with T4.100 above.

T5. IACS GUIDELINES AND RECOMMENDATIONS FOR INCLINING EXPERIMENT [IACS REC 31 MODIFIED]

Guidance

The IACS Guidelines and Recommendations for Inclining Experiment have been modified where different from NORMAM 01, the National Administration regulations. The modifications are clearly stated in the following text.

For ships under the Brazilian Flag, the NORMAM 01 additional / substitutive requirements are to be followed.

End of Guidance

100. General Preparation for the Test

101. Information to be submitted: the Instruction, containing the information of date and location of the test, responsible person, stability inclining weight, schemes of inclining weight positions etc., shall be presented to the Classification RBNA before the inclining test. The following information shall be available at the time of the inclining test as necessary:

a. General arrangement drawing;

b. Tank capacity plan;

c. Hydrostatic curves;

d. Draft marks locations.

200. The inclining test condition

201. The ship shall be as near to completion as possible. Equipment used by the yard on board shall be limited to the utmost extent possible. Prior to the inclining test, lists of all items which are to be added, removed, or relocated shall be prepared. These weights and their locations shall be accurately recorded. Normally, the total value of missing weights shall not exceed 2 percent and surplus weights, excluding liquid ballast, not exceed 4 percent of the light ship displacement. For smaller vessels, higher percentages may be allowed.

202. All objects shall be secured in their regular positions. All weights which may swing or shift must be secured in their known position. If more than one sea stowage position is possible, the actual stowage position used during the test shall be recorded.

a. Additional National Administration requirements (NORMAM 01)

a.1. Booms of lifting appliances, lifeboats, or jibs must be fixed in the position “stowed for voyage” when taking the readings, and

a.2. Hatch covers must be closed where possible.

203. The ship shall be cleared of residues of cargo, tools, debris, scaffolding and snow. Icing of the inner and outer surfaces, the underwater hull included, is not permitted.

204. All bilge water and other extraneous standing liquids must be removed. When draining individual tanks is impracticable, allowances for such liquids shall be at the discretion of the RBNA.

205. All service tanks and machinery plant piping are to be filled as for the working condition.

206. In general, only the people participating in the inclining test shall stay on board the ship.

a. Additional National Administration requirements (NORMAM 01)

a.1. The people remaining on board must be stationed at the centre line.

207. All spaces shall be safe for inspection.

208. Preferably, all tanks shall be either full or empty. The number of tanks containing liquids shall be kept to a minimum.

209. Soundings and density of liquids in tanks shall be taken. Shapes of tanks which are partly filled are to be known in order to determine the free liquid surface effect.

210. Adequate measures are to be taken to preclude air pockets in completely full tanks. All connections between tanks are to be closed and all empty tanks are to be adequately dried.

a. Additional National Administration requirements (NORMAM 01)

a.1. Where tanks cannot be totally full or empty due to trim / stability reasons, care must be taken to keep them at a level where free surface determination is possible. This level is to be kept constant throughout the test.

211. Mooring lines shall be free of any tension in the transverse direction of the ship during the reading after each weight shift. No external moments shall be brought upon the ship (from mooring lines, quay, etc.). If possible, the ship shall be located in a calm, protected area free from external forces.

212. The depth of water under the hull shall be sufficient to ensure that the hull will be entirely free of the bottom. Prior to the test the depth of water shall be measured in as many

locations as necessary to positively satisfy this requirement, taking into account tide differences, if applicable.

213. An ideal mooring arrangement would involve bow and stern lines on both sides of the ship attached at or near the centre-line. Longitudinal mooring lines shall be as long as practicable. More commonly, a ship may be moored by bow and stern lines on one side only and supplemented by spring lines. Where a single bow or stern line is proposed, the surveyor shall be assured that the ship's freedom of movement does not adversely effect the conduct of the experiment.

214. The ship may be moored by means of other special arrangement approved by the RBNA.

215. When tidal currents are present the experiment shall normally be conducted at or around slack tide.

216. The ship's gangway shall be in the stowed position and any shore gangway removed during the inclining test. As few cables, hoses, etc., as possible shall be connected to shore. Those which are needed shall be slack.

217. The test shall not be conducted under adverse wind, wave and current conditions where the accuracy of the results cannot be assured.

300. Inclining Weights, pendulum and instruments

301. For the inclining test, solid inclining weights normally shall be used.

302. Use of water ballast transfer to incline the vessel may be permitted only in cases where it is impractical to incline the vessel using solid weights. If the transfer of water ballast is to be used, a detailed procedure, including calculation procedure, is to be submitted to the RBNA for approval prior to the experiment.

303. The total weight used shall be sufficient to provide a minimum inclination of one degree and a maximum of four degrees of heel to each side of the initial position. However, in those cases where it is absolutely impractical to reach a minimum angle of 1 degree by use of solid weights or water ballast a lesser inclination angle may be accepted, provided that the requirements on pendulum deflection or U-tube difference in height are complied with.

304. Each weight is to be compact, impervious to water and shaped such that its centre of gravity may be accurately determined. It is recommended that not fewer than four weights (or sets of weights) be used, each approximately equal in mass, and that the inclining weights (or sets of weights) be positioned as symmetrically as possible and parallel to the centre line in places convenient for the shifting of weights and measurement of the arms.

305. Each inclining weight shall be marked with an identification number. The inclining weights shall have been weighed with a calibrated instrument to the satisfaction of the Surveyor.

306. The use of three measuring devices is recommended to determine the vessel's inclination after each weight shift, however, a minimum of two devices shall be used, one of which is to be a pendulum or U-tube arrangement. The length and arrangement of pendulum/U-tube are to be such as to ensure the accuracy of the readings of deflection/difference. The minimum deflection/difference, to each side of the initial position, corresponding to the total weight shift, shall be 15cm.

307. The use of a stabilograph is also acceptable provided the calibration of the instrument has been verified to the Surveyor's satisfaction prior to the experiment. A trace of the recorded heel pattern is to be included in the test report.

308. Additional National Administration requirements (NORMAM 01) **Moving weights**

a. The moving weights are to be determined by means of the following equation:

$$P = \frac{\Delta \, GM \, tg \, \theta}{d}), \text{ where:}$$

P = total weight to be transferred, in metric tons;
Δ = Estimated displacement for the trial, in metric tons;
GM = initial metacentric height estimated for the trial condition, in meters;
d = transversal path of the inclining weight, in meters; and
θ = inclining angle generated by moving the inclining weights , recommended to be within a range as follows:

$$1° < \theta < 3°,$$

depending upon the ships particulars.

b. Liquid ballast weight is allowed only where solid weights are considered absolutely and technically impracticable.

c. Where liquid ballast is used as weight, care shall be taken as follows:

c.1. Liquid transfer must be only between directly symmetrical tanks;

c.2. The density of the liquid is to be measured;

c.3. Piping lines for the transfer are to be filled up before the commencement of the trial and a strict control is to be maintained over the valve manoeuvres.

c.4. The level of liquid in the tanks to be employed for the liquid transfer must be such as to allow for measurement of the free surface

309. Additional National Administration requirements (NORMAM 01) **Pendulum and "U" Tubes**

a. the pendulums (and/or "U" tubes) shall be at least two in number and away from each other as much as possible, in the longitudinal direction of the vessel;

b. the length of the pendulum wire shall be the largest possible, so as to provide, for the inclination of the vessel, the largest possible deviation;

c. the weight of the pendulum shall be enough to keep the wire taught and must have the format shown in detail B of Figure F.A3.309.1. The minimum mass of impact shall be 5 Kg;

d. the pendulum wire must be flexible and diameter steel enough to support the weight of the pendulum without undergoing elongation, thus ensuring that the pendulum does not touch the bottom of the oil pan;

e. the pendulum wire support, at the point of suspension, shall be such that it can guarantee the free oscillation of the pendulum without slipping, as suggested in detail in Figure F.A3.309.1.

f. to dampen the oscillations of the pendulum a container shall be used filled up with oil. The dimensions of the container shall be such that, at the largest angle of heel and taking into account the oscillation, the pendulum will not touch the edge of the container, as well as remain immersed; and

g. to measure the deviation of the pendulum a ruler (graduated or not) can be used, the solidarity easels prevented from travelling, as suggested in Figure F.A3.309.1.

400. Trim and Stability

401. The vessel shall be upright prior to the inclining. However, an initial list of the ship not exceeding 0.5° is permissible.

402. Excessive trim shall be avoided for certain hull forms where changes in waterplane shape would occur in the region of the waterline when the ship is heeled. Such features

shall be taken into account to select a suitable draught and trim for the test.

403. The persons conducting the test shall be satisfied that the vessel has adequate, positive stability and acceptable stress levels during the test. The estimated initial metacentric height shall be at least 0.20 m.

404. Accuracy of Data: Measurement of Inclining Test data is to be as accurate as possible and to the satisfaction of the attending Surveyor.

500. Draught and Water Density Measurements

501. Draught/freeboard shall be measured immediately before and verified after the test, to ensure that no significant changes in vessel's condition have occurred during the test.

502. Draughts/freeboards shall be measured at fore and aft and midship draught marks at both sides. If the freeboards are not measured from the upper edge of deck line at side of freeboard deck or at the same frame locations as the draught marks, the locations and vertical datum must be stated.

503. A suitable boat with low freeboard shall be available for the draught measurements.

504. To control the correctness of draught measurements, it is recommended to plot two waterlines by draught readings and by measured values of the freeboard when the latter is available. With correct measurements, both waterlines are to coincide. In case of non-coincidence of separate points, additional measurements shall be taken.

505. Sufficient water samples are to be taken at suitable locations and depths to enable and accurate assessment of water density to be made.

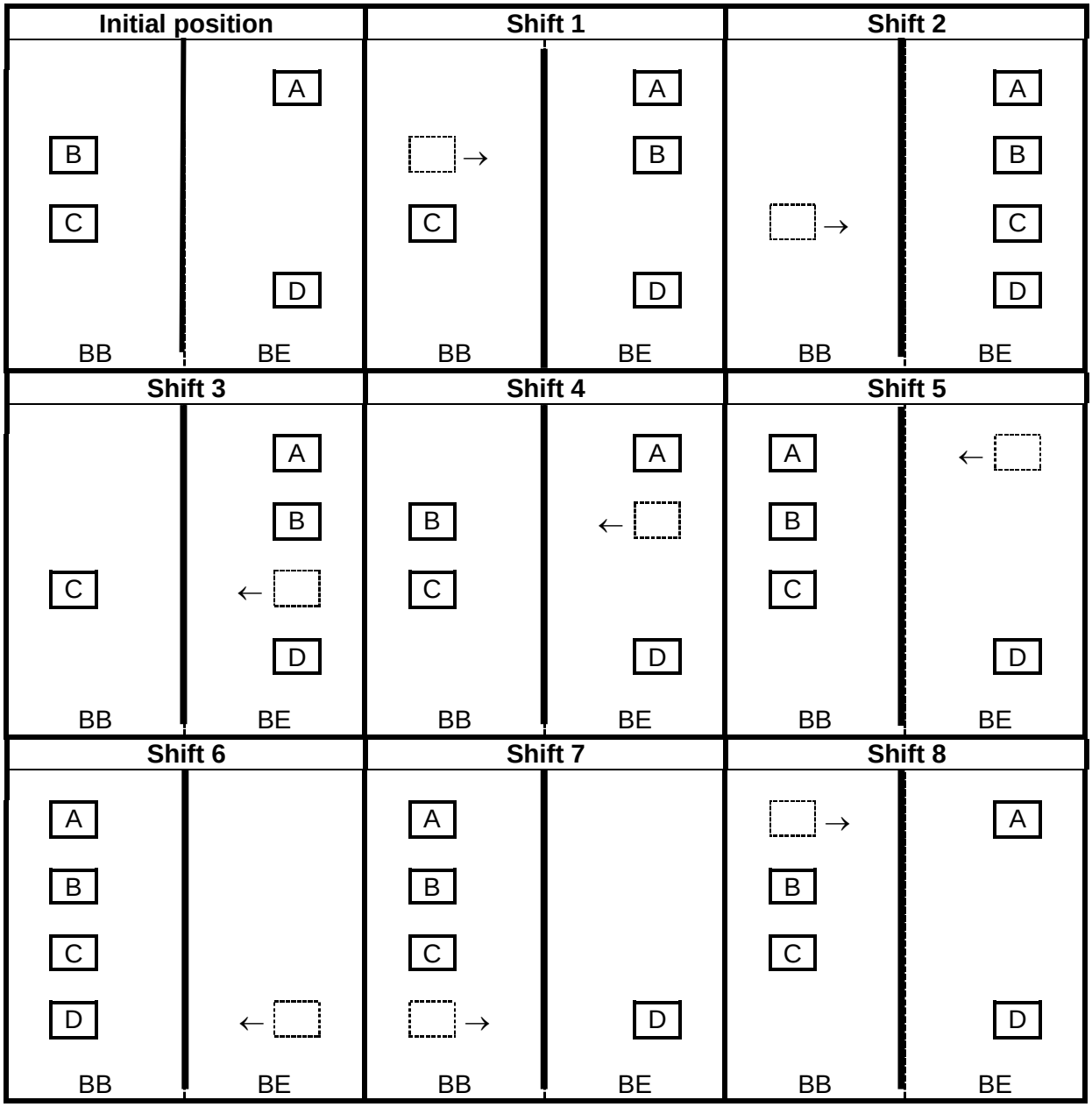
600. Weight shifts and Inclination Measurements.

601. Two recommended procedures of shifting weights are shown in table T.T5P.601.1 and figure F.T5.601.1 below.

TABLE T.T5.601.1– WEIGHT SHIFTS

No. of Weights or Weight Groups				
Weight Shifts	Four		Six	
	PS	SB	PS	SB
No. 0	2, 4	1, 3	2, 4, 6	1, 3, 5
No. 1	4	1, 2, 3	4, 6	1, 2, 3, 5
No. 2		1, 2, 3, 4		1, 2, 3, 4, 5, 6
No. 3	1	2, 3, 4	6	1, 2, 3, 4, 5
No. 4	1, 3	2, 4	2, 4, 6	1, 3, 5
No. 5	1, 2, 3	4	1, 2, 3, 4, 6	5
No. 6	1, 2, 3, 4		1, 2, 3, 4, 5, 6	
No. 7	2, 3, 4	1	1, 2, 4, 6	3, 5
No. 8	2, 4	1, 3	2, 4, 6	1, 3, 5
PS and SB denotes port and starboard sides of ship respectively. The underlined numbers indicate the last weights or weight groups shifted.				

FIGURE F.T3.601.1 – WEIGHT SHIFTS



602. The inclining weight positions shall be marked on the deck to ensure that consistency in placement is achieved. The transverse shift distance is to be as great as practicable and appreciable changes in longitudinal or vertical position when moving port to starboard and vice versa are to be avoided.

603. The pendulum length is to be measured from its point of suspension to the recording batten on which deflections are read.

604. Pendulum, or U-tube reading on the recording batten or scale can be registered by either of the following ways:

a. on the final stable position of the pendulum or liquid column after stopping of ship motions due to shifting of the inclining weight;

b. by marking the mean value within the range of residual oscilliation.

605. When using other devices, angles of inclination are to be recorded according to instructions supplied with each device.

606. Checks shall be made in the process of the inclining test for each measuring device. These will, generally, be a progressive plot of angles of heel against heeling moments which shall give a series of points lying about a straight line passing through (or close to) the origin. If there is a deviation of points, either between the points for a particular weight movement, or from the straight line, the deflections and

moments shall be checked and corrected prior to the next weight movement.

607. Personnel shall be instructed to remain on their assigned positions while inclination readings are being taken and a check shall be made that all mooring lines, etc., remain slack following each weigh shift until all deflections have been taken and recorded.

700. Other Relevant Data

701. In the case where the inclinations are carried out by means of transfer of water, it has to be possible to evaluate accurately the weight and the centre of the shifted liquid in relation to the ship's heel and trim.

702. The weather conditions, i.e., wind speed and direction relative to the vessel, sea state, air and water temperatures, etc., during the test are to be recorded. If during the course of an inclining test circumstances arise such that the aforesaid requirements are not complied with the attending Surveyor shall advise the Person in Charge that the results may not be accepted.

800. Test Report and Analysis of Lightship Data

801. The Builder/Owner shall incorporate the data gathered during the test into a comprehensive test report, which may be combined with the analysis of the lightship data. Test readings not used in the final analysis shall still be recorded in the report.

802. The Surveyor is to ensure that the data given in the report is consistent with that gathered during the test and to sign the report.

803. The inclining test report and analysis, combined with the report or separately, shall be submitted to the RBNA for review and acceptance of results as the basis for approval of the stability information of the ship.

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