RUSSIAN MARITIME REGISTER OF SHIPPING

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RULES

FOR THE CLASSIFICATION AND CONSTRUCTION OF HIGH-SPEED CRAFT

PART V

RESERVE OF BUOYANCY AND SUBDIVISION

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RULES FOR THE CLASSIFICATION AND CONSTRUCTION OF HIGH-SPEED CRAFT

Rules for the Classification and Construction of High-Speed Craft of Russian Maritime Register of Shipping (RS, the Register) have been approved in accordance with the established approval procedure and come into force on 1 March 2023.

The present edition of the Rules is based on the 2018 edition taking into account the amendments developed immediately before publication.

The procedural requirements, unified requirements, unified interpretations and recommendations of the International Association of Classification Societies (IACS) and the relevant resolutions of the International Maritime Organization (IMO) have been taken into consideration.

The Rules are published in the following parts:

Part I "Classification";
Part II "Hull Structure and Strength";
Part III "Equipment, Arrangements and Outfit";
Part IV "Stability";
Part V "Reserve of Buoyancy and Subdivision";
Part VI "Fire Protection";
Part VII "Machinery Installations";
Part VIII "Systems and Piping";
Part IX "Machinery";
Part X "Boilers, Heat Exchangers and Pressure Vessels";
Part XI "Electrical Equipment";
Part XII "Refrigerating Plants";
Part XIII "Materials";
Part XIV "Welding";
Part XV "Automation";
Part XVI "Live-Saving Appliances";
Part XVII "Radio Equipment";
Part XVIII "Navigational Equipment";
Part XIX "Signal Means";
Part XX "Equipment for Pollution Prevention";
Part XXI "Craft for Personnel Transportation".

REVISION HISTORY

(Purely editorial amendments are not included in the Revision History)

For this version, there are no amendments to be included in the Revision History.

1 GENERAL

1.1 SCOPE OF APPLICATION

The requirements of Sections 1, 2, 3 of this Part the Rules for the Classification and Construction of High-Speed Craft[1] are mandatory for high-speed craft[2] of all types referred to in 1.1.1 of Part I "Classification" of these Rules.

The requirements of Section 4 of this Part apply to craft referred to in 1.1.1.1 and 1.1.1.2 of Part I "Classification" of these Rules.

[1] Hereinafter referred to as "these Rules".
[2] Hereinafter referred to as "HSC".

1.2 DEFINITIONS AND EXPLANATIONS

Definitions and explanations relating to general terminology are given in in 1.1 of Part I "Classification" of these Rules and in Part V "Subdivision" of the Rules for the Classification and Construction of Sea-Going Ships[1].

[1] Hereinafter referred to as "the Rules for the Classification".

1.3 SCOPE OF TECHNICAL SUPERVISION

For every craft meeting the requirements of this Part, the Register carries out:

.1 verification of structural arrangements taken to ensure subdivision of the craft with the requirements of Parts II "Hull Structure and Strength", III "Equipment, Arrangements and Outfit" and VIII "Systems and Piping" of these Rules;

.2 consideration and approval of Information on Damaged Trim and Stability;

.3 verification of correct assignment and marking of the design waterline.

1.4 GENERAL TECHNICAL REQUIREMENTS

General technical requirements given in 1.4.4 — 1.4.8 and 1.4.10 of Part V "Subdivision" of the Rules for the Classification apply to HSC of all types.

2 INTACT BUOYANCY

2.1 All craft shall have a sufficient reserve of buoyancy at the design waterline to meet the intact and damage stability requirements of this chapter. A craft in the displacement mode at a draught to the design waterline shall have at least 100 % reserve of buoyancy. The Register may require a larger reserve of buoyancy to permit the craft to operate in any of its intended modes.

2.2 The reserve of buoyancy shall be calculated by including only those compartments which are:

.1 watertight and situated below the watertight deck (or an equivalent structure);

.2 watertight or weathertight and situated above the watertight deck (or an equivalent structure);

.3 accepted as having scantlings and arrangements adequate to maintain their watertight integrity.

In considering the stability after damage, flooding shall be assumed to occur until limited by watertight boundaries in the equilibrium condition, and weather- tight boundaries in intermediate stages of flooding and within the range of positive righting lever required to satisfy the residual stability requirements.

2.3 Arrangements for checking the watertight or weatherhight integrity of compartments referred to in 2.2 shall be provided in accordance with Part II "Hull" of the Rules for the Classification.

2.4 Where entry of water into structures above the watertight deck defined in 2.2.1 will significantly influence the craft stability and buoyancy, such structures shall be:

.1 of adequate strength to maintain the weather-tight integrity and fitted with weathertight closing appliances; or

.2 provided with adequate drainage arrangements; or

.3 an equivalent combination of both.

2.5 The means of closing of openings in structures bounding weathertight compartmentsare shall be such as to maintain weathertight integrity of the compartments in all operational conditions.

2.6 Opening in watertight divisions.

2.6.1 The number of doors in watertight bulkheads shall be reduced to the minimum compatible with the design and proper working of the craft, and all such doors shall be closed prior to departure of the craft from the berth.

2.6.2 Doors in watertight bulkheads may be hinged or sliding. They shall be shown by suitable testing to be capable of maintaining the watertight integrity of the bulkhead. Such testing shall be carried out for both sides of the door and shall apply a pressure head 10 % greater than that determined from the minimum permissible height of the downflooding opening. Testing may be carried out either before or after the door is fitted into the craft but where shore testing is adopted, satisfactory installation on the craft shall be verified by inspection and hose testing.

2.6.3 Type approval may be accepted in lieu of testing individual doors, provided the approval process includes pressure testing to a head equal to, or greater than, the required head (refer to 2.6.2).

2.6.4 All watertight doors shall be capable of being operated when the craft is inclined up to 15°, and shall be fitted with means of indication in the operating compartment showing whether they are open or closed. All such doors shall be capable of being opened and closed locally from each side of the bulkhead.

2.6.5 Watertight doors shall remain closed when the craft is at sea, except that they may be opened for access. A notice shall be attached to each door to the effect that it shall not be left open.

2.6.6 Watertight doors shall be capable of being closed by remote control from the operating compartment in not less than 20 s and not more than 40 s, and shall be provided with an audible alarm, distinct from other alarms in the area, which shall sound for at least 5 s but no more than 10 s before the doors begin to move whenever the door is closed remotely by power, and continue sounding until the door is completely closed. The power, control and indicators shall be operable in the event of main power failure. In passenger areas and in areas where the ambient noise exceeds 85 dB(A) the audible alarm shall be supplemented by an intermittent visual signal at the door. If the Register is satisfied that hinged doors are essential for safe work of the craft, such watertight doors having only local control may be permitted for areas to which crew only have access, provided they are fitted with remote indicators as required in 2.6.4.

2.6.7 Where pipes, scuppers, electric cables, etc. are carried through watertight divisions, the arrangements for creating a watertight penetration shall be of a type, which has been prototype tested under hydrostatic pressure equal to or greater than that required to be withstood for the actual location in the craft in which they shall be installed. The test pressure shall be maintained for at least 30 min and there shall be no leakage through the penetration arrangement during this period. The test pressure head shall be 10 % greater than that determined from the minimum permissible height of a downflooding opening. Watertight bulkhead penetrations which are effected by continuous welding do not require prototype testing. Valves on scuppers from weathertight compartments, included in the stability calculations, shall have arrangements for remote closing from the operating station.

2.6.8 Where a ventilation trunk forms part of a watertight boundary, the trunk shall be capable of withstanding the water pressure that may be present taking into account the maximum inclination angle of the damaged craft allowable during all stages of flooding.

2.7 Inner bow doors.

2.7.1 Where ro-ro craft are fitted with bow loading doors, an inner bow door shall be fitted abaft such openings, to restrict the extent of flooding in the event of failure of the outer closure. This inner bow door, where fitted, shall be:

.1 weathertight to the deck above, which deck shall itself be weathertight forward to the bow loading opening;

.2 so arranged as to preclude the possibility of a bow loading door causing damage to it in the case of damage to, or detachment of, the bow loading door;

.3 forward of all positions on the vehicle deck in which vehicles are intended to be carried; and

.4 part of a boundary designed to prevent flooding into the remainder of the craft.

2.7.2 A craft shall be exempted from the requirement 2.7.1 for such inner bow door where one of the following applies.

2.7.2.1 The vehicle loading deck at the inner bow door position is above the design waterline by a height more than the significant wave height corresponding to the worst intended conditions.

2.7.2.2 It can be demonstrated using model tests or mathematical simulations that when the craft is proceeding at a range of speeds up to the maximum attainable speed in the loaded condition at all headings in long crested seas of the greatest significant wave height corresponding to the worst intended conditions, either:

.1 the bow loading door is not reached by waves; or

.2 having been tested with the bow loading door open to determine the maximum steady state volume of water which accumulates, it can be shown by static analysis that, with the same volume of water on the vehicle deck(s) the residual stability requirements are satisfied. If the model tests or mathematical simulations are unable to show that the volume of water accumulated reaches a steady state, the craft shall be considered not to have satisfied the conditions of this exemption.

Where mathematical simulations are employed they shall already have been verified against full-scale or model testing.

2.7.2.3 Bow loading openings lead to open ro-ro spaces provided with guard-rails or having freeing ports complying with 2.7.2.4.

2.7.2.4 The deck of the lowest ro-ro space above the design waterline is fitted on each side of the deck with freeing ports evenly distributed along the sides of the compartment. These shall either proven to be acceptable using tests according to 2.7.2.2 above or comply with the following:

.**1** $A \geq 0{,}3l$ (2.7.2.4.1)

where A = the total area of freeing ports on each side of the deck, in m2;
l = the length of the compartment, in m;

.2 the craft shall maintain a residual freeboard to the deck of the ro-ro space of at least 1 m in the worst condition;

.3 such freeing ports shall be located within the height of 0,6 m above the deck of the ro-ro space, and the lower edge of the ports shall be within 0,02 m above the deck of the ro-ro space; and

.4 such freeing ports shall be fitted with closing devices or flaps to prevent water entering the deck of the ro-ro space whilst allowing water which may accumulate on the deck of the ro-ro space to drain.

2.8 Other provisions for ro-ro craft.

2.8.1 All accesses to the ro-ro space that lead to spaces below the deck shall have a lowest point which is not less than the height required from the tests conducted according to 2.7.2.2 or 3 m above the design waterline.

2.8.2 Where vehicle ramps are installed to give access to spaces below the deck of the ro-ro space, their openings shall be capable of being closed weathertight to prevent ingress of water below.

2.8.3 Accesses in the ro-ro space that lead to spaces below the ro-ro deck and having a lowest point which is less than the height required from the tests conducted according to 2.7.2.2 or 3 m above the design waterline may be permitted provided they are watertight and are closed before the craft leaves the berth on any voyage and remain closed until the craft is at its next berth.

2.8.4 Accesses referred to in 2.8.2 and 2.8.3 above shall be fitted with alarm indicators in the operating compartment.

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

2.9 Indicators and surveillance.

2.9.1 Indicators.

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

2.9.2 Television surveillance.

Television surveillance and a water leakage detection system shall be arranged to provide an indication to the operating compartment and to the engine control station of any leakage through inner and outer bow doors, stem doors or any other shell doors, which could lead to major flooding.

2.10 Integrity of superstructure.

2.10.1 Where entry of water into structures above the bulkhead deck would significantly influence the stability and buoyancy of the craft, such structures shall be:

.1 of adequate strength to maintain the weathertight integrity and fitted with weathertight closing appliances; or

.2 provided with adequate damage arrangements; or

.3 an equivalent combination of both measures.

2.10.2 Weathertight superstructures and deckhouses located above the bulkhead deck shall have in the outside boundaries means of closing openings with sufficient strength such as to maintain weathertight integrity in all damage conditions where the space in question is not damaged. Furthermore, the means of closing shall be such as to maintain weathertight integrity in all operational conditions.

2.11 Doors, windows, etc. in boundaries of weathertight spaces.[1]

2.11.1 Strength of doors, windows, etc., and any associated frames and mullion in weathertight superstructures and deckhouses shall be equivalent to the strength of the structure in which they are fitted, i. e. they shall be weathertight and shall not leak or fail at a uniformly applied pressure to which the structure where they are fitted is designed.

2.11.2 For doors in weathertight superstructures, hose tests shall be carried out with a water pressure 200 kN/m^2 from the outside.

2.11.3 The height above the deck of sills to doorways leading to exposed decks shall be as high above the deck as is reasonable and practicable, particularly those located in exposed positions. Such sill heights shall not be less than 100 mm for doors to weathertight spaces on decks above the bulkhead deck, and 250 mm elsewhere. For craft of 30 m in length and under, sill heights may be reduced to the maximum which is consistent with the safe working of the craft.

2.11.4 Windows shall not be permitted in the boundaries of:

special category spaces; or

ro-ro spaces; or

below the bulkhead deck.

If required by restrictions in the Permit to Operate, forward facing windows, or windows which may be submerged at any stage of flooding shall be fitted with hinged or sliding storm shutters ready for immediate use.

2.11.5 Side scuttles to spaces below the bulkhead deck shall be fitted with efficient hinged deadlights arranged inside so that they can be effectively closed and secured watertight.

2.11.6 No side scuttle shall be fitted in a position so that its sill is below a line drawn parallel to and one metre above the design waterline.

2.12 Hatchways and other openings.[2]

2.12.1 Hatchways closed by weathertight covers.

The construction and the means for securing the weathertightness of cargo and other hatchways shall comply with the following:

.1 coaming heights shall be not less than 100 mm for hatches to weathertight spaces on decks above the bulkhead deck, and 250 mm elsewhere. For the craft of 30 m in length and under, coaming heights may be reduced to the maximum which is consistent with the safe working of the craft;

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[1] For the purpose of this paragraph the word "elsewhere" is applied to all the weathertight and watertight closures located on or below the datum.

[2] For the purpose of this paragraph the word "elsewhere" is applied to all the weathertight and watertight closures located on or below the datum.

.2 the height of these coamings may be reduced, or the coamings omitted entirely, on condition that the Register is satisfied that the safety of the ship is not thereby impaired in any sea conditions up to the worst intended conditions. Where coamings are provided, they shall be of substantial construction; and

.3 the arrangements for securing and maintaining weathertightness shall ensure that the tightness can be maintained in any sea conditions up to the worst intended conditions.

2.12.2 Machinery space openings.

2.12.2.1 Machinery space openings shall be properly framed and efficiently enclosed by casings of ample strength.

2.12.2.2 Height of sills and coamings shall be not less than 100 mm for openings to weathertight spaces on decks above the bulkhead deck, and not less than 380 mm elsewhere. For the craft of 30 m in length and under, these heights may be reduced to the maximum which is consistent with the safe working of the craft.

2.12.2.3 Machinery space ventilator openings shall comply with the requirements of 2.12.4.2.

2.12.3 Openings in exposed decks.

2.12.3.1 Manholes and flush scuttles on the bulkhead deck or within superstructures other than enclosed superstructures shall be closed by substantial covers capable of being made watertight. Unless secured by closely spaces bolts, the covers shall be permanently attached.

2.12.3.2 Service hatches to machinery, etc. may be arranged as flush hatches provided that the covers are secured by closely spaced bolts, are kept closed at sea, and are equipped with arrangements for portable guardrails.

2.12.3.3 Openings in exposed decks leading to spaces below the bulkhead deck or enclosed superstructures other than hatchways, machinery space openings, manholes and flush scuttles shall be protected by an enclosed superstructure, or by a deckhouse or companionway of equivalent strength and weathertightness.

2.12.3.4 The height above the deck of sills to the doorways in companionways shall not be less than 100 mm for doors to weathertight spaces on decks above the bulkhead deck, and 250 mm elsewhere. For the craft of 30 m in length and under, sill heights may be reduced to the maximum which is consistent with the safe working of the craft.

2.12.4 Ventilators.

2.12.4.1 Ventilators to spaces below the bulkhead deck or decks of enclosed superstructures shall have substantially constructed coamings efficiently connected to the deck. Coaming heights shall be not less than 100 mm for ventilators to weathertight spaces on decks above the bulkhead deck, and not less than 380 mm elsewhere. For the craft of 30 m in length and under, coaming heights may be reduced to the maximum which is consistent with the safe working of the craft.

2.12.4.2 Ventilators the coamings of which extend to more than one metre above the deck or which are fitted to decks above the bulkhead deck need not be fitted with closing arrangements unless they face forward.

2.12.4.3 Except as provided in 2.12.4.2, ventilator openings shall be provided with efficient weathertight closing appliances.

2.12.4.4 Ventilator openings shall face aft or athwartships wherever practicable.

2.13 Scuppers, inlets and discharges.

2.13.1 Discharges led through the shell either from spaces below the bulkhead deck or from within superstructures and deckhouses fitted above the bulkhead deck shall be fitted with efficient and accessible means for preventing water from passing inboard. Normally each separate discharge shall have one automatic non-return valve with a positive means of closing it from a position above the bulkhead deck. Where, however, the vertical distance from the design waterline to the inboard end of the discharge pipe exceeds $0{,}01L$, the discharge may have two automatic non-return valves without positive means of closing, provided that the inboard valve is always accessible for examination under service conditions. Where that vertical distance exceeds $0{,}02L$, a single automatic non-return valve without positive means of closing may be accepted. The means for operating the positive action valve shall be readily accessible and provided with an indicator showing whether the valve is open or closed.

2.13.2 Valves on scuppers from weathertight compartments included in the stability calculations shall be operable from the operating compartment.

2.13.3 In manned machinery spaces, main and auxiliary sea inlets and discharges in connection with the operation of machinery may be controlled locally. Such controls shall be readily accessible and shall be provided with indicators showing whether the valves are open or closed. In unmanned machinery spaces, main and auxiliary sea inlet and discharge controls in connection with the operation of machinery shall be:

.1 located at least 50 % of the significant wave height corresponding to the worst operational conditions and measured above the deepest damage waterline with damages defined in accordance with 4.3; or

.2 operable from the operating compartment.

2.13.4 Scuppers leading from superstructures and deckhouses not fitted with weathertight doors shall be led overboard.

2.13.5 All shell fittings and the valves required by the present Rules shall be of a suitable ductile material. Valves of ordinary cast iron or similar material shall not be acceptable.

2.14 Air pipes.

2.14.1 Main storage tanks containing flammable liquids or tanks which can be pumped or filled from the sea shall have air pipes which do not terminate in enclosed spaces.

2.14.2 All air pipes extending to exposed decks shall have a height from the deck to the point where water may have access below of at least 300 mm where the deck is less than 0,05L, above the design waterline, and 150 mm on all other decks.

2.14.3 Air pipes may discharge through the side of the superstructure provided that this is at a height of at least $0{,}02L$ above any waterline when the intact craft is heeled to an angle of 15°, or of at least $0{,}02L$ above the highest waterline at all stages of flooding as determined by the damaged stability calculations, whichever is higher.

2.14.4 All air pipes shall be equipped with weathertight closing devices that close automatically.

2.15 Freeing ports.

2.15.1 Where bulwarks on weather decks form wells, provision shall be made for rapidly freeing the decks of water and for draining them. The minimum freeing port area A, in m^2, on each side of the craft for each well on the weather deck of the main hull(s) shall be:

.1 where the length of bulwark l in the well is 20 m or less:

$$A = 0{,}7 + 0{,}035l; \qquad (2.15.1.1)$$

.2 where l exceeds 20 m:

$$A = 0{,}07l; \qquad (2.15.1.2)$$

and, in no case, l need be taken as greater than $0{,}7L$.

If the bulwark is more than 1,2 m in average height, the required area shall be increased by 0,004 m^2 per metre of length of well for each 0,1 m difference in height. If the bulwark is less than 0,9 m in average height, the required area shall be decreased by 0,004 m^2 per metre of length of well for each 0,1 m difference in height.

2.15.2 Freeing ports shall be located within the height of 0,6 m above the deck and the lower edge shall be within 0,02 m above the deck.

2.15.3 All such openings in the bulwarks shall be protected by rails or bars spaced approximately 230 mm apart. If shutters are fitted to freeing ports, ample clearance shall be provided to prevent jamming. Hinges shall have pins or bearings of non-corrodible material. If shutters are fitted with securing appliances, these appliances shall be of approved construction.

2.15.4 A craft, having superstructures which are open in front or both ends, shall comply with the provisions of 4.2.11.1.

2.15.5 In a craft, having superstructures which are open at the aft end, the minimum freeing port area, in m^2, shall be:

$$A = 0{,}3b \tag{2.15.5}$$

where b = the breadth of the craft at the exposed deck, in m.

2.15.6 Ro-ro craft fitted with bow loading openings leading to open vehicle spaces shall comply with the provisions of 2.7.

3 FREEBOARD

3.1 The freeboard for a craft in the displacement mode shall be assigned so that the requirements regarding reserve of buoyancy and intact stability of the craft are met for the appropriate design waterline.

3.2 Based on the reserve of power necessary for craft's motion in the operational mode, a greater freeboard than indicated in 3.1 may be assigned.

3.3 The design waterline shall be clearly and permanently marked on the craft's outer sides at the level of the load line mark described below. This and the reference line described in 3.4.2 shall be recorded in the High-Speed Craft Safety Certificate. For craft where this is not practicable, e.g. amphibious air-cushion vehicles fitted with peripheral skirts, defined deck reference points shall be provided, from which the freeboard can be measured, and hence the draughts obtained.

3.4 Load line mark.

3.4.1 The load line mark shall consist of a ring with an outside diameter of 300 mm and width of 25 mm which is intersected by a horizontal line of length 450 mm and having a breadth of 25 mm, the upper edge of which passes through the centre of the ring. The centre of the ring shall be placed at the longitudinal center of floatation in the displacement mode and a height corresponding to the design waterline.

3.4.2 To assist in verifying the position of the load line mark, a reference line shall be marked on the hull at the longitudinal centre of floatation by a horizontal bar having a length of 300 mm and a breadth of 25 mm and having the upper edge corresponding to the reference line.

3.4.3 Where practicable, the reference line shall be related to the uppermost deck at side. Where this is not possible, the position of the reference line shall be defined from the underside of the keel at the longitudinal centre of floatation.

3.4.4 The mark of the authority by whom the load lines are assigned may be indicated alongside the load line ring above the horizontal line which passes through the centre of the ring, or above and below it. This mark shall consist of not more than four initials to identify the authority's name, each measuring approximately 115 mm in height, and 75 mm in width.

3.4.5 The ring, lines and letters shall be painted in white or yellow on a dark ground or in black on a light ground, and permanently marked. The marks shall be plainly visible.

3.4.6 The load line marks of the craft less than 24 m shall be marked in compliance with 8.2 of the Load Line Rules for Sea-Going Ships. In addition, in all cases the freeboard shall not be less than the value defined in compliance with 8.4 of the Load Line Rules for Sea-Going Ships

3.5 Verification.

The High-Speed Craft Safety Certificate shall not be delivered until the Register has verified that the marks are correctly and permanently indicated on the sides of the craft.

4 SUBDIVISION

4.1 GENERAL

4.1.1 Stability and reserve of buoyancy under all service conditions (taking no account of icing) shall be sufficient for meeting the requirements for damage trim and stability.

4.1.2 Requirements for subdivision are considered satisfied if with damages referred to in 4.3, compartments flooded in the worst possible position of the hole and permeabilities determined in accordance with 4.2, trim and stability of the craft meet the requirements of 4.4.

4.1.3 Calculations confirming compliance with the requirements of 4.4 shall be made for such number of the worst service loading conditions as regards trim and stability, such location and extent of damage defined in 4.3 that it can be predicted with confidence that in all other cases the damaged craft will be in a better condition as regards trim and stability.

In doing so, account shall be taken of the actual configuration of damaged compartments, their permeabilities, type of closing appliances, intermediate decks, platforms, transverse and longitudinal bulkheads and enclosures, watertightness of which is such that these constructions restrict totally or temporarily water flow inside the craft.

Any damage of a lesser extent than that postulated in 4.3.1 — 4.3.4, as applicable, which would result in a more severe condition shall be also investigated. The shape of the damage shall be assumed to be a parallelepiped.

4.1.4 Calculations of damage trim and stability shall be made for the craft in the displacement mode.

4.1.5 Where the equalization time of the damaged craft is not specified, the requirement of 3.4.1.7 of Part V "Subdivision" of the Rules for the Classification shall be applied.

4.1.6 Arrangements for equalization of the damaged craft shall be self-acting and be approved by the Register.

4.2 PERMEABILITIES

4.2.1 For the purpose of making damage stability calculations the volume and surface permeabilities shall be in general as follows:

Table 4.2.1

Spaces	Permeability
Intended for cargo or stores	60
Accommodation	95
Machinery	85
Intended for liquids	0 or 95[1]
Intended for cargo vehicles	90
Void spaces	95
[1] Whichever results in the more severe requirements.	

4.2.2 Notwithstanding 4.2.1, permeability determined by direct calculation shall be used where a more onerous condition results, and may be used where a less onerous condition results from that provided according to 4.2.1.

4.2.3 Use of low-density foam or other media to provide buoyancy in void spaces may be permitted, provided that satisfactory evidence is provided to the Register that any such suggested medium is the most suitable alternative and:

.1 is of close-cell form if foam, or otherwise impervious to water absorption;

.2 is structurally stable under service conditions;

.3 is chemically inert in relation to structural materials with which it is in contact or other substances with which the medium is likely to be in contact (refer to 2.1.10 of Part VI "Fire Protection" of these Rules);

.4 properly secured in place and easily removable for inspection of void spaces.

4.2.4 The Register may permit void bottom spaces to be fitted within the watertight envelope of the hull without the provision of a bilge system or air pipes provided that:

.1 the structure is capable of withstanding the pressure head after any of the damages required by this section;

.2 when carrying out a damage stability calculation in accordance with the requirements of this section, any void space adjacent to the damaged zone shall be included in the calculation and the criteria of damage trim and stability shall be complied with;

.3 the means by which water has leaked into the void space shall be removed shall be included in the craft operating manual; and

.4 adequate ventilation is provided for inspection of the space under consideration.

.5 the space filled with a low-density foam or modular buoyancy elements, as well as any space not fitted with a venting system are considered as a void space for the purpose of this paragraph provided such foam or modular buoyancy elements fully comply with 4.2.3.

4.3 EXTENT OF DAMAGES

All possible damages shall be assumed in damage trim and stability calculations anywhere on the periphery of the craft.

4.3.1 Extent of side damage.

The following side damages shall be assumed anywhere on the periphery of the craft:

.1 the longitudinal extent of damage shall be $0{,}75\nabla^{1/3}$ or $(3\,m\,+\,0{,}225\nabla^{1/3})$, or 11 m, whichever is the least;

.2 the transverse extent of penetration into the craft shall be $0{,}2\nabla^{1/3}$. However, where the craft is fitted with inflated skirts or with non-buoyant side structures, the transverse extent of penetration shall be at least $0{,}12\nabla^{1/3}$ into the main buoyancy hull or tank structure; and

.3 the vertical extent of damage shall be taken for the full vertical extent of the craft, where:

∇= volume of displacement corresponding to the design waterline, in m^3.

The damage is supposed to have the shape of a parallelepiped[1]. The parallelepiped inboard face at its mid-length shall be tangential to the surface corresponding to the specified side damage (transverse extent of penetration) or otherwise touching in at least two places, as shown in Fig. 4.3.1-1.

The side damage shall not transversely penetrate a greater distance than the extent of 0,21/3 at the corresponding design waterline, except where a lesser extent is assumed in accordance with 4.3.1.2 (refer to Figs. 4.3.1-2 and 4.3.1-3).

If considering a multihull, the periphery of the craft is considered to only be the surface of the shell encompassed by the outboard surface of the outermost hull at any given section.

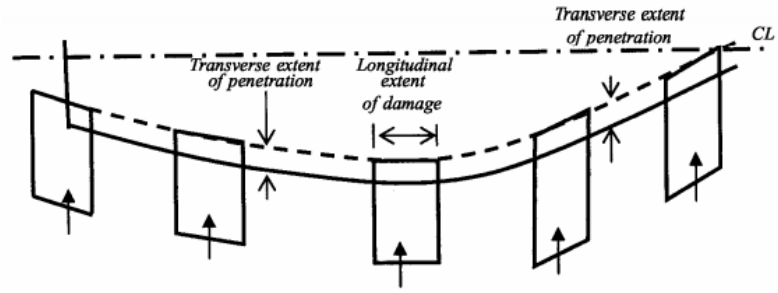

Fig. 4.3.1-1

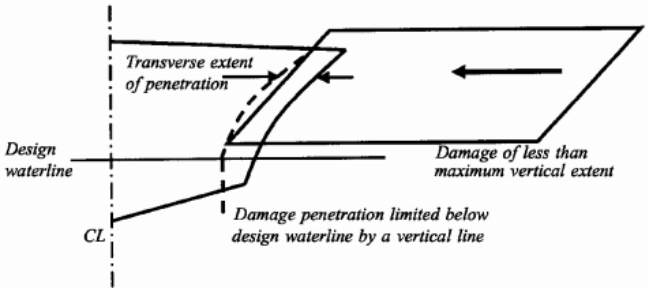

Fig. 4.3.1-2

[1] A parallelepiped is defined as "a solid contained by parallelograms" and a parallelogram is defined as "a four-sided rectilinear figure whose opposite sides are parallel".

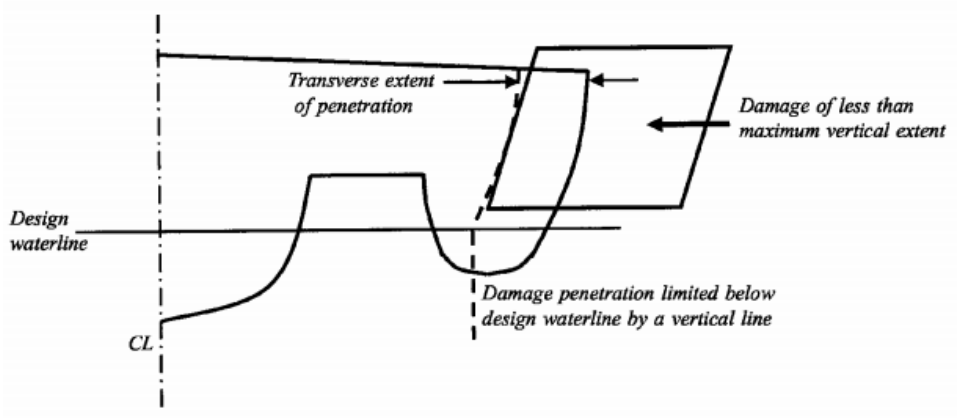

Fig. 4.3.1-3

4.3.2 Extent of bow and stern damage.

4.3.2.1 The following extents of damage shall be applied to bow and stem (refer to Fig. 4.3.2.1):

.1 at the fore end, damage to the area defined as A_{bow}, in compliance with 7.4.1 of Part III "Equipment, Arrangements and Outfit" of these Rules the aft limit of which being a transverse vertical plane, provided that this area need not extend further aft from the forward extremity of the craft's watertight envelope than the distance defined in 4.3.1.1;

.2 at the aft end, damage to the area aft of a transverse vertical plane at a distance 0,21/3 forward of the aft extremity of the watertight envelope of the hull.

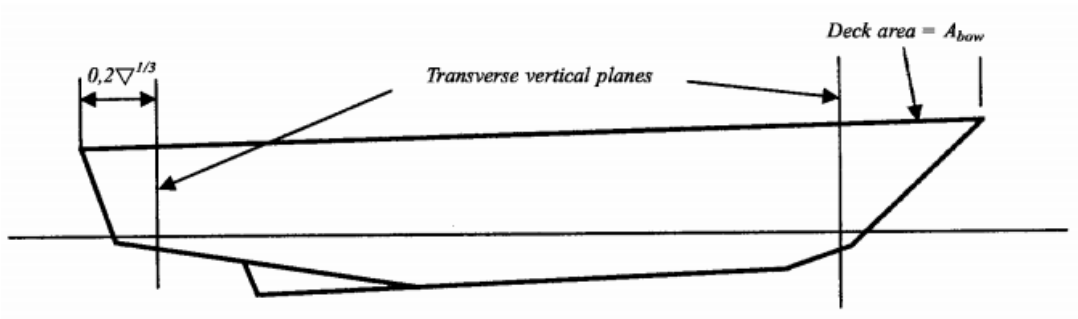

Fig. 4.3.2.1

4.3.2.2 Where the damage of a lesser extent than defined in 4.3.2.1 may lead to grave consequences, the damage trim and stability calculations shall be performed for such damage.

4.3.3 Extent of bottom damage in areas vulnerable to raking damage.

4.3.3.1 Application.

.1 any part of the surface of the hull(s) is considered to be vulnerable to raking damage if it is in contact with the water at 90 % of maximum speed in still water, and it also lies below two planes which are perpendicular to the craft centreline plane and at heights as shown in Fig. 4.3.3.1. For multihulls, individual hulls shall be considered separately;

.2 raking damage shall be assumed to occur along any fore-and-aft line on the surface of the hull(s) between the keel and the upper limit defined in the Fig. 4.3.3.1;

.3 damage shall not be applied at the same time as that defined in 4.3.1 or 4.3.4.

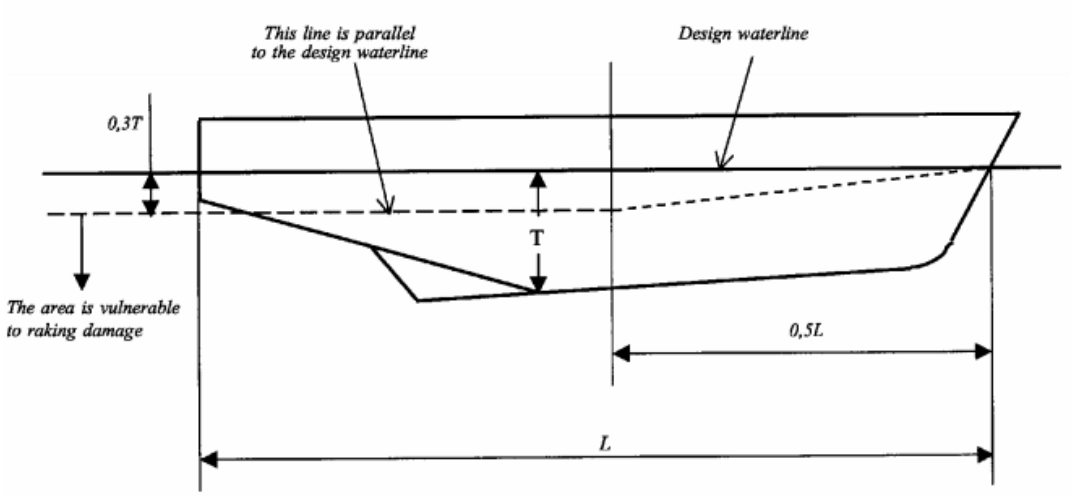

Fig. 4.3.3.1

T = maximum draught of the hull (each hull considered individually in case of multihulls) to the design waterline, excluding any non-buoyant structure such as single plate skegs or solid metal appendages.

4.3.3.2 Extents of damage.

4.3.3.2.1 Two different longitudinal extents shall be considered separately:

.1 55 % of the length L, measured from the most forward point of the underwater buoyant volume of each hull; and

.2 a percentage of the length *L*, applied anywhere in the length of the craft, equal to 35 % for a craft where $L = 50$ m and over and equal to $(L/2 + 10)$ % for a craft where L is less than 50 m.

4.3.3.2.2 Except as provided below, the penetration normal to the shell shall be $0{,}04\ \nabla^{1/3}$ or 0,5 m, whichever is the lesser, in association with a girth along the shell equal to $0{,}1\ \nabla^{1/3}$, where ∇ is the volume of displacement corresponding to the design waterline, in m^3. However this penetration or girth is under no circumstances to extend above the vertical extent of the vulnerable area as specified in 4.3.3.1.1.

4.3.3.2.3 The shape of damage shall be assumed to be rectangular in the transverse plane as shown in Fig. 4.3.3.2.3. The damage shall be assumed at a series of sections within the defined longitudinal extent in accordance with Fig. 4.3.3.2.3, the midpoint of the damaged girth being maintained at a constant distance from the centreline throughout that longitudinal extent.

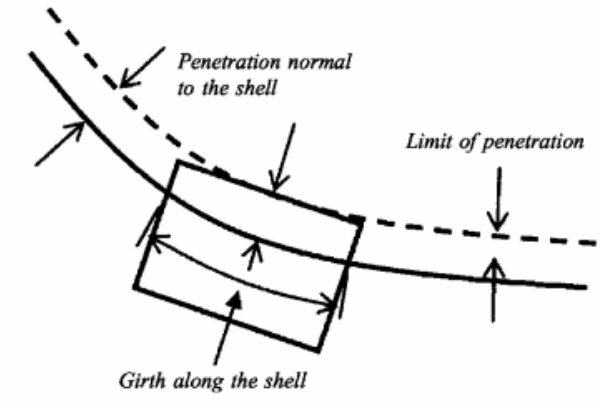

Fig. 4.3.3.2.3

4.3.4 Extent of bottom damage in areas not vulnerable to raking damage.

4.3.4.1 Application.

The requirements apply to all parts of the hull(s) below the design waterline which are not defined as vulnerable to raking damage in 4.3.3.1. Damage shall not be applied at the same time as that defined in 4.3.1 or 4.3.3.

4.3.4.2 Extent.

The following extent of damage shall be assumed:

.1 the length of damage in the fore-and-aft direction shall be $0{,}75\ \nabla^{1/3}$ or (3 m + $0{,}225\ \nabla^{1/3}$), or 11 m, whichever is the least;

.2 the athwartships girth of damage shall be $0{,}2\ \nabla^{1/3}$;

.3 the depth of penetration normal to the shell shall be $0{,}2\ \nabla^{1/3}$

(∇ = volume of displacement corresponding to the design waterline, in m^3);

.4 the shape of damage shall be assumed to be rectangular in the plane of the shell of the craft, and rectangular in the transverse plane as shown in Fig. 4.3.3.2.1.

4.3.5 In applying 4.3.3 and 4.3.4 to multihull craft, an obstruction at or below the design waterline of up to 7 m in width shall be considered in determining the number of hulls damaged of any one time. The requirement of 4.1.3 shall be applied.

4.3.6 Following any of the postulated damages detailed in 4.1.3 — 4.3.5, the craft in still water shall have sufficient buoyancy and positive stability to simultaneously ensure that:

.1 for all craft other than amphibious air-cushion vehicles, after flooding has ceased and a state of equilibrium has been reached, the final waterline is below the level of any opening through which further flooding could take place by at least 50 % of the significant wave height corresponding to the worst intended conditions;

.2 for amphibious air-cushion vehicles, after flooding has ceased and a state of equilibrium has been reached, the final waterline is below the level of any opening through which further flooding could take place by at least 25 % of the significant wave height corresponding to the worst intended conditions;

.3 there is a positive freeboard from the damage waterline to survival craft embarkation positions;

.4 essential emergency equipment, emergency radiostations, power supplies and public address systems needed for organizing the evacuation remain accessible and operational;

.5 the residual stability of craft meets the appropriate criteria as laid out in 4.6 and 4.7 according to Table 6.2.1 of Part IV "Stability" of these Rules. Within the range of positive stability governed by the criteria of 4.6 and 4.7, no unprotected opening shall be submerged.

4.3.7 Downflooding openings referred to in 4.3.6 shall include doors and hatches which are used for damage control or evacuation procedures, but may exclude those which are closed by means of weathertight doors and hatch covers and not used for damage control or evacuation procedures.

4.4 REQUIREMENTS FOR PASSENGER CRAFT

4.4.1 Following any of the postulated damages detailed in 4.3.1 — 4.3.5, in addition to satisfying the requirements of 4.3.6 and 4.3.7, the craft in still water shall have sufficient buoyancy and positive stability to simultaneously ensure that:

.1 the angle of inclination of the craft from the horizontal does not normally exceed 10° in any direction. However, where this is clearly impracticable, angles of inclination up to 15° immediately after damage but reducing to 10° within 15 min shall be permitted provided that efficient non-slip deck surfaces and suitable holding points, e. g., holes, bars, etc., are provided; and

.2 any flooding of passenger compartments or escape routes which might occur will not significantly impede the evacuation of passengers.

4.4.2 In addition to the requirements in 4.4.1, category B craft shall also satisfy the following criteria after sustaining raking damage of 100 % of length L, having the girth and penetration given in 4.3.3.2.2, to any part of the surface of the hull(s) defined in 4.3.3.2.1:

.1 the angle of inclination of the craft from the horizontal shall not exceed 20° in the equilibrium condition;

.2 the range of positive righting lever shall be at least 15° in the equilibrium condition;

.3 the positive area under the righting lever curve shall be at least 0,015 m·rad in the equilibrium condition;

.4 the requirements of 4.3.6.3 and 4.4.1.2 are satisfied;

.5 in intermediate stages of flooding, the maximum righting lever shall be at least 0,05 m·and the range of positive righting lever shall be at least 7°.

In complying with the above, the righting lever curve shall be terminated at the angle of downflooding, and only one free surface need be assumed.

4.5 REQUIREMENTS FOR CARGO CRAFT

Following any of the postulated damages detailed in 4.1.3, 4.3.1 — 4.3.5, in addition to satisfying the requirements of 4.3.6 and 4.3.7, the craft in still water shall have sufficient buoyancy and positive stability to simultaneously ensure that the angle of inclination of the craft from the horizontal does not normally exceed 15° in any direction. However, where this is clearly impracticable, angles of inclination up to 20° immediately after damage but reducing to 15° within 15 min may be permitted provided that efficient non-slip deck surfaces and suitable holding points, e.g., holes, bars, etc., are provided.

4.6 REQUIREMENTS FOR MONOHULL CRAFT

The stability required in the final condition after damage, and after equalization where provided, shall be determined as specified in 4.6.1 — 4.6.4.

4.6.1 The positive residual righting lever curve shall have a minimum range of 15° beyond the angle of equilibrium. This range may be reduced to a minimum of 10°, in the case where the area under the righting lever curve is that specified in 4.6.2, increased by the ratio

$$\frac{15}{range} \tag{4.6.1}$$

where the range is expressed in degrees.

4.6.2 The area under righting lever curve shall be at least 0,015 m·rad, measured from the angle of equilibrium to the lesser of:

.1 angle at which progressive flooding occurs;

.2 27° measured from the upright.

4.6.3 A residual righting lever GZ, in m, shall be obtained within the range of positive stability, taking into account the greatest of the following heeling moments:

.1 the crowding of all passengers towards one side;

.2 the launching of all fully loaded davit-launched survival craft on one side;

.3 due to wind pressure,

as calculated by the formula

$$GZ = \frac{heeling\ moment}{displacement} + 0{,}04. \tag{4.6.3.3}$$

However, in no case, this righting lever shall be less than 0,1 m.

4.6.4 For the purpose of calculating the heeling moments referred to in 4.6.3, the following assumptions shall be made.

4.6.4.1 Moments due to crowding of passengers shall be calculated in accordance with 13.1.1 of Part IV "Stability" of these Rules.

4.6.4.2 Moments due to launching of all fully loaded davit-launched survival craft on one side:

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

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

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

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

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

4.6.4.3 Moments due to wind pressure:

.1 the wind pressure P_d, in N/m^2, shall be taken as

$$P_d = 120(V_w/26)^2 \tag{4.6.4.3.1}$$

where V_w = wind speed, in m/s, corresponding to the worst intended conditions;

.2 the area applicable shall be the projected lateral area of the ship above the waterline corresponding to the intact condition; and

.3 the moment arm shall be the vertical distance from a point at one half of the mean draught corresponding to the intact condition to the centre of gravity of the lateral area.

4.6.5 In intermediate stages of flooding, the maximum righting lever shall be at least 0,05 m and the range of positive righting levers shall be at least 7°. In all cases, only one breach in the hull and only one free surface need he assumed.

4.7 REQUIREMENTS FOR MULTIHULL CRAFT

4.7.1 Calculation of criteria for the residual stability curve (refer to Fig. 4.7.1) is similar to that for intact stability except that the craft in the final condition after damage shall be considered to have an adequate standard of residual stability provided:

.1 the required area A_2 shall be not less than 0,028 m·rad (refer to Fig. 4.7.1);

.2 there is no requirement regarding the angle of inclination at which the maximum GZ value shall occur.

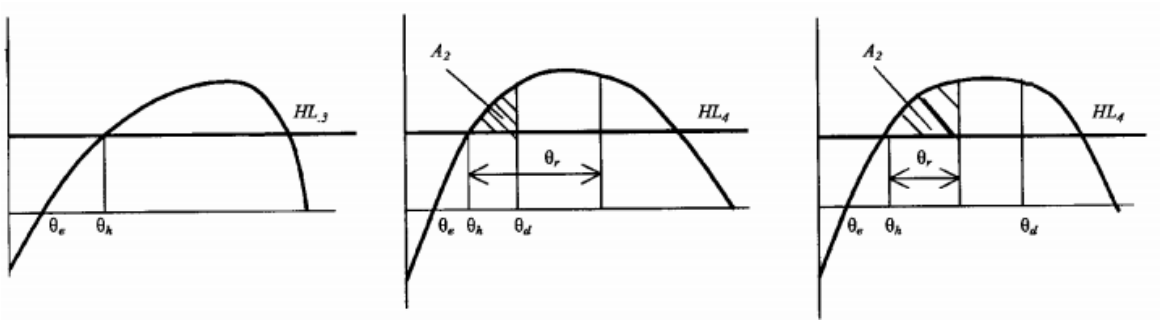

Fig. 4.7.1
Damage stability

Abbreviations used:
HL_3= heeling lever due to wind;
HL_4 = heeling lever due to wind plus passenger crowding;
θ_d= angle of downflooding;
θ_r = angle of roll;
θ_e = angle of equilibrium, assuming no wind and passenger crowding;
θ_h = angle of heel due to heeling lever HL_3 or HL_4

4.7.2 The wind heeling lever for application on the residual stability curve shall be assumed constant at all angles of inclination and shall be calculated as follows:

$$HL_3 = \frac{P_d A Z}{9800\Delta} \qquad (4.7.2)$$

where $P_d = 120\,(V_w/26)^2$, in N/m^2;
V_w= wind speed corresponding to the worst intended conditions, in m/s;
A= projected lateral area of the portion of the ship above the lightest service waterline, in m^2;
Z= vertical distance from the center of A to a point one half of the lightest service draught, in m;
Δ= displacement, in t.

4.7.3 The same values of roll angle shall be used as for the intact stability.

4.7.4 The residual stability curve shall terminate at the downflooding point. The area A_2 shall therefore be truncated at the downflooding angle.

4.7.5 The stability of the craft in the final condition after damage shall be examined and shown to satisfy the criteria, when damaged as stipulated in 4.3.

4.7.6 In the intermediate stages of flooding, the maximum righting lever shall be at least 0,05 m and the range of positive righting lever shall be at least 7°. In all cases, only one breach in the hull and only one free surface need to be assumed.

4.7.7 In applying the heeling levers to the damaged curves, the following shall be considered:

heeling lever due to steady wind HL_3, and

heeling lever due to steady wind plus heeling lever due to passenger crowding HL_4.

4.7.8 The angle of heel due to steady wind shall not exceed 15° for a passenger craft and 20° for a cargo craft.

Russian Maritime Register of Shipping

Rules for the Classification and Construction of High-Speed Craft
Part V
Reserve of Buoyancy and Subdivision

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