RULES
FOR THE CLASSIFICATION AND CONSTRUCTION OF SMALL SEA-GOING SHIPS

PART IV

STABILITY, SUBDIVISION AND FREEBOARD

November
2021

GDAŃSK

RULES FOR THE CLASSIFICATION AND CONSTRUCTION OF SMALL SEA-GOING SHIPS developed and edited by Polski Rejestr Statków S.A., hereinafter referred to as PRS, consist of the following Parts:

Part I – Classification Regulations
Part II – Hull
Part III – Hull Equipment
Part IV – Stability, Subdivision and Freeboard
Part V – Fire Protection
Part VI – Machinery and Piping Systems
Part VII – Electrical Installations and Control Systems,

whereas the materials and welding shall fulfil the requirements specified in Part IX – Materials and Welding, of the Rules for Classification and Construction of Sea-going Ships.

Part IV – Stability, Subdivision and Freeboard – November 2021, was approved by PRS Executive Board on 24 November 2021, and comes into force on 26 November 2021.

Upon the entry into force of this *Part IV*, its requirements apply to new ships in the full scope.

The requirements of this *Part IV* apply to the existing ships to an extent resulting from the provisions of *Part I – Classification Regulations*.

The requirements of *Part IV – Stability, Subdivision and Freeboard* are extended by the following Publications:

Publication No. 6/P – Stability,
Publication No. 14/P – Principles of Approval of Computer Programs,
Publication No. 29/P – Guidelines on Calculation and Assessment of Stability of Sailing Ships with Length above 20 m
Publication No. 66/P – Onboard Computers for Stability Calculations,
Publication No. 76/P – Stability, Subdivision and Freeboard of Passenger Ships Engaged on Domestic Voyages.

PRS/RP, 11/2021

CONTENTS

page

1 GENERAL

1.1 Application

1.1.1 This *Part IV – Stability, Subdivision and Freeboard* applies to small sea-going fully-decked displacement ships specified in paragraph 1.1.1 of *Part I – Classification Regulations*.

1.1.2 With respect to speedboats, hovercraft and hydrofoil craft, the requirements of this *Part IV* are applicable to an extent agreed with PRS.

1.1.3 For ships with propulsion under sail, the requirements specified in *Publication No. 29/P – Guidelines on Calculation and Assessment of Stability of Sailing Ships with Length above 20 m* are applicable to an extent agreed with PRS.

1.1.4 Ships after alteration or major repair shall have stability in accordance with the requirements specified in this *Part IV* or the requirements which they fulfilled before such an alteration or major repair.

1.1.5 For ships flying other flag than Polish one, PRS may consider the stability and damage stability criteria as fulfilled if such ships have been considered by the Administration as being in compliance with the stability requirements specified by this Administration.

1.2 Definitions and Symbols

Definitions relating to the general terminology of the *Rules for Classification and Construction of Small Sea-going Ships* (hereinafter referred to as the *Rules*) are contained in *Part I – Classification Regulation*. Where definitions or symbols explained in other parts of the *Rules* are used, reference is made to the relevant parts.
For the purposes of *Part IV*, the following additional definitions and symbols are hereby introduced.

1.2.1 Wind pressure, q_w – assumed pressure of wind taken for calculations.

1.2.2 Length of ship L – 96% of the total length on a waterline at 85% of the moulded depth, measured from the base plane, or the length from the fore side of the stem to the axis of the rudder stock on that waterline, if that be greater. In ships designed with a rake of keel, the waterline on which this length is measured shall be parallel to the design waterline.

1.2.3 Stability booklet – a document containing reliable information enabling the master, by rapid and simple processes, to obtain accurate guidance as to the stability of the ship in any loading condition.

1.2.4 Critical angle, θ_{kr} – the lesser angle out of the downflooding or capsizing angles.

1.2.5 Angle of intact ship downflooding, θ_z – the minimum value of heel angle at which the ship interior is flooded by outboard water through openings in the hull, deck, deckhouses or superstructures considered to be open or through the openings open during normal service of the ship.

1.2.6 Basic criterion, K (weather criterion) – the ratio of capsizing moment to the heeling moment due to wind.

1.2.7 Liquid cargo – all liquids aboard the ship, including stores, water ballast, etc.

1.2.8 Homogeneous cargo – a cargo having constant stowage factor.

1.2.9 Heeling moment due to wind, M_w – conventional heeling moment caused by the dynamic pressure of wind.

1.2.10 Capsizing moment, M_{kr} – a conventional design moment, applied dynamically which heels the ship to an angle equal to the angle of capsizing or the angle of flooding, or the dynamic margin angle of heel (where determined), whichever is lesser.

1.2.11 Superstructure – a decked structure on the freeboard deck, extending from side to side of the ship or with one side or both sides being inboard of the ship sides not more than 0.04*B*. A raised quarter deck is considered as a superstructure.

1.2.12 Openings considered to be open – openings in the upper deck or ship sides and also in decks, side walls and bulkheads of superstructures and deckhouses whose closing arrangements do not fulfil (in respect of tightness, strength and reliable operation) the requirements specified in *Part III – Hull Equipment*.

1.2.13 Cross curves – arms of form stability.

1.2.14 Deckhouse – a decked structure on the freeboard deck (or on the superstructure deck) with the sides (one or both) being inboard of the ship sides more than 0.04*B*.

1.2.15 Upper deck – the uppermost continuous deck extending over the full length of the ship.

1.2.16 Correction for free surfaces – a correction taking into account deterioration of the ship's stability due to the effect of liquids free surface.

1.2.17 Inclining test – a test carried out to determine the lightweight of the ship and the position of its centre.

1.2.18 Passage or towage – the ship's navigation outside the assigned area of navigation after fulfilling the specified requirements and subject to a permit granted in each particular case.

1.2.19 Design arm of wind pressure, z – distance from the centre of the windage area to the waterline.

1.2.20 Dry cargo ship – cargo ship intended for the carriage of various cargoes except for liquid cargo carried in cargo tanks.

1.2.21 Light ship – a ship ready for operation, but without cargo, stores, ballast water, passengers, crew and their effects.

1.2.22 Breadth of ship, B – the greatest breadth of the ship measured amidships between the outer edges of frames – in a ship with metal shell plating or between the outer surface of the hull – in ship with shell plating of any other material.

1.2.23 Displacement of ship, D – mass of water, in tonnes, of the volume equal to the volume of the submerged part of the ship's hull.

1.2.24 Moulded depth of ship H – the vertical distance measured amidships from the base plane to the top of the uppermost continuous deck beam at side. In ships having a rounded gunwale, the moulded depth is to be measured to the point of intersection of the moulded lines of the deck and side.

Where thick garboard strakes are applied, the distance is measured from the intersection of the extended – towards the plane of symmetry – line of the bottom flat part with the side surface of the keel. If the uppermost continuous deck is stepped and the raised part of the deck extends over the point at which the moulded depth shall 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.

1.2.25 Stores – fuel oil, fresh water, provision, lubricating oil, consumables.

1.3 Scope of Survey

1.3.1 In respect of stability, PRS survey covers:

.1 prior to the ship construction commencement:
- consideration of the ship stability documentation and verification of calculations;
- acceptance of preliminary *Stability Booklet* and damage stability calculations (where such calculations are required);

.2 during the ship construction and tests:
- acceptance of the hull measurement results (the main dimensions, keel position) and survey of draught marks' location;

– witnessing the inclining test and the acceptance of inclining test report;
– consideration and approval of the *Stability Booklet* and damage stability calculations (where such calculations are required);

.3 during the ship service, within the scope of the ship's periodical and occasional surveys: lightweight survey to determine changes in the ship mass due to its service, repair or alteration performed in order to confirm validity of the *Stability Booklet*.

1.4 General Requirements

1.4.1 General Assumptions and Principles

1.4.1.1 Fulfilment of the stability criteria does not provide immunity against capsizing and does not absolve the master from his responsibility for the safety of the ship. An additional requirement to ensure the safety of the ship is its proper operation, having regard to the prevailing circumstance.

1.4.1.2 It is assumed that the master will operate the ship with prudence and good seamanship, with due regard paid to the season of the year, weather forecasts and the navigational zone and will take appropriate action as to speed and course warranted by the prevailing circumstances.

1.4.1.3 It is assumed that the cargo has been properly stowed and secured so as to minimise the possibility of longitudinal and transverse shifting, while at sea, under the effect of acceleration caused by rolling and pitching.

1.4.1.4 It is assumed that the ship has been so loaded and ballasted (where necessary) that the stability criteria, specific for a particular ship, are complied with at all times during a voyage fulfilled.

1.4.1.5 The number of partially filled tanks shall be kept to a minimum as necessary due to their adverse effect on the ship's stability.

1.4.2 Calculation Methods

1.4.2.1 Calculations shall be performed in accordance with the methods common to naval architecture. It is recommended that calculations should be done using programs approved by PRS in accordance with *Publication No. 14/P – Principles of Approval of Computer Programs*.

1.4.3 Calculation of Cross Curves of Stability

1.4.3.1 Cross curves of stability shall be calculated for waterlines parallel with the load waterline.

1.4.3.2 When calculating cross curves of stability, account may be taken of those tiers of the enclosed superstructures which:

.1 fulfil the requirements specified in *Part III – Hull Equipment*;

.2 are provided with entrance from an exposed deck above, ensuring the crew access to working spaces inside the superstructures and to the machinery space – when the bulkheads openings are closed.

If the doors in superstructure bulkheads are the only exit at the ship's maximum draught to the deck and the upper edges of door sills in superstructures immerse at an angle lesser than the required angle of static stability range, the design height of superstructures shall be assumed to be half their actual height.

If, however, the upper edges of door sills in superstructures at the ship's maximum draught immerse at the angle of heel equal to or greater than the required angle of static stability range, such superstructures shall be taken into account in full height.

1.4.3.3 In calculations of cross-curves of stability, deckhouses may be considered only to the height of the first tier, if they comply with the requirements of 1.4.3.2.1 and have second exit to the deck above them or to both sides.

1.4.3.4 Cross curves' drawing shall indicate a schematic layout of superstructures and deckhouses taken into account in calculations, location of the reference point for the cross curves of stability as well as the point of ship downflooding.

1.4.4 Plans of Cargo Compartments and Tanks

1.4.4.1 For each cargo space, the plan of cargo compartments shall incorporate data stating its capacity and the centre of volume coordinates as well as data which enable determining the centre of mass coordinates of the loaded cargo.

1.4.4.2 The plan of tanks shall incorporate all tanks other than cargo tanks, tables of volumes and the centre of volume coordinates, as well as data necessary to determine the free surface effect on stability. The plan of tanks shall be supplemented with valid sounding tables.

1.4.5 Arrangement Plan of Doors, Companionways and Sidescuttles

1.4.5.1 Arrangement plan of doors and companionways shall include all doors and companionways leading to open decks, as well as all doors and hatches in the shell plating, with reference made to their drawings. The plan shall also include all sidescuttles located below the continuous upper deck, as well as sidescuttles in the superstructures and deckhouses taken into account in calculations of cross curves of stability.

1.4.5.2 Openings considered to be open for which the angle of flooding has been determined shall be indicated on the plan.

1.4.6 Windage Area Calculations

1.4.6.1 Windage area F_w and its static moment shall be calculated for the ship's draught $T_{\min}$.

Windage area for other draughts may be calculated by linear interpolation taking the second point of the draught corresponding to the summer load waterline.

1.4.6.2 Position of the centre of the windage area shall be determined by a method generally used in determining the coordinates of the geometric centre of a plane figure.

1.4.6.3 Windage area includes the projections, on the ship's centre plane, of all continuous walls and surfaces of the hull, superstructures and deckhouses, masts, ventilators, boats, deck machinery, all tents which may be stretched in stormy weather, as well as the projections of lateral surfaces of cargoes to be carried on deck.

It is recommended that the windage area of discontinuous surfaces of rails and rigging (except masts) of ships not provided with sails, as well as the windage area of various small objects should be taken into account by increasing the windage area calculated for draught T_{min} by 5% and the static moment of this area – by 10%.

In order to take into account the windage area of discontinuous surfaces and small objects under icing conditions, the projected lateral area and the static moment of this area, calculated for T_{min}, shall be increased by 7.5% and 15 %.

These increased values of windage areas of discontinuous surfaces and small objects, as well as their static moments shall be assumed constant for all service draughts.

1.4.7 Effect of Free Surfaces of Liquids

1.4.7.1 Ship's static stability characteristics shall take into account, for all loading conditions, the effect of free surfaces of liquids on the position of the ship's centre of mass, the initial metacentric height and the righting levers' curves.

1.4.7.2 When calculating the effect of free surfaces on the ship's stability, account shall be taken of tanks in which free surfaces may occur during the ship's service. To select such tanks, design combinations (sets) of tanks where free surfaces may occur simultaneously shall be assumed and then such a

combination shall be chosen for which the sum of products of the free surface moment of inertia and mass density of a cargo in the tank takes the maximum value.

1.4.7.3 The moment of inertia shall be calculated assuming that a tank is filled in 50% of its capacity.

1.4.7.4 Tanks changing the metacentric height by 0.01 m or less shall not be taken onto account in the calculations.

Liquid cargo residues in empty cargo tanks may be neglected in calculations.

1.4.8 Loading Conditions

1.4.8.1 Ship's stability shall be checked for all the loading conditions specified in Chapter 3 for particular ship types.

1.4.8.2 In the case of ships, for which no special requirements are specified in Chapter 3, the stability shall be calculated for the following loading conditions:

.1 ship in the fully loaded condition, with full stores;
.2 ship in the fully loaded condition, with 10% stores;
.3 ship without cargo, however with full stores;
.4 ship without cargo and with 10% stores.

1.4.8.3 If the loading conditions, anticipated in the ship's normal service, are worse in respect of stability than those specified in 1.4.8.2 or required in Chapter 3, then for each such loading condition the stability shall also be checked.

1.4.8.4 If there is permanent ballast on board, its mass shall be included in the lightweight of the ship.

1.4.9 Stability Curves

1.4.9.1 For all loading conditions considered, static and dynamic stability curves shall be prepared taking account of the free surface corrections.

1.4.9.2 If in the ship side, upper deck or superstructures there are openings considered to be open, through which water may penetrate into the ship hull, then the stability curves are considered as reliable only in respect of angle of heel corresponding to the downflooding angle. For the heeling angles exceeding the angle of downflooding, it shall be assumed that the ship has no stability at all, and the stability curves have their end at such a point.

1.4.9.3 If the spread of water, coming to a superstructure through openings considered to be open, is limited to this superstructure or a part thereof, such superstructure or its part shall be considered as non-existent at the angles of heel exceeding the angle of flooding. In that case, the static stability curve shall be stepped and the dynamic stability curve – broken.

1.4.10 Stability Check-related Documentation

1.4.10.1 For consideration by PRS, the following documentation related to the stability check and damage stability check (if required) shall be submitted: calculations for loading conditions, initial stability calculations, stability curves, calculations of windage areas and their centres, calculations of angles of heel due to crowding of passengers towards one side, calculations of the angles of heel resulting from the centrifugal force due to the ship's turning, icing calculations, etc.

1.4.10.2 The results of calculations of displacement, initial stability and trim for all the loading conditions shall be compiled in tables of results. The tables shall also contain the results of the stability check for conformity with the requirements specified in this part of the *Rules*.

1.4.10.3 For consideration by PRS, the following shall be submitted: a curve of minimum operating metacentric height or a curve of the height of the centre of mass depending on the ship's displacement or

draught to enable assessment whether the requirements of this part of the *Rules* are fulfilled in all loading conditions.

1.4.10.4 Where stability calculation programs are used aboard for normal operating conditions and the possible damage, such programs shall fulfil the requirements specified in *Publication No. 66/P – Onboard Computers for Stability Calculations*. These programs are subject to PRS approval.

1.4.11 Stability Booklet

1.4.11.1 The ship shall be provided with reliable information and appropriate means to enable the master to obtain, by simple and rapid processes, data on the ship's stability in varying operating conditions.

1.4.11.2 Each ship shall be provided with the *Stability Booklet* approved or recognised by PRS in accordance with the provisions. The *Stability Booklet* shall contain guidelines and principles for the ship operation in accordance with the requirements specified in this part of the *Rules*.

1.4.11.3 Stability booklet and the related documentation shall be drawn up in the working language of the ship. If the language used is not English and the ship is engaged on international voyages, stability booklet shall be translated into English and also approved.

1.4.11.4 The form and scope of the *Stability Booklet* shall conform to the ship type and operating conditions.

1.4.11.5 Assessment of the ship's stability shall be based on the approved diagram or print-out of the permissible values of the vertical coordinate of the ship's centre of mass (KG_{max}), determined taking into account all the required criteria (specified in this part of the *Rules*) and including the whole operation range of the ship's displacement and draught.

1.4.11.6 *Stability Booklet* shall also contain:

- **.1** ship identification data (name of ship, port of registry, shipyard, number of build, date of build, main dimensions, operating area, maximum mean permissible draught, deadweight, number of crew, number of passengers, ship's lightweight and the position of the lightweight centre of mass);
- **.2** specification of stability criteria taken for stability assessment and short characteristics of the ship's stability;
- **.3** data on the ship's stability in typical loading conditions (general arrangement plan of the ship indicating the stowage of stores, cargo, etc., calculations of stability parameters, draughts, stability curves);
- **.4** guidance on loading, weather and other restrictions associated with design features or ship's operation, necessary to ensure the safety of the ship as regards stability;
- **.5** instructions and auxiliary diagrams facilitating assessment of the ship's stability in loading conditions other than those specified in the *Stability Booklet* (where applicable);
- **.6** guidance and instructions on the proper use of the means of stability safety improvement or special action resulting from the ship's structural features (for fishing vessels – see paragraph 3.4.8);
- **.7** plan of permanent ballast, where provided;
- **.8** inclining test report of the ship or of a sister ship, which was the basis for assuming the light ship parameters;
- **.9** freeboard calculations in accordance with the requirements specified in Chapter 5.

Note: When considering the form and editorial quality of the *Stability Booklet,* due regard shall be paid to its intended many years' usage.

1.4.11.7 *Stability Booklet* shall contain a statement that fulfilment of the requirements and guidance on the ship stability does not provide immunity against the loss of stability or capsizing unless the prevailing circumstance of ship operation is taken into consideration properly and does not absolve the master/skipper from his responsibility for the safety of the ship and from the necessity to use good seamanship.

1.4.11.8 For ships less than 20 m in length, the *Stability Booklet* shall contain information on the permissible speed of ship and rudder angle at the commencement of ship turning.

The permissible speed of ship and ruder angle at the commencement of ship turning are determined experimentally during the ship delivery tests. The angle of heel shall not exceed the angle of downflooding the continuous upper deck or 12°, whichever is lesser.

1.4.11.9 *Stability Booklet* of a ship less than 20 m in length, irrespective of her intended service, shall contain indication that speed, v_s, of ship when navigating at following sea where the wave length is not less than the length of ship shall never exceed the value determined in accordance with the formula below:

$$v_s = 1.4\ \sqrt{L},\ \text{[knots]} \qquad (1.4.11.9)$$

L – length of ship, [m].

1.4.11.10 *Stability Booklet* shall be developed based on the inclining test.

For series-constructed ships, the *Stability Booklet* shall be prepared based on the inclining tests of the first ship of each group of five ships.

Stability Booklet of the first ship of the first of any five ships may be used for a ship of another group provided that variation in the light ship displacement determined through the inclining tests does not exceed 2%, and the vertical position of the ship's centre of gravity has not risen by more than the value calculated in accordance with the requirements specified in paragraph 1.5.2.2 and if the requirements specified in this part of the *Rules* are fulfilled.

In that case, the light ship displacement and vertical position of the light ship's centre of gravity determined through the inclining test for the first ship of the particular group shall be taken into account while preparing the *Stability Booklet*.

1.5 Inclining Test

1.5.1 Inclining test shall be performed for each:

.1 new non-series-constructed ship;

.2 ship after alteration;

.3 ship after major repair, repeated outfitting or modification – in accordance with the requirements specified in paragraph 1.5.3;

.4 ship where permanent ballast has been placed of supplemented – in accordance with the requirements specified in paragraph 1.5.4.

1.5.2 Where ships are constructed in series by the same shipyard, inclining test shall be performed for:

.1 the first ship, and then for every fifth ship of the constructed series (i.e. the sixth, the eleventh, etc.), except for the cases specified in paragraph 1.5.5;

.2 a series-constructed ship, where the modification – compared to the ship subjected to the inclining test in accordance with the requirements specified in paragraph 1.5.2.1 – caused the following changes:

- variation of the light ship displacement by more than 2%, or
- vertical position of the light ship's centre of gravity has risen by more than 2% or 4 cm – whichever is lesser, or
- the requirements specified in this part of the *Rules* are not fulfilled in the most unfavourable, in respect of stability, loading condition.

Such a series-constructed ship shall be considered, in respect of stability, as the first one, and the order of the inclining tests for subsequent ships shall fulfil the requirements specified in paragraph 1.5.2.1.

1.5.3 Following a major repair, repeated outfitting or modification, an inclining test shall be performed for those ships whose structural alterations determined by calculations result in:

- mass variation (total of the deducted and added masses) by more than 6% of the lightweight of the ship; or
- variation in the lightship displacement by more than 2%; or

– rise of the vertical position of the lightship's centre of gravity by more than specified in paragraph 1.5.2.2; or
– non-compliance with the requirements specified in this part of the *Rules* for the changed parameters in the most unfavourable, in respect of stability, loading condition.

Irrespective of the submitted calculations, PRS may require that an inclining test be performed taking account of the ship technical condition.

1.5.4 Each ship in which permanent ballast has been arranged shall be subjected to an inclining test. The inclining test may be waived where:
– PRS finds that during the series construction of ships both ship weight and position of the ballast centre of mass have not changed,
– it is possible to accurately determine the position of ballast supplemented after the previously performed inclining test and the mass of such additional ballast does not exceed 2% of the lightweight ship.

1.5.5 Each passenger ship shall be subjected to periodical check of the light ship mass every five years. If variation in the mass of light ship exceeds 2% or in the longitudinal position of the light ship mass centre exceeds 1% of the ship length compared to the approved and applied light ship parameters before such a check, the inclining test shall be performed.

1.5.6 If the results of the inclining test of the series-constructed ship indicate that her lightweight displacement differs from that stated for the ship previously subjected to the inclining test by more than 2%, and the vertical position of the light ship's centre of gravity has risen by more than the value determined in accordance with the requirements specified in paragraph 1.5.2.2, then the reasons for such change supported by calculations together with the inclining test report shall be submitted to PRS.

Based on the above mentioned calculations, or in the case such calculations are unavailable, PRS may increase the number of ships, specified in paragraph 1.5.2.1, which are subject to the inclining test.

1.5.7 If the requirements specified in this part of the *Rules* are fulfilled for the vertical position of the light ship's centre of gravity higher than the calculated value by 20%, then PRS may waive the inclining test upon the Owner's request.

1.5.8 The ship load during the inclining test shall be as far as possible close to her light weight displacement. Mass of the subtracted elements shall not exceed 2% of the light ship displacement and the mass of the superfluous elements, without shifting ballast as well as the ballast in accordance with the requirements specified in paragraph 1.5.9 shall not exceed 4% of the lightweight of the ship.

1.5.9 Metacentric height during the inclining test shall not be less than 0.2 m. For this purpose, necessary amount of ballast may be taken. In the case of water ballast, the tanks shall be filled to the full.

1.5.10 To determine the angles of heel, at least two plumb lines or at least two devices approved by PRS shall be used.

1.5.11 Where the inclining test has been performed properly, the obtained value of the metacentric height may be taken for calculations without subtracting the probable error of the test.

The inclining test is considered to have been performed properly if:

.1 for each inclination, the following requirement is fulfilled:

$$\overline{GM}_i - \overline{GM}_k \le 2 \sqrt{\frac{\sum(\overline{GM}_i - \overline{GM}_k)^2}{n-1}} \qquad (1.5.11.1)$$

$\overline{GM_i}$ – metacentric height obtained from individual values of inclination, [m];

$\overline{GM_k}$ – inclining test metacentric height, [m];

n – number of measurements.

Measurements, for which the above condition is not fulfilled, are not taken into account in the repeated calculations of the metacentric height $\overline{GM_k}$.

.2 probable test error, $w \cdot t_{\alpha n}$, fulfils the following conditions:

$$w \cdot t_{\alpha n} = (0.02/(1 + \overline{GM_k})) \text{ for } \overline{GM_k} \leq 2 \text{ m} \quad (1.5.11.2\text{-}1)$$

and

$$w \cdot t_{\alpha n} = 0.04\ \overline{GM_k} \text{ for } \overline{GM_k} > 2 \text{ m} \quad (15.11.2\text{-}2)$$

$t_{\alpha n}$ – factor determined in accordance with Table 1.5.11.2;

$$\text{w} = \sqrt{\frac{\sum(\overline{GM}_i - \overline{GM}_k)^2}{n(n-1)}}$$

.3 the number of correct measurements is not lesser than 8.

.4 Where more than one measurement do not fulfil the condition specified in 1.5.11.1, this shall be agreed with PRS.

Table 1.5.11.2

n	6	7	8	9	10	11	12	13	14	15	16
$t_{\alpha n}$	6.9	6.0	5.4	5.0	4.8	4.6	4.5	4.3	4.2	4.1	4.0

1.5.12 Where the requirements specified in paragraph 1.5.11 are not fulfilled, the value of the metacentric height obtained during the inclining test, with the probable error determined according to 1.5.11.2 deducted, may be taken for calculations subject to PRS agreement.

1.5.13 Inclining tests shall be witnessed by PRS Surveyor and performed in accordance with the principles specified in *Publication No. 6/P – Stability*.

Inclining test may also be performed the other way if PRS is submitted a proof that reliability of the test results fulfil the requirements contained in this part of the *Rules*.

1.6 Departures from *Rules*

1.6.1 If, despite her compliance with the requirements of this part of the *Rules*, any ship raises doubts in respect of her stability, or if the requirements of this part of the *Rules* are considered as too strict, then PRS may, on their own initiative or upon the designer's or Owner's justified request, agree on appropriate departures from the requirements contained in this part of the *Rules* for such a ship.

1.6.2 Where a ship with a particular operating area mark does not fulfil the requirements of this part of the *Rules*, PRS may restrict the operating area for an individual ship or apply other restrictions depending on the ship stability parameters, as well as her operating conditions and intended service.

1.6.3 For fishing vessels, the value of the required maximum static stability arm GZ_{max} can be reduced to 0.225 m at an angle of heel not less than 25° if the value of the static stability arm GZ is at least 0.20 m at the angle of heel of 30°.

1.7 Stability Criteria

Stability of ships in all loading conditions shall fulfil the following requirements:

.1 remaining not capsized, the ship shall resist simultaneous dynamic wind pressure and heeling of the parameters specified in Chapter 2;

.2 the values of the static stability curve parameters in still water shall not be less than those specified in Chapter 2;

.3 the impact of icing on the ship stability shall be taken into account in accordance with the requirements specified in Chapter 2;

.4 ship stability shall fulfil additional requirements specified in Chapter 3 for a particular type of ship;

.5 in the case of ships which should remain floatable in damaged condition in accordance with the requirements specified in Chapter 4, their intact stability shall be such that in the damaged condition the floatability and damage stability requirements are fulfilled.

1.8 Passage or Towage

1.8.1 Ship stability during passage or towage shall fulfil general requirements for the operating area in which the ship will pass or be towed.

1.8.2 Where the ship does not fulfil the stability requirements specified in paragraph 1.8.1, the ship may be permitted to undertake the passage or towage subject to PRS agreement and on condition that weather restrictions are applied.

2 GENERAL STABILITY REQUIREMENTS

2.1 Basic Criteria

2.1.1 Ship stability is considered sufficient, in respect of the basic criterion, K, unless in all service loading conditions the heeling moment, M_w, caused by the dynamic wind pressure exceeds the capsizing moment M_{kr}, i.e. if the following equation is fulfilled:

$$M_w \leq M_{kr}$$

or

$$K = \frac{M_{kr}}{M_w} \geq 1.0 \qquad (2.1.1)$$

For ships intended for operation in heavy seas (e.g. weather observation ships), the basic criterion value, K, is subject to PRS consideration; it is, however, recommended that it should not be less than 1.5.

2.1.2 For ships of restricted service **III**, except for rescue ships and passenger ships, the ship stability in respect of the basic criterion, K, need not be checked.

2.1.3 Stability of fishing vessels, irrespective of their operating area, shall be additionally checked in respect of the basic criterion, K, in accordance with the requirements specified in paragraphs 3.4.4 and 3.4.5.

2.2 Heeling Moment due to Wind Pressure

2.2.1 Heeling moment due to wind pressure M_w shall be determined in accordance with the following formula:

$$M_w = 0{,}001\ q_w\ F_w\ z \quad \text{[kN m]} \qquad (2.2.1)$$

q_w – wind pressure, [Pa];
F_w – windage area, [m^2];
z – design arm of wind pressure (to the waterline plane), [m].

The value of the wind heeling moment shall be taken constant within the full range of the ship's inclination.

2.2.2 The value of the wind pressure q_w shall be taken in accordance with Table 2.2.2, depending on the ship navigation area and design arm of wind pressure z.

2.3 Angle of Roll

2.3.1 For a round-bilged ship having no bilge or bar keel, the angle of roll shall be determined in accordance with the following formula:

$$\theta_a = X_1\ X_2\ Y \quad \text{[degrees]} \qquad (2.3.1)$$

The values of factor Y shall be taken in accordance with Table 2.3.1-1 depending on the operating area and ratio $\sqrt{GM_0}\ /\ B$, (GM_0 – metacentric height uncorrected for free surface effects, B – moulded breadth). The values of factor X_1 shall be taken in accordance with Table 2.3.1-2 depending on ratio B/T.

The values of factor X_2 shall be taken in accordance with Table 2.3.1-3 depending on the block coefficient of the underwater part of hull, δ.

Table 2.2.2
Wind pressure, q_w, Pa

Operating area \ z, m	0.5	1.0	2.0	3.0	4.0
I	365	402	490	549	588
II	177	196	235	265	284
III	124	137	165	185	199

Table 2.3.1-1
Factor Y, degrees

$\frac{\sqrt{GM_o}}{B}$	0.04 and less	0.05	0.06	0.07	0.08	0.09	0.10	0.11	0.12	0.13 and more
Operating areas I and II	16.0	17.0	19.7	22.8	25.4	27.6	29.2	30.5	31.4	32.0

Table 2.3.1-2
Factor X_1

B / T	2.4 and less	2.5	2.6	2.7	2.8	2.9	3.0	3.1	3.2	3.3	3.4	3.5 and more
X_1	1.00	0.98	0.95	0.95	0.93	0.91	0.90	0.88	0.86	0.84	0.82	0.80

Table 2.3.1-3
Factor X_2

δ	0.45 and less	0.50	0.55	0.60	0.65	0.70 and more
X_2	0.75	0.82	0.89	0.95	0.97	1.00

2.3.2 For ships having bilge keel, a bar keel or both, the angle of roll shall be determined in accordance with the following formula:

$$\theta_a' = k\,\theta_a \quad \text{[degrees]} \qquad (2.3.2)$$

The values of coefficient k shall be taken in accordance with Table 2.3.2 depending on ratio $\frac{F_k}{LB}$ (F_k – total overall area of bilge keels, or area of the lateral projection of the bar keel, or sum of these areas, [m^2]).

Table 2.3.2
Factor k

$\frac{F_k \cdot 100}{LB}$,%	0	1.0	1.5	2.0	2.5	3.0	3.5	4.0 and more
k	1.00	0.98	0.95	0.88	0.79	0.74	0.72	0.70

2.3.3 Rolling angle of ships having sharp bilge shall be taken as 70% of the value determined in accordance with formula 2.3.1.

2.3.4 The rolling angle values may be rounded to the integer number of degrees.

2.4 Static Stability Curve

2.4.1 Maximum static stability lever, GZ_m, shall not be less than 0.25 m for the heel angle not less than 30°.

2.4.2 Where the static stability curve has two maxima due to superstructures or deckhouses, the first maximum shall occur at an angle not less than 25°.

2.4.3 Positive static stability range shall not be less than 60°.

2.4.4 In ships with ratio $B/H > 2$, the positive range and angle which correspond to the maximum of the static stability curve may be lesser than required in paragraphs 2.4.1, 2.4.2 and 2.4.3, by the following values:

.1 for the curve range – by the value of angle $\Delta\theta$ determined in accordance with the formula below:

$$\Delta\theta = 20\ (B/H - 2) \quad \text{[degrees]} \qquad (2.4.4.1)$$

however by not more than 10^{o};

.2 for the angle corresponding to the static stability curve maximum – by the value equal to the half of the range positive angle.

2.4.5 Ships shall fulfil the requirements for static stability curves specified in paragraphs 2.4.1 to 2.4.4, taking account of the corrections for free surface effects on the static stability curves in accordance with the requirements specified in paragraph 1.4.7.

2.5 Metacentric Height

2.5.1 Metacentric height corrected for free surface effects in all loading conditions, except for the light ship, shall be as follows:

.1 not less than 0.35 m for fishing vessels of more than 20 m in length,

.2 not less than 0.5 m for other ships.

2.5.2 Metacentric height of the light ship may be determined taking account of trim. In that case such height shall be positive.

2.6 Icing

2.6.1 For ships intended for winter navigation, stability shall be checked taking account of icing in accordance with the requirements specified in this sub-chapter.

2.6.2 Ship stability in icing conditions shall be performed for the most unfavourable, in respect of stability, expected loading condition taking account of the variation in the light ship displacement, position of the centre of mass and windage area due to icing.

The mass of ice shall be regarded as an additional mass, not included in the ship's deadweight.

2.6.3 Mass of ice per square metre of the total area of horizontal projection of exposed weather decks shall be taken equal to 15 kg. Total horizontal projection of these decks shall include horizontal projections of all exposed decks and gangways, irrespective of awnings above them. The moment due to this loading related to the waterline shall be determined for heights of the centres of mass of the corresponding areas of decks and gangways above the waterline.

Deck machinery, arrangements, hatch covers, etc. are assumed to be included in the projection of decks and shall not be taken into account separately.

2.6.4 Mass of ice per square metre of the windage area shall be taken equal to 7.5 kg. The windage area and the position of its centre of mass shall be determined for draught T_{min} in accordance with the requirements specified in sub-chapter 1.4.6.

2.6.5 Mass of ice and the moment related to the base plane, calculated in accordance with the requirements specified in paragraphs 2.6.3 and 2.6.4, shall be taken into account for all loading conditions contained in the *Stability Booklet*.

2.6.6 Static stability curve range, taking account of icing, shall not be less than 55°, and the maximum static stability lever (GZ_m) – not less than 0.2 m at the angle of heel not less than 25°.

For ships with ratio $B/H > 2$, the static stability curve range may be reduced by the half of the value specified in paragraph 2.4.4.1.

3 ADDITIONAL STABILITY REQUIREMENTS

3.1 Dry Cargo Ships

3.1.1 Stability of dry cargo ships shall be checked for the following loading conditions:

.1 ship having a draught to the summer load waterline with cargo homogeneously distributed in the holds, with full stores;

.2 ship in the same condition as in .1, however with 10% stores and water ballast;

.3 ship without cargo and with full stores;

.4 ship in the same condition as in .3, however with 10% stores.

3.1.2 Where ships are normally engaged in the carriage of deck cargoes, the stability shall be checked for the following additional conditions:

.1 ship loaded to the summer load waterline, with holds filled with homogeneous cargo, with deck cargo and full stores;

.2 ship in the same condition as in .1, however with 10% stores.

3.2 Passenger Ships

3.2.1 General Requirements

3.2.1.1 Stability of passenger ships shall be checked for the following loading conditions:

.1 ship with the crew and 100% stores

.2 ship with the crew and 50% stores

.3 ship with the crew and 10% stores

.4 ship in the same conditions as in .1, .2 and .3 + 100% passengers

.5 ship in the same conditions as in .1, .2 and .3 + 50% passengers.

Where more unfavourable than the above mentioned loading conditions – in respect of the ship stability – are expected during the ship service, then the ship stability shall also be checked.

For the loading conditions mentioned in .4 and .5, *Passengers' Disposition Plan* shall be prepared taking account of such alternative arrangements for which the stability requirements specified in sub-chapter 3.2.2 or 3.2.3 are fulfilled.

In the *Passengers' Disposition Plan*, the requirements specified in sub-chapter 9.1 of *Part III – Hull Equipment* shall also be taken into account .

3.2.1.2 As regards passenger ships who are intended to be assigned additional mark **pas A** or **pas B** in the symbol of class, the requirements specified in sub-chapter 3.2.2 apply.

3.2.1.3 As regards passenger ships who are intended to be assigned additional mark **pas C** or **pas D** in the symbol of class, the requirements specified in sub-chapter 3.2.3 apply.

3.2.1.4 In passenger ships who are intended to be assigned additional mark **pas A**, **pas B** or **pas C** in the symbol of class, seats shall be provided for all passengers irrespective of the seats on exposed weather decks.

3.2.2 Passenger Ships with Additional Mark pas A or pas B

3.2.2.1 Irrespective of the requirements specified in Chapters 1 and 2, passenger ships who are intended to be assigned additional mark **pas A** or **pas B**, shall fulfil the following requirements:

.1 for crowding of all passengers towards one side, the angle of heel shall not exceed 10°.

.2 for crowding of passengers towards one side and simultaneous static action of the heeling moment due to wind, the angle of heel shall exceed neither 12° nor the angle of deck downflooding.

.3 angle of heel resulting from simultaneous action of the heeling moment due to crowding of all passengers towards one side and the heeling moment due to turning shall exceed neither 12° nor the angle of deck downflooding.

3.2.2.2 Heeling moment due to crowding of passengers towards one side, M_p, shall be determined in accordance with the following formula:

$$M_p = 10Pa, \quad \text{[kNm]} \quad (3.2.2.2)$$

P – mass of all passengers, [t];
a – lever of passengers' crowding towards one side, [m].
To determine the number of passengers crowding towards one side, the following assumptions shall be made:

– number of passengers in accordance with the *Passengers' Disposition Plan*;
– passengers distribution density – 4 persons per square metre of the deck area;
– height of the centre of mass for standing passengers – 1.10 m above the deck;
– height of the centre of mass for sitting passengers – 0.3 m above the seats;
– mass of each passenger – 75 kg;
– passages between seats of less than 0.7 m in width shall be taken for calculations with the factor 0.5.

3.2.2.3 Heeling moment caused by the wind pressure shall be determined in accordance with the requirements specified in sub-chapter 2.2.1 taking:
– q_w = 450 Pa for ships with additional mark **pas A**
– q_w = 400 Pa for ships with additional mark **pas B**.

3.2.2.4 Heeling moment due to turning, M_c, shall be determined in accordance with the following formula:

$$M_c = \frac{0.2Dv^2}{L}\left(Z_G - \frac{T}{2}\right) \quad \text{[kNm]} \quad (3.2.2.4)$$

D – ship displacement, [t];
v – rated speed, [m/s];
Z_G – height of the centre of mass corrected for the effects of free surfaces, [m].

3.2.2.5 Irrespective of the above mentioned additional requirements, the relevant requirements specified in Chapter 4 shall be fulfilled.

3.2.3 Passenger Ships with Additional Mark pas C or pas D

3.2.3.1 Irrespective of the requirements specified in Chapters 1 and 2, passenger ships who are intended to be assigned additional mark **pas C** or **pas D** (provided with seats in enclosed spaces for all passengers) in the symbol of class, shall fulfil the requirements specified in paragraphs 3.2.2.1 to 3.2.2.4, and for the calculation of the heeling moment caused by the wind pressure the following assumptions shall be taken:
– q_w = 350 Pa for ships with additional mark **pas C**
– q_w = 300 Pa for ships with additional mark **pas D**.

3.2.3.2 Passenger ships carrying passengers only on exposed weather decks or not provided with seats for all passengers in enclosed spaces may be assigned additional mark **pas D** in the symbol of class with the operating area restriction entered in the Certificate of Class if the following requirements are fulfilled:

.1 for crowding of all passengers towards one side, the angle of heel shall not exceed 10°;
.2 for crowding of passengers towards one side and simultaneous static action of the heeling moment due to wind, the angle of heel shall exceed neither 12° nor 80% of the angle of deck downflooding;
.3 angle of heel resulting from simultaneous action of the heeling moment due to crowding of all passengers towards one side and the heeling moment due to turning shall exceed neither 12° nor 80% of the angle of deck downflooding;
.4 freeboard shall be at least such that 0.2 m of the residual freeboard of the immersed side is maintained in the case of crowding of passengers towards one side and static wind pressure and in the case of crowding of passengers towards one side and ships turning.

Heeling moments shall be calculated in accordance with the requirements specified in paragraphs 3.2.2.2 to 3.2.2.4.

3.2.3.3 Passenger ships assigned additional mark **pas D** flying decorative sails shall fulfil the following additional requirements:

.1 maximum actual area S of all sails considered as decorative shall not exceed:

$$S = 5 \times D^{2/3} \quad [\text{m}^2]$$

where: D – ship maximum displacement, [t].

.2 decorative sails may be used at a wind force not exceeding 4°B. Arrangements operable from the deck shall be provided for ready furling or lowering of the decorative sails. Decorative sails may be used only when the main engine is in operation. Decorative sails shall not be used in port or while manoeuvres of port call or leaving the port;

.3 masts and rigging shall fulfil the requirements specified in the Rules for Classification and Construction of Sea-going Yachts;

.4 the Stability Booklet shall contain two additional loading conditions: with 10% and with 100% stores for the most unfavourable disposition of passengers. In such conditions, additional wind pressure on the set sails shall be taken into account. The sail windage area shall be calculated as of projection of the sail surface, in the position closest to the ship centre plane, on the ship's plane of symmetry. In such additional loading conditions, the following criteria shall be fulfilled:

.4.1 static angle of heel due to crowding of passengers towards one side and due to wind pressure on the windage area including sails shall exceed neither 12° nor 0.8, i.e. the following condition shall be fulfilled:

$$\varphi_p + \varphi_w \leq 12\,^\circ \text{ or } 0.8\varphi_{Zp}$$

(whichever is lesser)

In the calculations, wind pressure 0.3 kPa shall be taken.

.4.2 residual freeboard shall not be less than 0.2 m, i.e. the following condition shall be fulfilled:

$$WB_\varphi \geq 0.2\,\text{m}$$

where:

φ_p – static angle of heel due to crowding of passengers towards one side, [degrees]

φ_w – static angle of heel due to wind pressure on the windage area including sails, [degrees]

φ_{Zp} – angle of deck downflooding, [degrees]

WB_φ – residual freeboard, [m].

3.2.3.4 Irrespective of the above mentioned additional requirements, the relevant requirements specified in Chapter 4 shall be fulfilled.

3.3 Non-passenger Ships Carrying not more than 12 Passengers

3.3.1 Stability of ships carrying other persons than the crew shall be checked for the most unfavourable expected loading conditions required in this Chapter for a particular type of ship.

3.3.2 Initial stability of ships mentioned in paragraph 3.3.1 shall be such that the static angle of heel due to crowding of all persons other than the crew on the uppermost deck towards one side as close as possible to the bulwark exceeds neither the angle corresponding to the residual freeboard equal to 0.1 m nor 12°, whichever is lesser.

3.3.3 When determining the angle of heel in accordance with the requirements specified in paragraph 3.3.2, the mass of each person shall be assumed to be 75 kg, their distribution density – 4 persons per square metre of the deck area and the height of the centre of mass for standing persons 1.1 m above the deck.

3.3.4 Calculation of the static angle of heel in accordance with the requirements specified in paragraph 3.3.2 shall be made with no regard to icing, however taking account of the free surface effects in accordance with the requirements specified in sub-chapter 1.4.7.

3.3.5 For all passengers carried in operating area **I** or **II**, seats shall be provided in enclosed spaces.

3.4 Fishing Vessels

3.4.1 Stability of fishing vessels shall be checked in the following loading conditions:

- **.1** departure for fishing grounds with full stores;
- **.2** arrival at home port with full catch in hold and on deck (where provision for deck catch cargo has been made) and 10% stores;
- **.3** arrival at home port with 20% of full catch in holds or/and on deck (where provision for deck catch cargo has been made), with 70% of ice and salt rating and 10% stores;
- **.4** other more unfavourable, in respect of stability, expected conditions.

3.4.2 The amount of full catch (in tonnes) shall be determined depending on the vessel's type, capacity of cargo holds and the characteristics of the vessel's stability. This shall correspond to the permissible draught accepted by PRS and shall be clearly indicated in both the stability calculations and *Stability Booklet*.

3.4.3 For net fishing vessels, allowance shall be made for wet fishing nets on deck in loading conditions specified in 3.4.1.2 and 3.4.1.3.

3.4.4 Stability of the fishing vessel in the fishing conditions shall be checked against the basic criteria for the following loading condition: vessel on the fishing ground with no catch cargo in holds with open hatches, with the catch and wet fishing nets on deck, with 25% of stores and full stock of ice and salt. For vessels where nets and catch are hauled in with the help of cargo booms, account shall also be taken of the hoisted cargo of a mass equal to the rated hoisting capacity of the boom. The mass of catch allowed to be stowed on deck shall be specified in the *Stability Booklet*.

3.4.5 The angle of roll shall be taken equal to 10° in the loading condition specified in paragraph 3.4.4, and the angle of heel for which the hatch cover becomes immersed shall be taken as the downflooding angle of openings considered to be open. Wind pressure in such loading condition shall be taken in accordance with the requirements specified for operating area **III**.

3.4.6 If the curve of static stability for a ship in the loading condition specified in paragraph 3.4.4, cuts short at the angle of flooding, it need not fulfil the requirements in the loading condition specified in paragraphs 2.4.1 and 2.4.3.

The maximum static stability righting lever ships shall not be less than 0.2 m.

3.4.7 Corrected metacentric height for fishing vessels pulling out nets with the catch using booms in the loading condition specified in paragraph 3.4.4 shall be such that the static angle of heel while working with the nets at the outer position of the boom exceeds neither 10° nor the angle of deck downflooding whichever is lesser. For ships less than 20 m in length, metacentric height shall not be less than 0.35 m.

3.4.8 Fishing vessel's *Stability Booklet* shall contain, in addition to the recommendations specified in sub-chapter 1.4.11, guidance and information for the skipper necessary to ensure the safety of the ship as regards stability – see Annex.

3.5 Tugs

3.5.1 Stability of tugs shall be checked in the following loading conditions:

- **.1** with full stores;
- **.2** with 10% stores.

3.5.2 In addition to fulfilment of the requirements specified in Chapter 2, tugs shall have sufficient dynamic stability to withstand the heeling effect of an assumed jerk of the towing line, i.e. the angle of dynamic heel Q_{dh} due to the assumed jerk of the towing line shall exceed neither the downflooding angle nor the capsizing angle, whichever is lesser.

3.5.3 It is assumed that tugs have sufficient dynamic stability to withstand the heeling effect of an assumed jerk of the towing line if the following condition is fulfilled:

$$K_1 = \sqrt{\frac{l_{dk}}{l_{dw}}} \geq 1.00 \tag{3.5.3}$$

K_1 – safety factor;
l_{dk} – dynamic stability lever being an ordinate of the tug dynamic stability curve for the angle of heel equal to the downflooding angle (see paragraph 3.5.5) or the capsizing angle, whichever is lesser, [m];
l_{dw} – dynamic heeling lever characterising the assumed jerk effect of the towing line, [m].

3.5.4 Dynamic heeling lever, l_{dw}, shall be determined in accordance with the following formula:

$$l_{dw} = l_v \left(1 + 2\frac{T}{B}\right)\frac{b^2}{(1+c^2)(1+c^2+b^2)} \quad \text{[m]} \tag{3.5.4-1}$$

c – "dynamic" abscissa of the towing hook suspension point, to be determined from the formula:

$$c = 4.55\ \frac{X_H}{L} \tag{3.5.4-2}$$

X_H – distance between the towing hook suspension and the ship's centre of mass, measured in horizontal plane, [m];
b – "dynamic" ordinate of the towing hook suspension point, to be determined from the formula:

$$b = \frac{\frac{Z_H}{B} - a}{e} \tag{3.5.4-3}$$

Z_H – ordinate of the towing hook suspension point in relation to the base plane, [m];
B – moulded breadth, [m];

$$a = \frac{0.2 + 0.3\left(\frac{2T}{B}\right)^2 + \frac{Z_G}{B}}{1 + 2\frac{T}{B}} \tag{3.5.4-4}$$

$$e = 0.145 + 0.2\ \frac{Z_G}{B} + 0.06\ \frac{B}{2T} \tag{3.5.4-5}$$

$l_v = \frac{v_R^2}{2g}$ – ordinate of the hydraulic pressure load point related to the base plane corresponding to the assumed top velocity v_R [m], determined in accordance with Table 3.5.4 depending on main engine shaft power P, [m].
Z_G – ordinate of the ship's centre of mass above the base plane, [m].

Table 3.5.4
Values of l_v and v_R

P, [Kw]	0÷150	300	450	600	750	900	1050
v_R, [m/s]	1.30	1.33	1.37	1.43	1.55	1.70	1.88
l_v, [m]	0.0862	0.0903	0.096	0.104	0.122	0.147	0.180

3.5.5 When checking the stability of tugs for the towing line transverse jerk effect, the angle of down-flooding shall be determined assuming that all doors leading to the engine casing and boiler casing and to the upper deck superstructure, as well as the doors of all companionways to the spaces below the upper deck, are open, irrespective of the doors design.

3.5.6 When checking the stability of tugs for the towing line transverse jerk effect, no account shall be taken of icing and the effect of free surfaces of liquids in tanks.

3.5.7 Where the tug is provided with special appliances for shifting the towing hook downwards or abaft, with the towing line athwartships, PRS may consider the assumption of X_H and Z_H values other than those specified in paragraph 3.5.4.

3.5.8 For tugs intended for sea towing, the angle of heel due to the towing line jerk under rolling shall not exceed the angle corresponding to the maximum of the static stability curve or the angle of flooding, whichever is lesser (the requirements specified in paragraph 3.5.5 are not applicable to these tugs). Therefore the following condition shall be fulfilled:

$$K_2 = \sqrt{\frac{l_{dm}}{l_{dw}}} - \Delta K \geq 1.00 \qquad (3.5.8\text{-}1)$$

K_2 – safety factor;
l_{dm} – ordinate of the dynamic stability curve at the angle of heel corresponding to the maximum of the static stability curve or the angle of flooding, whichever is lesser, [m];
l_{dw} – dynamic heeling lever determined in accordance with the requirements specified in paragraph 3.5.4, [m], where l_v = 0.200 m shall be taken.

The value of ΔK takes account of the effect of rolling on the resultant angle of heel and shall be determined in accordance with the following formula:

$$\Delta K = 0.03\ \theta'_a \left[\frac{1+c^2}{b} - \frac{1}{e}\left(a - \frac{Z_G}{B} \right) \right] \sqrt{\frac{\overline{GM}_o}{1+2\frac{T}{B}}} \qquad (3.5.8\text{-}2)$$

θ'_a – angle of roll, determined in accordance with the requirements specified in paragraph 2.1.3, [degrees];
$\overline{GM}_0$ – metacentric height, [m];
a, b, c , Z_G, B and *e* – see paragraph 3.5.4.

3.6 Rescue Ships

3.6.1 Stability of rescue ships shall be checked for the following loading conditions:
.1 outfitted vessel with full stores;
.2 outfitted vessel with 50% stores and survivors;
.3 outfitted vessel with 10% stores and survivors.

3.6.2 Rescue ships shall fulfil the requirements contained in Chapter 2, except that:
.1 wind pressure, q_w, shall be taken in accordance with Table 2.2.2, for operating area I;
.2 positive range of the static stability curve shall not be less than 90°.

3.6.3 Rescue ship shall fulfil the requirements specified in paragraph 3.5.8.

3.6.4 Rescue ships shall also fulfil the requirements specified in Chapter 4.

3.7 Auxiliary Vessels and Technical Floating Units

3.7.1 Stability of auxiliary vessels and technical floating units shall be checked for the following loading conditions:
.1 outfitted vessel with full stores;
.2 outfitted vessel with 10% stores;
.3 vessel in typical loading conditions – depending on its purpose and intended service pattern.

3.7.2 Fire-fighting ships shall fulfil the requirements specified in Chapter 2. The sum of angles of dynamic heel caused by the wind pressure and operation of water monitors shall not exceed the deck down-flooding angle (the angle of roll shall not be taken into account).

3.7.3 Pilot craft and worksite craft shall fulfil the requirements specified in Chapter 2. Craft carrying not more than 12 passengers shall fulfil the requirements specified in sub-chapter 3.3.

3.7.4 Diving bases shall fulfil the requirements specified in Chapter 2.

3.7.5 Floating cranes shall fulfil the requirements specified in the current *Rules for the Classification and Construction of Sea-going Ships*.

3.7.6 Dredging fleet ships shall fulfil the requirements specified in the current *Rules for the Classification and Construction of Sea-going Ships*.

3.7.7 Supply ships shall fulfil the requirements specified in the current *Rules for the Classification and Construction of Sea-going Ships*.

3.7.8 Stability requirements for floating pontoons shall be each time agreed with PRS.

3.8 Supply Vessels

3.8.1 Supply vessels shall fulfil the stability requirements specified in IMO Resolution A.469(XII).

4 SUBDIVISION

4.1 Application

4.1.1 The requirements of this Chapter are obligatory for passenger ships and rescue ships, respectively. Other ship types may, on a voluntary basis, comply with the requirements of subchapters 4.2 and 4.3.2.

4.1.2 Compliance with the requirements contained in this Chapter is confirmed by an additional mark **[1]** affixed in the symbol of class.

4.2 General Requirements

4.2.1 Subdivision

4.2.1.1 Ships shall be properly subdivided into watertight compartments.

4.2.1.2 Ship's division into watertight compartments is considered to be proper if the ship fulfils the requirements for subdivision and damage stability after flooding a compartment/ compartments as a result of damage, specified in the present *Rules* for the particular type of ship.

4.2.2 Calculation of Damage Stability Characteristics

4.2.2.1 The volume of water which can flood the ship's compartments and free surfaces shall be calculated to the inner surface of the shell plating.

4.2.2.2 When plotting static stability curves for a damaged ship, enclosed superstructures, deckhouses, deck cargo, the angles of flooding through openings in the ship's sides, decks, bulkheads of hull and superstructures, considered to be open, as well as correction for the effect of free surfaces of liquids shall be taken into account in the same way as shown in sub-chapter 1.4.9 for intact stability curves.

4.2.2.3 Superstructures and deckhouses which sustained damage shall be taken for calculations with adequate permeability only or shall be disregarded. Openings in such structures, leading to spaces which are not flooded, shall be considered as open at the relevant angles of heel only in the cases where they are not provided with weathertight closures.

4.2.2.4 When calculating the draught, heel and trim, as well as damage stability of a damaged ship, the changes in loading conditions of the ship shall be taken into account by substituting adequate amount of sea water in damaged tanks for liquid cargo.

4.2.3 Stability Booklet and Subdivision Booklet

4.2.3.1 *Subdivision Booklet* shall contain requirements and guidance enabling the master to estimate the condition of the ship when its compartment / compartments are flooded and to undertake necessary measures to maintain the damaged ship afloat.

4.3 Basic Requirements for Various Ship Types

4.3.1 Passenger Ships

4.3.1.1 The requirements specified in this sub-chapter apply to passenger ships intended to be assigned additional mark **pas A**, **pas B**, **pas C** or **pas D** in the symbol of class.

4.3.1.2 New passenger ships intended to be assigned additional mark **pas A** in the symbol of class shall fulfil the requirements concerning:

.1 subdivision;
.2 stability parameters of a damaged ship at the final stage of flooding and after equalization, where provided;
.3 stability parameters of a damaged ship at intermediate stages of flooding;
.4 hull watertight integrity,

specified in *SOLAS Convention*, Chapter II-1, Parts A, B, B-1, B-2, B-3 and B-4 (as amended).

4.3.1.3 New passenger ships intended to be assigned additional mark **pas B**, **pas C**, or **pas D** in the symbol of class shall fulfil the requirements concerning subdivision of ships less than 24 m in length specified in *Publication No. 76/P – Stability, Subdivision and Freeboard of Passenger Ships Engaged on Domestic Voyages*.

4.3.1.4 Existing passenger ships intended to be assigned additional mark **pas A**, **pas B**, **pas C** or **pas D** in the symbol of class shall be so subdivided with bulkheads that after one compartment has been flooded due to the hull damage remain afloat in a satisfactory state of equilibrium.

4.3.1.4.1 Existing passenger ship fulfils the conditions of remaining afloat in a satisfactory state of equilibrium if:

.1 metacentric height is not less than 0.1 m at the final stage of flooding,
.2 damage waterline at the final stage of flooding is located below the bulkhead deck and at least 300 mm below the lower edge of any opening through which flooding of other compartments may take place,
.3 the angle of heel at the final stage of unsymmetrical flooding prior to equalization does not exceed 8°,
.4 additionally, for the existing ships with additional class notation **pas A, pas B**, or **pas C**, static stability curve range (at the final stage of flooding after possible equalisation) measured from the position of equilibrium shall not be less than 15°. Maximum righting lever *GZ* (under the curve) shall not be less than 0.1 m.

4.3.1.4.2 For calculations, the following shall be taken:

.1 permeability:
0.85 – for machinery spaces,
0.95 – for empty tanks,
0 – for full tanks,
0.95 or determined through detailed calculation – for other spaces;
.2 extent of damage:
– vertical extent – from the moulded line of the bottom shell plating at centreline upwards without limit,

– transverse extent – *B*/5 m (measured at the level of the deepest waterline),
– longitudinal extent – 3.0 m (measured between afterpeak bulkhead and forepeak bulkhead).

4.3.2 Rescue Ships and Other Ship Types

4.3.2.1 Rescue ships and ships to whom the requirements specified in this Chapter are applicable shall be so subdivided with bulkheads that, after one compartment has been flooded due to the hull damage, remain afloat in a satisfactory state of equilibrium.

4.3.2.2 Rescue ships and ships to whom the requirements specified in this Chapter are applicable are considered to fulfil the condition of remaining afloat in a satisfactory state of equilibrium if:

.1 damage waterline at the final stage of flooding is located below the bulkhead deck;

.2 metacentric height at the final stage of flooding is not less than 0.05 m.

4.3.2.3 Extent of damage and permeabilities shall be taken in accordance with the requirements specified in paragraph 4.3.1.4.2.

5 FREEBOARD

5.1 General Requirements

5.1.1 Freeboard is the distance measured vertically downwards amidships from the upper edge of the maximum loadline to the point where the upper surface of the deck (or its continuation outwards) intersects the outer surface of the shell (or the continuation of shell line).

5.1.2 Ships shall have a readily visible maximum loadline mark assigned in accordance with the requirements specified in this Chapter.

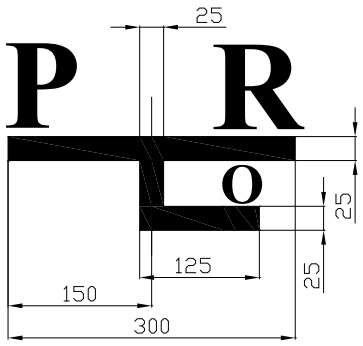
5.2 Maximum Loadline Mark

5.2.1 Maximum loadline mark shall be placed amidships on each side of the ship.

5.2.2 Maximum loadline mark is a line 300 mm in length and 25 mm in breadth whose upper edge indicates the maximum permissible draught of ship. Over the maximum loadline line, the mark of Polski Rejestr Statków in the form of letters P and R having dimensions 115×75 mm (Fig. 5.2.2) shall be placed.

Fig. 5.2.2

5.2.3 *If, for the fishing vessel, two maximum permissible draughts have been assigned:*
– for carrying fish in bulk (in portable bulkheads),
– for transport of fish in packages (in boxes),
the mark of the permissible draught shall be made as shown in Fig. 5.2.3 (drawn for the starboard side), where the upper edge of the line "O" means the maximum draught for the transport of fish in packages.



Size of letters:
P, R – 115 x 75 mm,
O – 40 x 40 mm

Fig. 5.2.3

5.3 Maximum Permissible Draught

5.3.1 Maximum permissible draught of ship shall be assigned taking account of:

.1 strength criteria;

.2 stability criteria;

.3 floatability and damage stability requirements (for ships which fulfil the requirements specified in Chapter 4);

.4 required minimum freeboard (determined in accordance with the requirements specified in sub-chapter 5.4).

5.3.2 The least ship draught out of the values determined taking account of the requirements specified in paragraph 5.3.1 is the maximum permissible draught of ship.

5.3.3 The data enabling placing of permissible draft mark and its monitoring during cutter service shall be included in the *Stability Booklet*.

5.4 Minimum Freeboard

5.4.1 Basic Freeboard

Minimum freeboard of ship shall not be less than the basic freeboard resulting from Table 5.4.1 taking also account of the corrections in accordance with the requirements specified in sub-chapter 5.4.3.

Table 5.4.1
Basic freeboard

Length of ship, [m]	≤ 10	15	20	24
Freeboard, [mm]	306	340	375	400

For intermediate values of length, basic freeboard values shall be determined by interpolation.

5.4.2 Superstructures

5.4.2.1 Standard height of superstructure is 1 m.

5.4.2.2 The design length of superstructures of the standard height or higher shall be assumed as equal to their actual length.

Where the enclosed superstructure height is lower than the standard value, its design length shall be assumed as the actual length reduced proportionally using the actual height to standard height ratio.

5.4.2.3 Where the superstructure constitutes a forecastle, the design length of such a superstructure shall be taken by multiplying the actual length of forecastle by 1.5.

5.4.3 Corrections to Basic Freeboard

5.4.3.1 Where a ship has enclosed superstructures, the freeboard specified in accordance with the requirements specified in 5.4.1 may be reduced by:

5% – for the design length of superstructures equal to 0.2 *L*,

20% – for the design length of superstructures equal to 0.5 *L* or more.

For intermediate values of length, the reductions shall be determined by interpolation.

5.4.3.2 Where height of coamings on the deck are less then the values required in *Part III – Hull Equipment*, the freeboard determined in accordance with the requirements specified in sub-chapter 5.4.1 shall be increased by the difference between the required and actual values of the coaming height. The coaming height values greater than required do not result in the freeboard reduction.

5.4.3.3 Minimum freeboard of fishing vessels shall be such that the deck downflooding angle is not less than 6^{o}.

5.5 Design Requirements for Permissible Draught Assignment

5.5.1 Openings in deck and shell plating shall be provided with effective means of closing ensuring adequate integrity of the spaces below the deck.

5.5.2 Construction and closing arrangements of superstructures, deckhouses, machinery cases, companionways, hatches, skylights, scuttles, air pipes, ventilation heads and openings, as well as openings in side shell including piping and fittings shall fulfil the requirements specified in *Part II – Hull*, *Part III – Hull Equipment* and *Part VI – Machinery and Piping Systems*.

5.5.3 Exposed parts of the deck shall be protected by a bulwark or other barrier of the construction and height in accordance with the requirements contained in *Part II – Hull and Part III – Hull Equipment*.

5.5.4 Bulwark ports shall fulfil the requirements contained in *Part II – Hull*.

5.5.5 In passenger ships, fishing vessels and rescue ships, the bow height measured at the fore perpendicular from the maximum permissible draught waterline to the deck top edge at the side shall not be less then 10% of the length of ship, and the stern height measured at the aft perpendicular shall not be less then 4% of the length of ship. For passenger ships assigned a restricted service mark in the symbol of class or having weather restrictions, the height of bow and stern may be reduced subject to PRS agreement in each particular case.

5.5.6 The required height of bow may be achieved by sheer of deck or forecastle having a length not less than 0.07 of the length of ship or 1.5 m, whichever is lesser.

The required bow height may include bulwark of the required height, however not more than 0.8 m – provided that the bulwark is also vertically continuous and extends for at least 0.15 of the length of ship abaft the forward perpendicular.

6 RETROACTIVE REQUIREMENTS

6.1 Fishing ships constructed before the year 1988 (except for cutters for which the Stability Booklet was not required) shall comply with the requirements of Chapter 5 for assigning and placing the permissible draft mark on ship sides.

6.1.1 The permissible draft mark shall be assigned based on existing documentation, considering the strength and stability conditions in accordance with 5.2.

ANNEX

RECOMMENDATIONS FOR FISHING VESSEL SKIPPER ON VESSEL'S STABILITY

The instructions and information contained in this Annex regarding the vessel's stability considerations shall be included in the *Stability Booklet* although most of them fall into the skipper's responsibilities, skills and professional knowledge.

Instructions on the matters elaborated in detail, e.g. ballasting, deck cargo mass or adopted restrictions shall be specified in detail.

Instructions which are not applicable due to the ship's structural features shall be omitted.

1. Entrances and openings through which water will not penetrate into the hull or deckhouses, forecastles, etc. shall be effectively closed during heavy weather conditions and the closing appliances shall be kept aboard in good order and sufficient number.
2. Hatches and manholes not being used during fishing operations shall be effectively closed and secured.
3. Portable covers for sidescuttles and windows shall be of welded construction and shall be applied to protect those sidescuttles and windows during heavy weather conditions.
4. Fishing equipment and other elements of considerable mass shall be effectively secured and placed as low as practicable under the deck.
5. Special caution shall be exercised during fishing operations considering that the load caused by the outboard fishing equipment endangers the ship stability in case of encountering an obstacle (jerk).
6. The device for releasing the catch carried in bulk on the deck shall be operational and readily operable as required.
7. Bulwark ports provided with closing appliances shall always be operable. They shall not be closed especially during heavy weather conditions.
8. If the deck is adjusted to carry fish in bulk and is therefore divided then the divisions shall be of construction enabling free flow of water to bulwark ports.
9. Carriage of fish in bulk in the holds is not permitted unless it has been checked that the portable divisions in the holds are secured effectively.
10. The number of partially filled tanks shall always be kept to a minimum.
11. The instructions on filling tanks with ballast water shall always be fulfilled considering that partially filled tanks may endanger the ship stability.
12. Closing appliances for air pipes of oil fuel tanks shall be kept in good order and shall be closed effectively during heavy weather conditions.
13. Rudder position fixing (mechanical interlocking) or leaving automatic control of the rudder unattended may pose a risk as it precludes performance of an immediate manoeuvre.
14. It shall be born in mind that following sea and quartering sea endanger the ship stability.
15. Neither ship deadweight nor permissible draught shall be exceeded in any loading condition.
16. In case of icing of a ship, every measure shall be taken to reduce the amount of ice on the decks.

Listing of Changes effective on the 26 November 2021

Item	*Title/Subject*	*Source*
4.1.1	Paragraph has been amended to read	PRS
4.1.2	Paragraph has been amended to read	PRS
4.3.2	Paragraph has been amended to read	PRS
