RUSSIAN MARITIME REGISTER OF SHIPPING

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RULES

FOR THE CLASSIFICATION AND CONSTRUCTION OF PLEASURE CRAFT

PART III

EQUIPMENT, ARRANGEMENTS AND OUTFIT

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RULES FOR THE CLASSIFICATION AND CONSTRUCTION OF PLEASURE CRAFT (PART III)

The present version of the Rules for the Classification and Construction of Pleasure Craft of Russian Maritime Register of Shipping (RS, the Register) has been approved in accordance with the established approval procedure and come into force on 1 November 2025.

The present version is based on the version dated 1 January 2018 taking into account the amendments and additions developed immediately before publication (refer to the Revision History).

REVISION HISTORY[1]

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

[1] With the exception of amendments and additions introduced by Rule Change Notices (RCN), as well as of misprints and omissions.

1 GENERAL

1.1 APPLICATION

1.1.1 The requirements of this part of the Rules for the Classification and Construction of Pleasure Craft[1] apply to craft equipment, arrangements and outfit used on small pleasure craft.

1.1.2 Scope of application is defined more exactly in the relevant paragraphs of this Part.

1.1.3 The cargo handling gear specified in 1.3.1.6 shall comply with the requirements of the Rules for the Cargo Handling Gear of Sea-Going Ships.

1.2 DEFINITIONS AND EXPLANATIONS

1.2.1 The following definitions and explanations are used in this Part.

Bitt is a bollard placed on the craft deck to fix the tow lines, mooring ropes or anchor cables.

Windlass is the anchor mechanism with the horizontal axis of rotation of the driving shaft intended for anchoring and weighing as well as for hauling in anchor cables.

Oar is a device for rowing which has a blade to create thrust. There may be a single-blade or double blade oars and single-bank oars.

Auxiliary steering gear is the equipment other than any part of the main steering gear necessary to steer the craft in the event of failure of the main steering gear, but not including the tiller, quadrant or components serving the same purpose.

Retractable steering propeller (RSP) is the azimuthing thruster which design enables to lift propeller inside the craft hull in non-operating condition.

Main steering gear is the machinery, rudder actuators, steering gear power units, if any, ancillary equipment and the means of applying torque to the rudder stock (e.g. tiller or quadrant) necessary for effecting movement of the rudder for the purpose of steering the craft under normal service conditions.

Main steering gear may be power-operated or hand-operated one.

Cargo handling gear is a combination of appliances installed on board ship and intended for loading, unloading and moving of loads from one position to another and for conveyance of persons.

Propulsion steering system (PSS) is the propulsion and steering element of a craft. Oars, sail, rudder, azimuthing thrusters, vane propellers, thrusters and outboard motors.

Hull fittings are the auxiliary items placed on the craft deck serving for passage and fixing of towing, mooring and anchor lines, as well as different rigging.

Hull fittings are bitts, blocks, bollards, deck organizers, eyebolts, rollers, cleats, lever stoppers, rigging shackles, etc.

Closing arrangement is an arrangement intended for closing openings in hull or in craft superstructure: shell doors, cargo hatch covers, doors, companion hatches and skylights, windows etc.

Canhook or a quisition is any part of craft which may be seized by hand to reduce risk of falling overboard even if this is not its main function.

Fairlead is a plate of special form put on the bulwark gunwale and intended for directing the mooring line to the bollard or the warping drum. It may have either simple design or be fitted with the rollers.

Bollard is a column used for mooring. The bollard may be single head, double head and cross bollard.

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

Vertical-axis propeller is the propeller with the vertical axis of rotation consisting of the vertical blades fixed on the vertical drum.

Guard Rails is a barrier on open deck consisting of posts and ropes or tubes extended between them.

Pulpit is a rigid frame railing.

Sailing rig is a set of arrangements, spars and rigging, which provide the craft motion using the wind energy.

Azimuth thruster is an open or ducted propeller fitted on an arrangement rotating 360 degrees around the vertical axis. Azimuth thrusters of great power may be used as the main propulsion and steering unit.

Thruster is an arrangement providing transverse or longitudinal thrust and used for improvement of the craft steerability at low speed.

Railing is a tube rail.

Rudder and steering gear is an arrangement intended for craft steering and keeping it on its course.

Rudder is one or several bearing surfaces (wings or plates) which angle in respect to the craft centerline plane (deflection angle) may be changed by craftmaster.

Balanced rudder is the rudder, which part is located before the axis of the rudder stock to reduce the spindle torque.

Unbalanced rudder is the rudder which rudder stock axis coincides with the leading edge of rudder or passes in close vicinity to it.

Streamlined rudder is the rudder with the symmetrical aviation profile in the transverse section.

Plate rudder is the rudder of the easiest design which transverse section is the flat plate.

Suspended rudder is the rudder which is fixed to the rudder stock only in the upper part.

Semi-spade rudder is the rudder which upper part is fixed to the rudder stock, in the middle part it has one or several attachments to horn/rudder post or sterntube and it has no support in the lower part (rudder heel).

Simple rudder is the rudder which is fixed to the rudder stock in the upper part and it is supported in the lower part (rudder heel) and it may have one or several attachments to horn/rudder post or sterntube in the middle part if placed after them.

Transom rudder is the rudder placed on the craft transom.

Power actuating system of the steering gear is the hydraulic or mechanical equipment provided for supplying power to turn the rudder stock or steering nozzle and comprising a steering gear power unit or units, together with the associated pipes and fittings, and rudder deflection servo or steering nozzle. The power actuating systems may share common mechanical nodes, such as tiller, quadrant, rudder stock or nodes serving the same purpose.

Steering gear power unit:

in the case of electrical steering gear it is an electrical motor and its associated electrical equipment;

in the case of electrohydraulical steering gear it is an electrical motor and its associated electrical equipment and connected pump;

in the case of hand-operated hydraulic steering gear it is a hand-operated gear and connected pump.

Steering gear control system is the power-driven device used together with the main steering gear to transmit commands from the navigating bridge to steering gear power units. The steering gear control systems comprise detectors, receivers, hydraulic control pumps and their associated motors, motor controllers, piping and cables.

Active means of craft's steering (AMSS) are the special propulsion and steering units and any combination of them or with main propulsion devices capable to create thrust or traction force both at a fixed angle to the centre line plane of the craft and at the variable

angle either under all running conditions or part thereof including slow speed and zero speed. The active means of craft's steering comprise fixed and retractable steerable propellers, water jets, thrusters, outboard electric motors and other devices of similar purpose.

Safety harness (lifebelt) is a set of belts connected against each other which man puts on together with safety line with snap shackles on both ends, one of them is attached to the safety belt and the other to the element rigidly fixed on a craft (on deck, deckhouse, superstructure etc.) and intended for assuring safety during crew work on deck under the hard storm conditions.

Craft arrangements is a set of the craft equipment and service mechanisms intended to assure the required operating and navigational properties of craft.

Transom rudder is a plate rudder located on craft transom.

Lanyard is a rope strainer used on crafts instead of the stretching screw to assure rail rope or lashing tension.

Cleat is an item of special (generally, twin-horn) form intended for fastening of the steel mooring ropes and running rigging.

Mooring and towing arrangement is the arrangement intended to provide safe moorage of a craft by berth or any other floating structure (craft, moorings, floating landing stage) as well towing assistance to any other similar craft or her own towing by another craft.

Mooring pipe is an item with the oval hole fitted in the craft bulwark or on deck and intended for directing the mooring rope to the bollard or bitt.

Centreboard, bilgeboard is a wing casted outboard of the crafts to reduce their drift.

Mooring windlass is a mooring mechanism with the vertical axis of rotation of the driving shaft intended for hauling in a rope to draw a craft nearer to berth.

Vertical shaft windlass is an anchor mechanism with the vertical axis of rotation of the driving shaft intended for anchoring and weighing as well as for hauling in anchor cables.

Anchor gear is an arrangement serving for the safe anchorage of a craft at sea, on road stead and other places far from shore by means of securing to the ground by an anchor and anchor cable (cable or rope).

Cable pipes are the special castings fitted on deck and onboard to direct the anchor cable.

1.3 SCOPE OF SURVEY

1.3.1 The following parts of craft arrangements are liable to survey by Register during manufacture.

1.3.1.1 Steering gear:

.1 rudder stocks;

.2 rudder blade;

.3 rudder axles;

.4 pintles of rudders and steering nozzles;

.5 bushes of pintles;

.6 fastening of the rudder stocks, rudder stock with rudder blade steering nozzles and also of rudder axle with sternframe (muff couplings, keys, bolts, nuts etc.);

.7 parts of the system of rudder stops;

.8 rudder stock bearings;

.9 rudder trunk;

.10 details hand-operated rope steering gear;

.11 details and nodes of hand-operated shaft steering gear;

.12 details and nodes of hand-operated remote steering gear.

1.3.1.2 Anchor arrangement:

.1 anchors;

.2 chain cables or ropes;

.3 anchor stoppers;

.4 devices for securing and releasing the inboard end of chain or rope;

.5 anchor deck organizers.

1.3.1.3 Mooring arrangement:

.1 mooring ropes;

.2 mooring bollards, belaying cleats, fairleads, deck organizers, rollers and stoppers.

1.3.1.4 Towing arrangement:

.1 tow lines;

.2 towing bollards, bitts, fairleads, deck organizers and stoppers;

1.3.1.5 Spars and rigging:

.1 standing and running spars;

.2 standing and running rigging;

.3 sails;

.4 cable plates, parrals, bollards, belaying cleats, fairleads, rollers and stoppers;

.5 signal masts.

1.3.1.6 Cargo handling gear — within scope set forth in the Rules for the Cargo Handling Gear of Sea-Going Ships including the following:

.1 ship's derricks, ship's cranes and hoists (pulley blocks, trolleys, telphers, etc.) having lifting capacity 1 t and more;

.2 ship's cargo lifts with safe working load 250 kg and more and electrically driven passenger lifts intended for lifting and lowering of persons and/or loads in the car moved by the ropes with a speed not in excess of 1,0 m/s;

.3 ship's elevating platforms with a lifting capacity 1 t and more which move up and down with a speed not in excess of 0,1 m/s;

.4 slings, spreaders, lifting beams, frames, etc., being part of the ship;

.5 ship's cranes having lifting capacity 1 t and more, used to convey the personnel and appliances designed to convey the personnel.

1.3.1.7 Closing appliances:

.1 all closing appliances located on the craft outer hull surfaces, superstructures and deckhouses;

.2 all closing appliances located inside craft in the watertight structures.

1.3.1.8 Equipment of craft spaces:

.1 stairways and vertical ladders;

.2 guard rails, bulwark and gangways.

1.3.2 Survey of products listed in 1.3.1.1.5, 1.3.1.1.8, 1.3.1.1.9, 1.3.1.1.10, 1.3.1.1.11, 1.3.1.1.12, 1.3.1.3.2, 1.3.1.4.2, 1.3.1.5.3, 1.3.1.5.4 by the Register is limited to review of the technical documentation.

1.3.3 For items specified in 1.3.1 the following documents shall be submitted to the Register:

.1 assembly drawing;

.2 gears and arrangements calculations;

.3 drawings of nodes and details if they are manufactured according to standards or technical conditions which are not agreed with the Register.

1.3.4 Materials used for items specified in 1.3.1.1.1-1.3.1.1.4, 1.3.1.3.1, 1.3.1.3.2, 1.3.1.4.1, 1.3.1.6, 1.3.1.7, are subject to the RS survey during manufacture.

1.3.5 The following arrangements, equipment and outfit are subject to the Register survey when the craft is under construction:

.1 rudder and steering gear;

.2 anchor arrangement;

.3 mooring arrangement;

.4 towing arrangement;

.5 rigging;

.6 cargo-handling gear;

.7 signal masts;

.8 closing appliances;

.9 emergency outfit.

1.4 MATERIALS AND WELDING

1.4.1 Materials for manufacture of the arrangements, equipment and outfit unless otherwise is not explicitly specified in these Rules are to comply with the requirements listed in the documentation of the design approved by the Register.

1.4.2 Welding of structural elements of craft's arrangements, equipment and outfit is to be performed in accordance with the requirements of Part XIV "Welding", Rules for the Classification.

1.5 INERTIAL LOADS

1.5.1 Inertia loads arising during craft movement at seaways shall be considered in calculation of craft's arrangements.

The value of inertia loads is determined by an acceleration arising at craft's motions in waves.

Acceleration at motions in waves is calculated according to 2.1.4.7, Part II "Hull". Accelerations at motions in waves shall be submitted to the Register for agreement by the designer.

1.6 SPECIAL STRONG STRUCTURES

1.6.1 Anchor, mooring and towing arrangements shall have strong design to withstand forces acting in ropes and cables. Meanwhile, the structures of strong design of anchor and mooring arrangements may be used in the towing arrangement.

Tensile strength of ropes/cables used in these arrangements shall not exceed 80 per cent ultimate load of the corresponding strong design structure.

According to ISO 15084:2003 there shall be at least the following number of the strong design structures:

.1 at all craft — one strong design structure in the fore end for anchor and towing arrangements;

.2 on craft which length is $L_H > 6$ m — at least one strong design structure for mooring arrangement in the aft;

.3 on craft which length is $L_H > 12$ m — at least one additional structure in addition to those specified in 1.6.1.1 or 1.6.1.2, strong design structure for the mooring arrangement in the fore end and in the aft;

.4 on craft which length is $L_H > 18$ m — at least one additional structure in addition to those specified in 1.6.1.3, strong design structure for the portside and starboard mooring arrangement.

1.6.2 Requirements of ISO 15084:2003 are to be considered in the design of strong structures in respect of assignment of dimensions, strengthenings, corrosion resistance and marking.

1.7 GUIDELINES FOR THE CRAFT OWNER

1.7.1 The following information shall be given in the Guidelines for the craft owner to comply with ISO 15084:2003 in respect of the anchor and mooring/towing arrangement:

.1 information on the ultimate (breaking) load of strong (carrying) structures of the anchor and mooring/ towing arrangements;

.2 information on assignment of strong design structure if marked by the ship yard in cases when its purpose is not evident (for instance: strong design structure is intended for anchoring and/or towing);

.3 recommendations on necessity of towing of another craft or towing of its own craft at slow speed and warning on observing the speed limit during towage of the water displacing craft;

.4 recommendations on the method of securing the towing rope to be able to pay it off under load;

.5 information about responsibility for the supply of a craft with the relevant mooring and towing ropes, anchor cable, anchor ropes and anchor. Tensile strength of the mooring and towing ropes, anchor ropes and cables shall not exceed 80 per cent breaking force of the relevant strong design structure.

Craft owners shall consider what actions will be needed to fix a towing rope onboard;

.6 information on used non-metal strong design structures. Limited service life of the non-metal strong design structures is to be taken into account. They are to be replaced as soon as any signs of deterioration, visible surface cracks or residual deformation appear.

N o t e . Dark products are less exposed to fracture caused by the UV rays than the light products.

2 STEERING GEAR

2.1 GENERAL

2.1.1 Each craft shall have a reliable steering gear, enabling its manoeuvrability and course-keeping qualities under design operating conditions. Such arrangements may be: steering gear, vane propeller, azimuth thruster, outboard motor (motors) and other arrangements approved by the Register.

Birth connected craft may not have the steering gear.

Considering the area of navigation and operating conditions, the non-self-propelled craft may not be fitted with the steering gear or only stabilizer may be installed. Design category, area of navigation and operating conditions of the non-self-propelled craft which allow absence of the steering gear or installation of stabilizers only shall be substantiated by the designer.

2.1.2 Position of helmsman is to provide proper vision around the craft. If there is not a proper view from the emergency control station then there shall be a voice contact with a member of the crew who has such view.

2.1.3 The craft is steered by deflection of the rudder blade (blades), steering oar, rotation of the water-jet nozzle, change of the thrust vector of outboard motor and sterndrive or by other methods. Rudder blade may be rotated by tiller or by steering gear. The steering tiller or other mechanical arrangement shall be provided for the emergency operation (except for craft of design categories **C, C1, C2, C3** and **D**).

2.1.4 The deflection angle of rudder blade (or direction of thrust vector) is to be visible to the helmsman personally or by means of the indicator.

2.1.5 The steering gear is to be designed so that to enable easy access for control and maintenance of some elements. There should be no equipment and outfit located close to the steering gear that may interfere operation of this arrangement. Steering gear should be designed so that the rudder blade doesn't impinge the hull plating preventing damage to any element of the steering gear.

2.1.6 Requirements of this Section cover the steering gear that have rudders listed in Fig. 2.1.6. It is recommended to apply requirements set forth in 2.2, Part III, "Equipment, Arrangements and Outfit", Rules for the Classification and Construction of Sea-Going Ships[1] to nozzled steering gears and rudders which design differ from those given in Fig. 2.1.6.

Unusual steering gears: rudder with rotor, flap-type rudder, multi-blade rudders like Enkel rudders etc., as well as the azimuth thruster, vane propellers etc., may be used in case the substantiation of this technical solution is submitted by the designer.

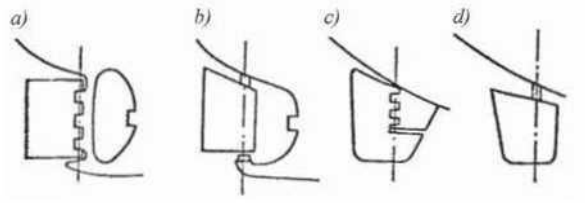


Fig. 2.1.6
Types of rudders:
a — ordinary unbalanced multipintle rudder;
b — ordinary balanced rudder;
c — semi-spade balanced rudder;
d — suspended balanced rudder

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

Considering the purpose, special features of a craft and intended regimes of its operation it may be allowed that the regulated steerability of a craft at slow speed is provided by simultaneous action of the means listed in 2.1.1 and active means of craft's steering (AMSS).

2.1.7 In any case the rudder shall have at least two supports, meanwhile, depending on type of the steering gear, the rudder heel pintle may be one of the supports (lower). It is not allowed to use the power system as a support (steering gear actuator) unless it is not intended for the said purpose.

Number of rudder pintles which serve as a support for its blade is not regulated by the Register.

2.1.8 The specific pressure shall not exceed values given in Table 2.1.8 when the specific pressure of rudder pintles and rudder stock bearings is checked.

Table 2.1.8

Frictional couple's material	Specific pressure p, in MPa, if lubricated by	
	water	oil
Stainless steel or bronze against lignum vitae	2,4	—
Stainless steel or bronze against textolite or synthetic materials	Upon agreed specification of the manufacturer	—
Stainless steel against bronze or vice versa	6,9	—
Steel against the white metal	—	4,4

2.2 INITIAL DESIGN DATA

2.2.1 The initial design data specified in this Chapter are valid only for the choice of scantlings of ordinary rudders and nozzle rudders with rigidly fixed stabilizers and cannot be used for determination of steering gear output characteristics. Methods of determination of these characteristics are not regulated by the Register, and the relevant calculations are not subject to approval by the Register. The steering gear is checked by the Register during sea trials of the ship to make sure that the steering gear output characteristics comply with the requirements of 2.9.2, 2.9.3 and 2.9.7.

2.2.2 Rudder force and rudder torque.

2.2.2.1 The rudder blade force F, H, acting on the rudder blade at headway movement shall be calculated by the formula

$$F = K_1 K_2 V_0^2 A_0 \qquad (2.2.2.1)$$

where K_1 is the coefficient calculated according to Table 2.2.2.1-1;
λ = is the relative elongation of the rudder blade, $\lambda = b^2/A_0$;
b = is the mean height of the submerged part of the rudder blade, m;
A_0 = effective square of rudder together with horn (skeg), in m²;
$A_0 = A$ for structures shown on Figs. 2.2.4-1 and 2.2.4-4;
$A_0 = A + A_{st}$ for structures shown in Figs. 2.2.4-2, 2.2.4-3 and 2.2.4-5;
A = square of rudder blade, in m², (for transom rudder — only square of the submerged part of it);
A_{st} = square horn (skeg) of rudder, in m²;
K_2 = coefficient taken according to Table 2.2.2.1-2, where Δ is the water displacement, in t, at draught to the design waterline;
V_0 = design craft velocity, in knots, depending on the type of craft according to 2.2.2.2.

Table 2.2.2.1-1

K_1 coefficients for rudders of different elongation

λ	0,5	1,0	1,5	2,0	2,5	3,0	3,5	4,0
K_1	61	93	113	126	135	140	141	141

Table 2.2.2.1-2

K_2 coefficient for craft of various types

Type of craft	K_2
Motor craft	1,2
Non-self-propelled crafts	1,1
Sailing craft, sailing-motor craft and motorsailing craft:	
$L_{wt}/\sqrt[3]{\Delta} \le 6$	1,6
$L_{wt}/\sqrt[3]{\Delta} > 6$	$0{,}11 + 0{,}25\, L_{wt}/\sqrt[3]{\Delta}$

2.2.2.2 Design craft speed, V_0 (knots), whichever is greater:

$$V_0 = 2{,}7\sqrt{L_{wt}} \text{ or } V_0 = V_{max} \qquad (2.2.2.2)$$

where V_{max} = actual maximum speed of craft, in knots.

2.2.3 Bending moments acting upon the rudder blade.

2.2.3.1 Balanced three pintle rudder.

The maximum value of the bending moment M_1 in Nm, acting upon the rudder blade shall be calculated by the formula

$$M_1 = 0{,}125\, F \cdot b. \qquad (2.2.3.1\text{-}1)$$

The maximum value of the bending moment of the rudder stock, in Nm, on the centre pintle is to be calculated by the formula

$$M_2 = 0{,}14\ F \cdot b \qquad (2.2.3.1\text{-}2)$$

where F = design hydrodynamic load, in N, according to 2.2.2.1;
b = mean height of the submerged part of the rudder, in m.

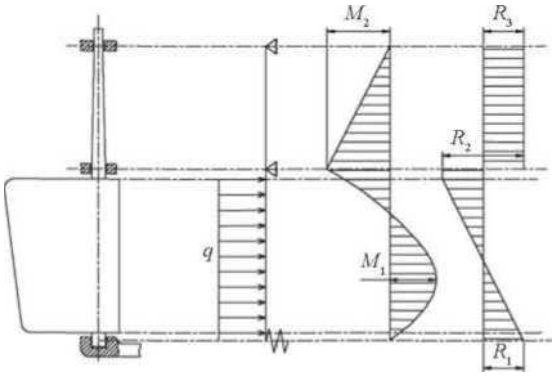


Fig. 2.2.3.1
Load, bending moments and transverse forces in the balanced rudder with rudder heel

2.2.3.2 Balanced suspended rudder.

The value of the bending moment M_1, in Nm, in the arbitrary horizontal section of the rudder blade shall be calculated by the formula

$$M_1 = (FA_b \cdot h_1) \,/\, A \qquad (2.2.3.2\text{-}1)$$

where F = design hydrodynamic load, in N, according to 2.2.2.1;
A_b = square, in m², of the part of rudder blade below the section in question;
$h1$ = vertical distance, in m, from the centre of gravity of the cut area A_b to the section in question;
A = square of the rudder blade, in m², according to 2.2.2.1.

The value of the bending moment in the rudder stock, M_2, in Nm, in the area of the lower bearing shall be calculated by the formula

$$M_2 = F \cdot h_2 \qquad (2.2.3.2\text{-}2)$$

where F = design hydrodynamic load, in N, according to 2.2.2.1;
h_2 = vertical distance, in m, from the centre of gravity of the square of rudder blade to the centre of the lower bearing.

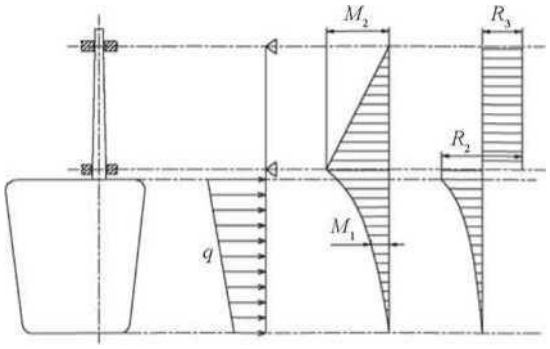


Fig. 2.2.3.2
Load, bending moments and shear forces of the balanced suspended rudder

2.2.3.3 Balanced semi-spade rudder.

The maximum value of the bending moment on the rudder blade M_1, in Nm, shall be calculated by the formula

$$M_1 = (FA_b \cdot h_2) \,/\, A \qquad (2.2.3.3\text{-}1)$$

where F = design hydrodynamic load, in N, according to 2.2.2.1;
A_b = square, in m², of the part of rudder blade below the section in question;
h_2 = vertical distance, in m, from the centre of gravity square A_b to the section in question;
A = square, in m², of the rudder blade according to 2.2.2.1.

The value of the bending moment in rudder stock M_2, in Nm, in the area of the lower bearing:

$$M_2 = Fh \,/17 \qquad (2.2.3.3\text{-}2)$$

where F = design hydrodynamic load, in N, according to 2.2.2.1;
h = mean height of the submerged part of the rudder, in m.

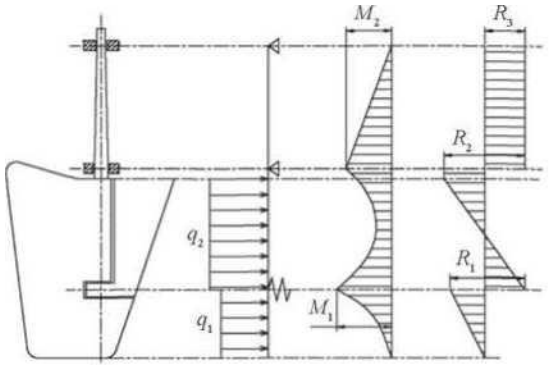


Fig. 2.2.3.3
Load, bending moments and shear forces of the balanced semi-spade rudder

2.2.3.4 Simple unbalanced multipintle rudder.

The height of the rudder stock up to the upper rudder bearing is exposed to twisting only in the simple rudders supported by pintles. Above the upper bearing the rudder stock is exposed to the bending moment (in excess of the spindle torque) caused by the force applied to the tiller or quadrant to turn rudder.

This bending moment is calculated by the formula

$$M_b = F\, r\, h_k \,/L_r \qquad (2.2.3.4)$$

where F = design hydrodynamic load, in N, according to 2.2.2.1;
$r = x_c + f$, see 2.2.4;
h_k = distance from the upper support bearing to the axis of tiller or quadrant, in m;
L_r = radius of the quadrant or length of tiller arm, in m.

2.2.4 Torque.

Torque caused by the hydrodynamic load on the rudder blade M_c, in Nm, is calculated by the formula

$$M_c = F \cdot r \qquad (2.2.4)$$

where F = design hydrodynamic load, in N, according to 2.2.2.1;
r = radius of the action force, in m;
$r = x_c - f$, if a rotation axis is on the rudder blade;
$r = x_c + f$, if a rotation axis is before the rudder blade;

$r = x_c$ – for rudders with the rudder heel and horn (skeg) of large square ($A_1/A_{st} < 2$);

x_c = horizontal distance between the point where the resultant hydrodynamic force is applied and the leading edge of the blade (or stabilizer) in accordance with the value shown in Figs. 2.2.4-1 — 2.2.4-5.

f = horizontal distance between the rotation axis and the leading edge of the blade (or horn), measured at the height of point where the resultant hydrodynamic force is applied according to Figs. 2.2.4-1 — 2.2.4-5.

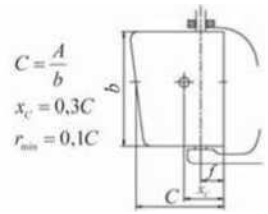


Fig. 2.2.4-1
Rudder with heel without skeg

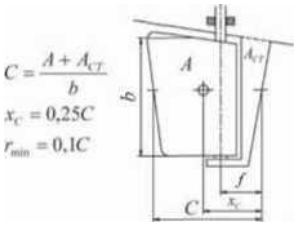


Fig. 2.2.4-2
Rudder with heel and narrow skeg

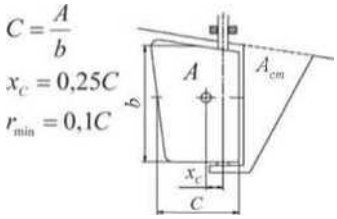


Fig. 2.2.4-3
Rudder with heel and large skeg

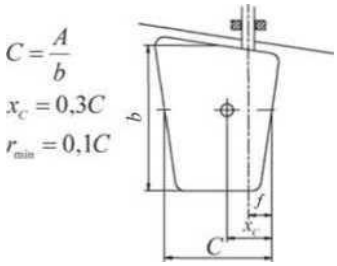


Fig. 2.2.4-4
Balanced suspended rudder

$$A = A_1 + A_2$$

$$C = \frac{A_1 + A_2 + A_{CT}}{b}$$

$$x_c = C(0{,}2h_1 / b + 0{,}3)$$

$$r_{min} = C(0{,}1 - 0{,}05h_1 / b)$$

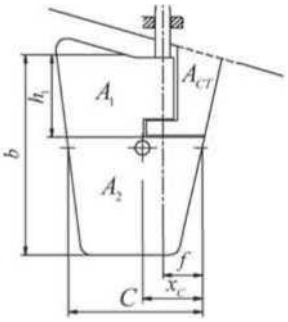


Fig. 2.2.4-5
Balanced semi-spade rudder

2.3 RUDDER BLADE DESIGN

2.3.1 Rudder blade can be made of metal, laminate, solid wood or plywood.

The metal blade plating thickness shall not be less than the minimum thickness of hull plating specified in Part II "Hull". The distance between the stiffeners of such rudder shall not exceed frame spacing of craft calculated on the basis of the load to the bottom in the area of the aft end and approved thickness of rudder blade plating.

2.3.2 In an arbitrary section of the rudder blade the combined stresses caused by bending and twisting σ_{com}, in MPa, calculated by Formula 2.3.2, shall not exceed 0,3 times the upper yield stress of the rudder blade material:

$$\sigma_{com} = \sqrt{\sigma^2 + 3\tau^2} \qquad (2.3.2)$$

where σ = normal bending stresses, in MPa;
τ = tangential stress caused by twisting, in MPa.

If the rudder blade is made of several different materials, the condition for the reduced stress is to be checked for each of them.

2.3.3 The metal plating of the rudder blade is to be welded to stiffeners by the fillet weld, it is allowed to apply plug welds.

2.3.4 Rudder blade is to be made of the solid laminate manufactured in two enantiomorphous forms and glued provided:

the blade is glued following the technology approved by the Register;

manufactured blade is checked for bending by the load equal to 1,5 M_1, where M_1 is the bending moment according to 2.2.3.

If these conditions are not complied with then it is necessary to fix the halves of blade by laminate strip on the lower, leading and upper edges.

2.3.5 The inner cavity of the volumetric rudder blade is to be properly packed.

It is recommended to fill the blade cavity with the material which doesn't imbibe water. The volumetric blade made of the metal or laminate which is not filled in shall be subjected to density tests by 2,5 m of water head. This requirement doesn't apply to rudder blades made of stainless steels.

2.4 RUDDER STOCK

2.4.1 Rudder stock is to pass through hull by means of the strong pipe and appropriate sealing glands are to be used to prevent penetration of outer water inside craft hull.

It is allowed to use pipes made of synthetic materials provided the following conditions are complied with:

rudder stock bearings are immovably fixed on hull;

the pipe reaches minimum 0,75 height of freeboard in the aft end;

guaranteed water tightness of all equipment under any operating conditions.

2.4.2 Except special cases, the rudder stock and other main parts of the steering gear are to made of steels with the yield strength at least 235 MPa. Rudder stock is to be firmly connected to the rudder blade. There should be no points with a weak strength in the connection of the blade and rudder stock.

2.4.3 Diameters of the solid metal rudder stock d_{ti} (refer to Fig. 2.4.3), mm, shall not be less than those calculated by the following formula:

$$d_{t1} = 33\sqrt[3]{\frac{M_s}{R_m+R_e}}; \quad (2.4.3\text{-}1)$$

$$d_{t1} = 33\sqrt[3]{\frac{0{,}75M_2^2+M_s^2}{R_m+R_e}}; \quad (2.4.3\text{-}2)$$

for supported and semi-spade rudders:

$$d_{t3} = (d_{t1} + d_{t2})/2; \quad (2.4.3\text{-}3)$$

for suspended rudders:

$$d_{t3} = 1{,}15(d_{t1} + d_{t2})/2; \quad (2.4.3\text{-}4)$$

for supported and semi-spade rudders:

$$d_{t4} = 0{,}6d_{t2}; \quad (2.4.3\text{-}5)$$

for rudder stocks passing through the whole height of rudder blade:

$$d_{t5} = d_{t3} \quad (2.4.3\text{-}6)$$

where: M_s = spindle torque according to 2.2.4, in Nm;
M_2 = bending moment according to 2.3.2, in Nm;
Rm = ultimate tensile strength of the used material, in MPa;
R_e = yield strength of the used material, in MPa.

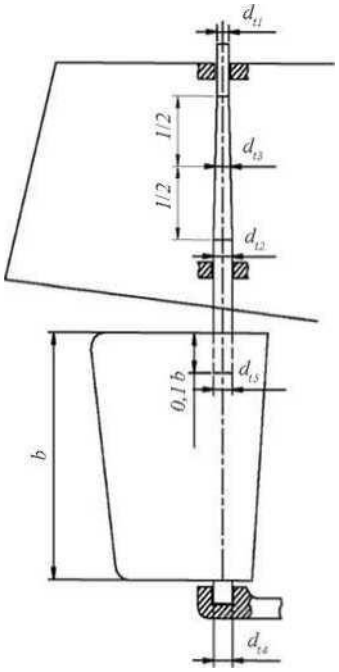


Fig. 2.4.3
Rudder stock

2.4.4 It is allowed to make rudder stocks of pipes.

Diameter of such pipe and thickness of its walls should be so that their strength at twisting or simultaneous exposure to twisting and bending of the hollow rudder stock is the same as for the solid rudder stock.

If material of the same strength is used, the diameter of the hollow rudder stock (pipe) is to be taken so that to observe the following dependence:

$$d_c \leq \sqrt[3]{\frac{d_{out}^4 - d_{in}^4}{d_{out}}} \qquad (2.4.4)$$

where d_c = diameter of the solid rudder stock, in mm;
d_{out} = outer rudder stock diameter made of pipe, in mm;
d_{in} = inner rudder stock diameter made of pipe, in mm.

It is not recommended to use pipes with wall thickness less than 0,1 d_{out}.

2.4.5 Measures shall be taken to prevent rudder stock loosing (displacement) from bearings.

2.5 TRANSOM RUDDERS

2.5.1 Design of the permanent (stationary) transom rudder is to comply with the requirements 2.3.1-2.3.5.

2.5.2 If the rudder blade is detachable, then it is necessary to take measures to prevent its spontaneous lifting during motion. Meanwhile, the design of the both blade and the yoke shall comply with the requirements 2.3.1-2.3.5.

2.5.3 Diameters of steel pintles d_{s1}, d_{s2} and d_{s3}, in mm, used to hang up the transom rudder are shown in Fig. 2.5.3 and they shall not be less than

$$d_{s1} = 0{,}2\sqrt{F\,(t\,/\,a)}; \qquad (2.5.3\text{-}1)$$

$$d_{s2} = 0{,}2\sqrt{F\,(1-t\,/\,a)}; \qquad (2.5.3\text{-}2)$$

$$d_{s3} = 0{,}2\sqrt{F\,(1+t\,/\,a)}; \qquad (2.5.3\text{-}3)$$

where d_{s1} = diameter of upper pintle;
d_{s2} = diameter of lower pintle, if F force is applied between pintles;
d_{s3} = diameter of lower pintle if F force is applied below this pintle;
F = design hydrodynamic load according to 2.2.1, in N;
t = vertical distance between the lower pintle and the point where the F force is applied, in mm;
a = vertical distance between the pintles, in mm.
However, pintle diameters shall not be less than d_s:
d_s = 14 mm – for structural steel;
d = 12 mm – for stainless steel.

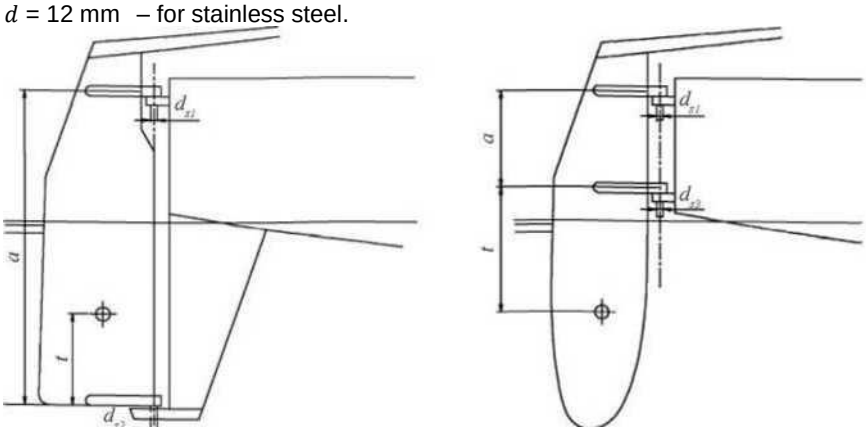


Fig. 2.5.3
Transom rudders

2.5.4 The rudder hanging on the pintles is to be fitted with arrangements preventing its spontaneous lifting and falling out.

2.5.5 Design of ironworks for hanging rudder on the aft end is to correspond with the loads acting in the places of fixing the ironworks.

Thickness of flat ironworks which are used for holding rudder pintles shall be at least 0,2 diameter of the said pintles.

2.6 COUPLINGS OF RUDDER STOCK WITH RUDDER BLADE

2.6.1 Some structural elements of the rudder stock connection with the rudder blade are to be made in accordance with the loads specified in 2.2.2 and 2.2.3.

2.6.2 If flange connections are used the diameter of bolts d_s, in mm, connecting flanges should be at least those calculated by the formula

$$d_s = 0{,}62\sqrt[3]{\frac{d_t^3}{n \cdot r_s} \cdot \frac{R_{et}}{R_{es}}} \qquad (2.6.2)$$

where d_t = diameter of rudder stock calculated according to 2.4.3, in mm;
n = number of bolts which shall not be less than:
$n = 4$ – for craft which length is less than 12 m;
$n = 6$ – for craft which length is 12 — 24 m;
r = mean distance from the bolt axis to the middle of pintles, in mm;
R_{et} = yield strength of the rudder stock material, in MPa;
R_{es} = yield strength of the bolt material, in MPa.

2.6.3 All bolts shall be stud bolts except cases when keys are fitted, then only two stud bolts are enough. Nuts are to be of normal size. Bolts and nuts are to be firmly fixed. At least two bolts are to be located in front of the rotation axis of the rudder stock.

2.6.4 The distance between the bolt axis and flange edge is to be at least the diameter of bolt.

2.6.5 Yield strength of steel the bolt is made of shall not be less than 235 MPa.

2.6.6 Flange connection shall be made of the same casting as the rudder stock. It is allowed to weld flange to the rudder stock, which end is set to diameter by 10 per cent exceeding the design one (at least $d_t + 10$ mm), the height of setting shall not be less than the flange thickness. On craft which length is less than 12 m if stainless steel is used and the rudder stock diameter is by 10 per cent more than the design one it is allowed to weld the flange without setting of the rudder stock end. Method of connection is to be agreed with the Register.

2.6.7 Flange thickness shall not be less than the design diameter of the bolt specified for $n = 6$.

2.6.8 Flange connections shall be fitted with the key but if the bolt diameter is 10 per cent greater than the required one then a key may not be used.

2.6.9 If cone connections are used, then the conical part of the rudder stock is to comply with the dependence:

$$1/12 \leq (d_1 - d_2)/l \leq 1/8; \qquad (2.6.9\text{-}1)$$

$$l \leq 1{,}5\, d_1 \qquad (2.6.9\text{-}2)$$

where d_1 = rudder stock diameter in the largest cone section, in mm;
d_2 = rudder stock diameter in the least cone section, in mm;
l = length of cone, in mm.

2.6.10 The conical connection shall be fitted with relevant key.

2.6.11 The size of nut shall not be less than the following ones:
inner thread diameter $d_3 \geq 0{,}65\, d_1$
height of nut $h_n \geq 0{,}60\, d_3$;
outer thread diameter $d_n \geq 1{,}20\, d_2$ or $d_n \geq 1{,}50\, d_3$, whichever is greater.
The nut shall be firmly fixed to prevent unscrewing.

2.6.12 Other types of rudder stock couplings shall be substantiated by the designer.

2.7 RUDDER BEARINGS

2.7.1 In respect of bearings of rudder stock and pintles accepting transverse load the requirement 2.1.8 shall be complied with.

Rudder bearing square A_n, in mm², (height multiplied by diameter) shall not be less than

$$A_n = R/P_a \qquad (2.7.1)$$

where R = design value of the reaction force, in N, caused by load calculated according to 2.2.1;
P_a = permissible pressure, in MPa, depending on the material of bearing:
$P_a = 2{,}5$ – soft synthetic material (teflon);
$P_a = 5$ – solid synthetic material (polyamides);
$P_a = 7$ for steel and bronze.

2.7.2 Height of bearings shall not be less than the rudder stock diameter in the place of installation of bearing, however, it shall not be more than 1,2 diameter of rudder stock for bearing made of metal or two diameters for the bearing made of synthetic material.

2.7.3 If a bearing bushing is made of steel it shall be made of the stainless steel. If a stainless steel is used for the rudder stock bearing also made of stainless steel it is necessary to provide measures against grinding.

2.7.4 Bearing linings (bushings) of bearings shall be firmly fixed in the bearing box in order to avoid accidental displacement.

In order to accept the weight of rudder and stock one of the bearings shall be a thrust bearing able to carry axial load equal at least the weight of rudder and rudder stock.

Measures shall be taken against the upward axial displacement of the rudder stock by the value more than that allowed by the steering gear design. Rigidity of hull structures carrying bearings of rudder stock and pintles (support), shall be checked for action of forces listed in 2.2.3 in respect of the specific case. Elastic displacement of support under this load shall not exceed single-sided clearance of bearing.

2.8 RUDDER SKEG AND HEEL

2.8.1 Design of the rudder support in the form of skeg or rudder heel shall be rigid and strong.

Stresses originating in any section due to design transverse reaction in the bearing of rudder heel shall not exceed $0{,}25\ R_m$ (ultimate tensile strength).

If the support doesn't comply with this condition then the design of rudder and its rudder stock is to comply with the requirements for rudders without lower support.

2.9 RUDDER TILLER AND QUADRANT

2.9.1 Dimensions of tiller or rudder quadrant arm (arms) shall be determined in relation to the design spindle torque and used material.

Modulus of resistance W_1, in mm³, tiller or rudder quadrant arm (arms) in the place of connection with the boss shall not be less than

$$W_1 = 1000M_s/kR_m. \quad (2.9.1\text{-}1)$$

Modulus of resistance, in mm³, in the end of tiller shall not be less than

$$W_2 = 180M_s/kR_m \quad (2.9.1\text{-}2)$$

where M_s = design spindle torque, in Nm, according to 2.2.4;
R_m = rupture strength of the applied material, in MPa;
k = coefficient depending on the material:
$k = 0{,}40$ for metals;
$k = 0{,}15$ for laminated wood;
$k = 0{,}09$ for solid wood.

2.9.2 If the lifting tiller is used, its fastening to rudder stock (or transom rudder) is to be able to withstand the design load at tiller lifted at 20° angle.

2.9.3 Dimensions of the emergency tiller are to be calculated for the moment equal to 0,7 design one.

2.9.4 Length of the emergency tiller is to be so that to ensure safe steering by rudder by not more than two men personally or by means of tackles.

2.9.5 If there is tetrahedral lobe on the rudder stock for fixing the emergency tiller, the side of the square shall be at least $0{,}7\,d_{t1}$, and its height at least $0{,}8\,d_{t1}$, where d_{t1} — diameter of the rudder stock head according to 2.4.3.

2.9.6 The outer diameter of the quadrant or tiller boss shall not be less than 1,8 diameter of rudder stock in the point of its forcing on, and its height — not less than that diameter. Bosses consisting of several parts shall be connected by at least four bolts, two on each side of the rudder stock.

Total square of the section of these bolts, in mm², shall not be less than

$$A = 12\,M_s/f \quad (2.9.6)$$

where M_s = design torque, in Nm;
f = distance from the bolt axis to the axis of the rudder stock, in mm.

2.9.7 Design of the steering gear quadrant with the mechanical drive shall comply with the requirements in 2.9.1.

2.10 STEERING GEAR

2.10.1 Each craft shall have two steering gears — main and auxiliary ones unless expressly provided otherwise.

Mechanical steering gear shall be capable of:

putting the rudder from one board to the other at least ±35°. For the outboard motor this angle shall be at least ±30°;

limit maximum deviations of the rudder by means of stoppers;

safe perception of loads caused by the design spindle torque due to action of the pressure force by all elements of the gear;

tangential force on the steering-wheel ring not more than 200 N;

information on the rudder blade position relative to the centre line plane by means of the relevant indicator on the wheelman's position;

use of the emergency tiller or other emergency steering gear complying with the requirements in 2.9.3.

2.10.2 The main steering gear shall be capable of putting the fully submerged rudder at a maximum operational ahead speed of the craft and under the same conditions from 35°on one side to 30° on the other side within 30 s.

2.10.3 The auxiliary steering gear shall be independent from the main steering gear and shall be capable of putting the rudder from 20° on one side to 20° on the other side in not more than 60 s at half of the maximum operational ahead speed at least:

for craft of design categories **A, A1, A2, B, C** and **C1** — 5 knots;

for craft of design categories **C2, C3** and **D** — half full speed.

It is allowed that the main and auxiliary gears have some common parts (for instance, tiller, quadrant, gear box, cylinder block etc.) provided the respective scantlings of these parts are increased in accordance with 6.2.8.2, Part IX "Machinery" of the Rules for the Classification.

2.10.4 The main steering gear may be hand-operated provided it meets the requirement of 2.10.2 at steering force not more than 120 N and the number of steering wheels of not more than 25 per one deflection of the rudder. If the said condition is not complied with, the main steering gear shall be operated by power.

Tiller may be used as a main steering gear if the requirement 2.10.2 is complied with at a tiller steering force not more than 160 N per each working man; meanwhile, there is no need to install the auxiliary steering gear.

2.10.5 Where the main steering gear consists of two equal power units, there is no need to install the auxiliary steering gear.

2.10.6 The auxiliary steering gear can be hand-operated, if the requirement 2.10.3 is complied with at a tiller steering force not more than 160 N per each working man and the number of turns of the wheel is not more than 25 per one full helm deflection.

Steering tackles or tiller can be used as the auxiliary steering gear if the requirement 2.9.3 is complied with at the force in the runner of steering tackle or tiller not more than 160 N per each working man.

In all other cases the auxiliary steering gear is to be power driven.

2.10.7 Steering gear shall have the stopper for the rudder rotation which permit its turn either board to the β° angle:

$$(\alpha^\circ + 1^\circ) \leq \beta^\circ \leq (\alpha + 1{,}5^\circ) \qquad (2.10.7\text{-}1)$$

where α° = maximum angle of putting the rudder to which the end switches of the steering gear are adjusted is usually taken as $\alpha^\circ \leq 35^\circ$.

All details of the stopper including those that are simultaneously used as the details of the steering gear shall be designed to withstand forces corresponding to the ultimate reverse torque on the rudder stock M_{ulf} in kN·cm, calculated by the formula

$$M_{ult} = 2{,}7\ d^3. \qquad (2.10.7\text{-}2)$$

Meanwhile, stress in these details shall not exceed 0,95 yield strength of their material.

2.10.8 Hand-operated shaft steering gear in respect of design, scope of bench tests and documentation shall comply with the requirements of ISO 13929:2001.

2.10.9 Hand-operated rope steering gear in respect of design, scope of bench tests and documentation shall comply with the requirements of ISO 8847:1987.

2.10.10 On craft with outboard motor the remote hand steering gear in general case in respect of design, scope of bench tests and documentation shall comply with the requirements of EN 28848:1993 or EN 29775:1993 at power of the outboard motor from 15 to 40 KW.

2.10.11 Hand-operated rope steering gear the tensile strength of rope steering rods, in N, shall not be less than that calculated by the formula

$$R = 9{,}5\ M_s/r_s \qquad (2.10.11)$$

where M_s = design spindle torque, in Nm, according to 2.2.4;
r_s = quadrant radius, in m.

Ropes of steering rods shall be made of stainless steel or another corrosion-resistant material of equivalent strength.

Lanyards and connection elements are to be chosen corresponding to the strength of rods. Diameter of leading blocks shall not be less than sixteen diameters of rope.

2.10.12 On craft with the remotely controlled outboard motor, the motor shall be fitted with the relevant lever on tiller for connection with the steering gear. If there are two engines both engines are to be connected between each other.

Meanwhile, the requirements of 2.10.1 shall be complied with in respect of the angles of deflection the helm and presence of stoppers (mechanical stops).

2.10.13 One pair of boat oars with rowlocks at $L_{wl} \leq 6$ m is to be provided as an emergency means of movement and steering on craft with the outboard motor.

2.10.14 In all other respects the steering gears are to comply with the applicable requirements of Part V "Machinery Installations. Machinery. Systems and Piping" and Part VII "Electrical Equipment".

2.11 RUDDER TRUNK

2.11.1 The rudder trunk design shall assure strength which would ensure resistance to forces emerging in the steering gear. The rudder trunk shall be strengthened in the longitudinal and transverse directions and be connected to the longitudinal and transverse framing.

The minimal wall thickness of the trunk made of metal materials shall be calculated by the formula

$$S = 0{,}9\sqrt{L_{wl}}\sqrt{k} \qquad (2.11.1\text{-}1)$$

where L_{wl} = craft length by design waterline, in m;
k = coefficient considering type of material:
$k = 1{,}0$ for usual carbon steel;
for steels with other characteristics;

$$k = 635/R_{eH} + R_m \qquad (2.11.1\text{-}2)$$

where R_{eH} = yield strength of steel, in N/mm²;
R_m = steel ultimate tensile strength, in N/mm²;
For sea water resistant aluminium alloys —

$$k = 635/R_{p0,2} + R_m \qquad (2.11.1\text{-}3)$$

where $R_{p0,2}$= 0,2 % yield strength of aluminium alloy, in N/mm²;
R_m = aluminium alloy ultimate tensile strength, in N/mm².

2.11.2 Strength of the rudder trunk on craft made of glass fiber plastic shall be equal to the strength of the bottom plating.

The rudder trunk shall pass through the craft hull till the crossing with the deck or be fitted with the seal higher than the actual waterline.

At height of 200 mm from the actual waterline hoses or sleeves like hoses made of material agreed with the Register may be used for extension of the rudder pipe.

2.11.3 On craft of design categories **A, A1, A2, B** and **C**, which upper end of the rudder trunk is not connected with the cockpit bottom or main deck and located in the inner underdeck space the seal is to be fitted in the upper end of the rudder trunk to prevent penetration of the outer water inside craft hull through the rudder trunk. Specific types of designs of these seals depend on the purpose of craft, dimensions etc. and it is a matter of the special consideration by the Register. However, without regard of the design of these seals, all of them are to be made so that they are accessible for inspection and maintenance by the crew at any time.

3 ANCHOR ARRANGEMENT

3.1 GENERAL

3.1.1 Each craft except of design category **D** shall be provided with the anchor arrangement ensuring capability of the long mooring of a craft far from shore exposed to current and at maximum wind and waves permissible for sailing of this craft as well as fast and safe release and hoisting of the anchors at all possible situations.

Craft of design category **D** may have no anchor arrangements.

3.1.2 The following elements shall be a part of the anchor arrangement:

anchor (one or several);

anchor cables and/or ropes;

anchor release and hoisting mechanisms (if necessary);

arrangements for stowage of anchors onboard (if necessary);

arrangements for stowage and release of inboard end of chain cables and/or ropes (if necessary).

3.2 CHARACTERISTICS OF ANCHOR OUTFIT

3.2.1 Supply of anchors, cables and ropes shall comply with Tables 3.2.1-1 and 3.2.1-2 on the basis of outfit characteristics.

Outfit characteristics, N_c, in m³, is calculated by the formula

$$N_c = 0{,}6\ L\ B\ D_1 + A \qquad (3.2.1)$$

where L = design craft length, in m, equal to half sum of craft length L_H and length at design waterline;

B = maximum craft breadth, in m, measured by the outer edges of framing from one side to another without regard of the out-whales;

D_1 = conditional depth, in m, equal to depth of craft *D* plus 1/6 keel height measured at transverse direction amidships at design waterline;

$A = 0{,}5$ of the volume of superstructures, in m³, meanwhile superstructures and deckhouses which width is less than B/4 may be disregarded.

Table 3.2.1-1

Anchors, chain cables/cables and towing ropes of sail boats, motor sailers

Outfit characteristic N_c, in m'	Water displacement Δ, in t	Weight of anchors in kg		Chain cable or cable			Towing rope	
		1st anchor[1]	2nd anchor	Length of chain, in m[2]	Diameter, in mm		Length, in m	Diameter[4], in mm
					Chain[3]	Cable[4]		
≤10	<0,15	2,5	—	—	—	8	$5L_H$	12
≤10	0,20	3,0	—	—	—	8		12
≤10	0,30	3,5	—	—	—	8		12
≤10	0,40	4,5	—	—	—	8		12
≤10	0,50	5,0	—	—	—	10		12
≤10	0,60	5,5	—	—	—	10		14
≤10	0,75	6,5	—	—	—	10		14
≤10	1,00	7,5	—	—	—	10		14
≤10	1,50	8,7	—	—	—	10		14
≤10	2,00	10,5	9,0	22,5	6,0	12		16
15	3,00	12,0	10,0	24,0	6,0	12		18
20	4,00	13,0	10,5	25,0	6,0	12		18
25	5,00	13,5	11,0	26,0	7,0	14		18
30	6,00	15,0	13,0	27,0	7,0	14		18
40	8,00	17,0	15,0	29,0	8,0	16		20
55	12,00	21,0	18,0	32,5	8,0	18		22
70	17,00	25,0	21,0	36,0	9,0	24	$4{,}75L_H$	22
90	23,00	29,0	25,0	40,0	10,0	26		22
110	29,00	34,5	29,0	43,0	10,0	28		24
130	36,00	40,0	34,0	47,0	11,0	—	$4{,}5L_H$	24
155	44,00	46,5	40,0	52,5	13,0	—		24
180	52,00	53,0	45,0	57,0	13,0	—		24
210	57,00	62,0	53,0	62,0	13,0	—		26
245	72,00	73,5	62,0	68,0	14,0	—	$4{,}25L_H$	26
280	84,00	84,0	71,0	74,0	16,0	—		26
300	100,00	95,0	81,0	78,0	16,0	—		26

[1] For craft of design categories **C2, C3** and **D** it is allowed to use anchors without a stock with a weight at least 1,33 of the figure specified in the table.

[2] It is applied individually to each anchor.

[3] Chain cable diameter.

[4] Nominal diameter of three-stranded rope twisted nylon cable according to Table 4.5.1

Table 3.2.1-2

Anchors, chain cables/cables and towing ropes of motor craft, oar-propelled and non-self-propelled craft

Outfit characteristic N_c, in m'	Water displacement Δ, in t	Weight of anchors in kg		Chain cable or cable			Towing rope	
		1st anchor[1)]	2nd anchor	Length of chain, in m[2)]	Diameter, in mm		Length, in m	Diameter[4)], in mm
					Chain[3)]	Chain[3)]		
≤10	≤0,15	2,5	—	—	—	8	$55L_H$	12
—	0,20	3,0	—	—	—	8		12
—	0,30	3,5	—	—	—	8		12
—	0,40	4,5	—	—	—	8		12
—	0,50	5,0	—	—	—	10		12
—	0,60	5,5	—	—	—	10		14
—	0,75	6,5	—	—	—	10		14
—	1,00	7,5	—	—	—	10		14
—	1,50	8,7	—	—	—	10		14
≤10	2,00	9,0	—	20,0	6,0	12		16
15	3,00	10,0	—	22,0	6,0	12		18
20	4,00	11,0	—	23,0	6,0	12		18
25	5,00	12,0	—	24,0	6,0	12		18
30	6,00	13,0	—	25,0	7,0	14		18
40	8,00	14,0	12,0	26,0	7,0	14		20
55	12,00	18,0	15,0	29,0	8,0	16		22
70	17,00	21,0	18,0	32,5	8,0	18	$4,75L_H$	22
90	23,00	25,0	21,0	36,0	9,0	24		22
110	29,00	29,0	25,0	38,5	10,0	26		24
130	36,00	34,5	29,0	42,0	10,0	28	$44,5L_H$	24
155	44,00	40,0	34,0	47,0	11,0	—		24
180	52,00	46,0	39,0	51,0	13,0	—		24
210	57,00	52,5	44,0	55,5	13,0	—		26
245	72,00	61,0	52,0	61,0	13,0	—	$44,25L_H$	26
280	84,00	70,5	60,0	66,5	14,0	—		26
300	100,0	79,5	67,5	70,0	16,0	—		26

[1)] For craft of design categories **C2, C3** and **D** it is allowed to use anchors without a stock with a weight at least 1,33 of the figure specified in the table.
[2)] It is applied individually to each anchor.
[3)] Chain cable diameter.
[4)] Nominal diameter of three-stranded rope twisted nylon cable according to Table 4.5.1

3.2.2 In case of a light craft which displacement is less than that specified in column 2, Tables 3.2.1-1 and 3.2.1-2, anchor appliances may be chosen on the basis of the mean value between the water displacement and characteristics of the anchor appliances. In this case the weight of the anchors is to be defined by means of the interpolation and diameter of chain links and length of cables and ropes are to be rounded upward to the nearest greatest value.

For craft of design categories **C2, C3** and **D** the anchor appliances are chosen on the basis of N_c corrected by the adjustment coefficient equal to 0,75.

3.2.3 For craft with water displacement less than 1,5 t the anchor appliances are chosen on the basis of the water displacement.

3.2.4 For berth connected craft the anchor appliances are chosen according to Table 3.2.1-2 on the basis of characteristics 3.2.1.

3.2.5 For anchors fitted with anchor cables it is a mandatory requirement to fit the cable to anchor by means of piece of cable of relevant diameter which length is not less than one anchor length of chain specified in 3.4.1.5.

3.3 ANCHORS

3.3.1 The weights of anchors listed in Tables 3.2.1-1 and 3.2.1-2 refer to anchors of the high holding power.

In order to acknowledge an anchor as a high holding power anchor it is necessary to carry out tests following the approved Test program. The requirements for manufacture of anchors are given in Section 3, Part III "Equipment, Arrangements and Outfit" of the Rules for the Classification and 3.5, Part IV "Technical Supervision during Manufacture of Products" of the Rules for Technical Supervision during Construction of Ships and Manufacture of Materials and Products for Ships".

3.3.2 If two anchors are fitted, the mass of each anchor separately may differ by 7 per cent from the figure given in Tables 3.2.1-1 and 3.2.1-2, meanwhile the total mass of these two anchors shall not be less than the mass required.

3.3.3 Materials for anchors shall comply with the requirements of Part XIII "Materials" of the Rules for the Classification. Anchors which mass is more than 75 kg and their chain cables are to be tested in the presence of the Register representative. Anchors which mass is less than 75 kg and anchors intended for craft of design categories **C1, C2, C3** and **D** may pass relevant tests at the manufacturer facilities without presence of the Register representative.

3.3.4 The sail monohull and multihull craft of design categories **A, A1, A2, B** and **C** shall be fitted with the floating anchor with diameter of bell mouth between 10 per cent and 15 per cent of craft length L_H.

The floating anchor shall be fitted with the anchor cable made of plain-laid nylon rope which length is equal to $10\ L_H$ and diameter equivalent to the tow line for this craft.

A weight of 20 kg shall be fitted onboard for embedding the floating anchor.

3.4 ROPES AND CHAIN CABLES

3.4.1 Anchor cables/ropes and chain cables.

3.4.1.1 The tow line may be used as an anchor cable on crafts with water displacement 1,5 t and less.

3.4.1.2 Chain cables may have short links or links with studs. They shall be made of mild steel or special steel in accordance with the requirements of Part XIII "Materials" of the Rules for the Classification.

3.4.1.3 It is allowed to use chain cables with short links which diameter is defined for the chain cables with studs.

3.4.1.4 Anchor cables shall be 1,5 longer that the length specified for the chain cable in Tables 3.2.1-1 and 3.2.1-2 and be spliced into a thimble at one end.

3.4.1.5 Anchor length of chain shall be inserted between the anchor cable and anchor which diameter is given in column 6, Table 3.2.1-1 or 3.2.1-2 and length according to Table 3.4.1.5.

Table 3.4.1.5

Nominal diameter of chain cable of anchor length of chain, in mm	Anchor length of chain, in m
6 — 8	6,0
9 — 16	12,5

Chain cables and anchor length of chain shall be fitted with enforced links on the ends. A swivel is to be fitted between an anchor and chain cable.

3.4.1.6 The inboard end of chain cable shall be connected to craft hull so that in case of danger it can be released at any time from the easily accessible and safe place for the crew. Inboard end of chain cable is to be at least by 15 per cent (but not greater than 30 per cent) stronger than the nominal breaking strength.

3.4.1.7 In order to serve for anchors with a mass from 30 to 50 kg it is recommended to use anchor winches. On sail boats the sheet winches may be used for release and hoisting such anchors.

3.4.1.8 Anchor machinery shall be used for serving anchors with a mass greater than 50 kg on a mandatory basis. It is recommended to use capstans or windlasses, winches and similar mechanisms as an anchor machinery.

3.4.1.9 Anchor machinery shall comply with the requirements of 3.7. If anchors weighing more than 50 kg are to operate together with ropes/cables, then the anchor winch is to be fitted with the rope drum enabling fast release of the inboard end of chain cable at all possible situations. Safety of its operation is to be confirmed in practice.

3.4.1.10 At all craft where it is allowed to use the tow line as an anchor cable there shall be details connecting tow cable with the anchor length of chain.

3.5 CHAIN LOCKER

3.5.1 Cable lockers shall be provided for stowage of each chain.

When one chain locker is designed for two chains it shall be provided with an internal division so that separate stowage of each chain is ensured. Transverse dimensions and height of the chain locker are to ensure direct and unimpeded lead of chain through the deck organizer even when the chain is absolutely heaved.

3.5.2 On craft with chain locker measures shall be taken to prevent flood of the adjacent compartments when the chain locker is submerged through the deck organizer.

3.6 ARRANGEMENT OF ANCHOR APPLIANCES ONBOARD

3.6.1 The actual number and mass of anchors, hull shape in the area of regular location of the anchor appliances, arrangement of details of the anchor appliances as well as arrangement of the foreward forepeak bulkhead, transom board and afterpeak bulkhead is to be considered during arrangement of anchor appliances onboard.

3.6.2 Mutual arrangement of deck organizers, anchors, chain cables and locker is to allow laying of the whole length of chain cable with minimum crew's labour input.

3.6.3 Regular place for anchors are bow and/or stern part of craft. Type and design of these regular places of storage of anchors onboard depend on the specific developed design of craft approved by the Register for the implementation.

3.6.4 Without regard of type, the main requirement for place of stowage is safe stowage of anchors at any heel and trim corresponding to her design category.

3.6.5 Anchor deck organizers shall comply with the following requirements:

internal diameter of hawse hole if it is a round one or the least diameter if it is an oval one or close to an oval shall be at least 10 diameters of chain cable or four diameters of the anchor cable and deck organizer wall thickness shall be not less than 0,5 chain cable diameter;

if stoppers are used onboard to fix the chain cable then its bending in the place of passage through the stopper and deck organizer is to be minimal.

3.6.6 Securing of anchors onboard shall assure their safe storage in the place of stowage at any significant heels and trims of craft.

3.6.7 For craft of design categories **A, A1, A2** and **B** safe storage of anchors and chain (in stowed for sea position) shall be ensured at maximum permissible angles of heel. Securing and stowage of the chain cable in the locker is to ensure that after return of a craft to the normal operating position the anchor cable shall not be tangled and it is in a condition ready for release if it is necessary to drop an anchor.

3.6.8 Stoppers, holding an anchor and chain cable are to be placed so that stopping and release of anchors is performed safely and rather easily.

3.7 ANCHOR MACHINERY

3.7.1 Scope of application.

The requirements of this Chapter apply to the anchor machinery (windlasses, capstans and winches) which are installed on a craft in accordance with the requirements in 3.4.1.8 and 3.4.1.9.

3.7.2 Type of drive.

3.7.2.1 Hand-operated drive is permissible as the main (primary) one.

Hand drive levers shall be fitted with protection against the counter rotation.

3.7.2.2 For power driven windlasses it is recommended to provide emergency drive independent from the main drive. If an emergency drive is a hand-operated one it shall be designed so that switching of a power driven drive will not cause any danger.

3.7.3 Overload protection.

If a drive of anchor machinery may originate a moment exceeding 0,5 of the trial load of chain cable then there should be protection against exceeding the said load which is fitted between the drive and machinery.

3.7.4 Disengaging clutches.

Anchor machinery shall have a disengaging clutch between a sprocket and drive shaft.

3.7.5 Breaks.

Anchor machinery shall be fitted with breaks which guarantee safe stopping and holding of anchors and chain when a sprocket is disengaged from shaft. Besides, in case of non-self-braking machinery there shall be arrangements preventing full paying out of chain if the drive fails to operate with the engaged sprocket.

3.7.6 Chain-wheels.

Chain wheels of anchor machinery shall have at least five cams. For sprockets with the horizontal axis the angle of contact with chain is to be at least 115°, for sprockets with the vertical axis this angle shall be at least 150°.

3.7.7 Power and strength dimensions.

3.7.7.1 Anchor machinery shall be capable of lifting triple mass of an anchor with a mean speed of 3 m/min. In case of hand-operated windlasses the force applied to a handle shall not exceed 15 kg at a radius approximately 35 cm and rotational speed 30 rpm.

3.7.7.2 The drive shall be able to withstand a short term overload during detachment of an anchor from soil.

3.7.7.3 Strength dimensions of drive elements shall be assigned in accordance with the usual design practice of craft machinery based upon requirements of Section 3, Part V "Machinery Installations. Machinery. Systems and Piping".

4 MOORING AND TOWING ARRANGEMENTS

4.1 GENERAL

4.1.1 Each craft shall be equipped with the mooring arrangement providing reliable and safe mooring operations.

The mooring arrangement is to be designed simultaneously with design of anchor and towing arrangements of a craft.

4.1.2 The mooring arrangement shall consist of the following main machinery and equipment (considering water displacement and size of craft):

machinery for craft mooring;

mooring cables;

details and equipment serving for fixing and guiding mooring cables (bollards, fairleads, rollers, belaying cleats, mooring deck organizers, etc.);

auxiliary equipment and arrangements usually used for craft mooring (mooring cable stoppers, reels, fenders, outwales, etc.).

Only one mooring cable is to be fixed on the mooring bollard or cleat at any mooring scenario. It is not allowed to lead more than one mooring cable through the mooring deck organizer or mooring fairlead.

At least 16 m one throwing line shall be provided on each craft.

4.2 MOORING APPLIANCES

4.2.1 Each craft shall be completed with mooring cables of the following quantity:
1 — for craft, which length is $L_H \leq 6$ m;
2 — for craft, which length is $L_H > 6$ m.
Cable nominal diameter shall comply with Table 4.2.1.
The length of mooring cables shall be:
$1{,}5\ L_H$ if a craft is completed with one cable;
at least $1{,}5\ L_H$ and $1{,}0\ L_H$, respectively, if a craft is completed with two cables.

Table 4.2.1

Cable nominal diameter

Craft water displacement, in t	Nominal diameter of three-stranded twisted polyamide cable[1], d_2, in mm
≤0,2	10
0,6	12
1,0	14
2,0	14
6,0	16
12,5	18
25,0	20
50,0	22
75	24
100 and more	26
Recommendations on choice of a cable, see Table 4.5.1.	

4.2.2 Mooring bollards, bitts and belaying cleats shall be made of metal (carbon construction steel, stainless steel, brass, bronze, aluminium).

Cast bollards and bitts, as well as side mooring deck organizers can be made of cast iron. On crafts with a length L_H up to 6 m inclusive the mooring cleats can be made of wood bound by metal fastened to foundation or on wooden craft — directly to deck.

4.2.3 The outer diameter of mooring bollard or bitt shall be at least 5 diameters of the mooring synthetic cable and height sufficient for four turns of cable laid upon each other. For safe fixing of mooring ends on bitts and bollards the spreaders with the diameter not less than 1,2 diameter of the mooring cable shall be fitted.

4.2.4 Bollards, bitts, belaying cleats, fairleads, mooring deck organizers and their foundations shall be chosen so that if force equal to breaking load of the mooring cable or tow line as well as anchor cable or chain is applied to them the stresses in them would not exceed 0,5 of their material's yield strength.

4.2.5 It is recommended to use capstans and winches with various mechanical drives (hand-operated drive, electrical or hydraulic drives) as a mooring machinery.

4.3 LOCATION OF MOORING ARRANGEMENT ONBOARD

4.3.1 General arrangement of mooring machinery and appliances depends on craft dimensions. Mutual location of mooring machinery and appliances shall ensure safe and convenient working conditions to handle mooring cables.

4.3.2 To ensure safe mooring of a craft to berthing structures the mooring machinery and appliances are to be located in the bow and aft ends of craft.

4.3.3 When mooring machinery with drives or bollards and capstans without drives are fitted there shall be provided a capability to pay out (haul) mooring cables to any side without slipping of these cables from drums, gipsy heads, mooring bollards, cleats and rollers during operation.

4.3.4 In order to assure uniformity of laying the mooring cables on drums of capstans and winches, the distance from the drum axis of mooring machinery to the arrangement changing direction of the cable (deck organizer, mooring fairlead, roller), shall be at least 7 lengths of drum.

4.3.5 Distance from the roller axis to the axis of warping drum (gipsy head) of mooring machinery shall be at least 50 diameters of the mooring cable.

4.3.6 The angle of vertical slope of the cable from the mooring fairlead to belaying cleats or bollards shall be not more than 15°.

4.3.7 If a mooring bollard or mooring belaying cleats are located forward from the midship section its relevant deck organizer shall be located forward from the mooring bollard or belaying cleats. If mooring bollard or mooring belaying cleats is located behind the midship section and its relevant deck organizer shall be located further astern from mooring bollard or belaying cleats.

4.3.8 Distance from the mooring fairlead or mooring deck organizer to relevant mooring bollards or belaying cleat shall be not less than 40 diameters of the mooring cable.

4.4 TOWING ARRANGEMENT

4.4.1 General.

4.4.1.1 Each craft shall be provided with the safe towage by another craft at wind and waves typical for the design category of this craft.

4.4.1.2 On motor craft and motor-sailing craft it is recommended to provide towing assistance to another craft of the same or less dimensions than this craft with regular arrangements to use her own engine of the propulsion plant.

4.4.1.3 The number and nomenclature of equipment and machinery of towing arrangement as well as their location on craft shall be chosen by designer in accordance with the structural features of hull and type of this craft as well as specific features of deck equipment.

4.4.2 Requirements for towing arrangement.

Craft towing arrangement shall consist of:

tow line of sufficient length and diameter in accordance with Table 3.2.1-1 or 3.2.1-2;

equipment for securing and guiding tow lines.

Designing of towing arrangement and developing methods of craft towage shall be integrated with designing of anchor and mooring arrangements.

4.4.3 Tow line.

4.4.3.1 In a craft designed to provide also towage assistance to other craft it is recommended for motor craft and motor-sailing to check breaking strength of tow line by the engine design thrust. Breaking strength of tow line F_p in KN, shall be at least

$$F_p = K \cdot F \qquad (4.4.3.1)$$

where $F = 0{,}25\,N_e$ – design thrust, in kN;
K = safety margin for tow line:
$5 \leq K \leq 7$ – for synthetic lines;
$K > 2$ – for steel ropes;
N_e = effective power of the craft propulsion plant, in kW.

4.4.3.2 The length of tow line La considering 4.4.3.1, shall not be less than that defined by the following dependence:

$$L_{tl} = (6{,}3 \div 6{,}5)L_H. \qquad (4.4.3.2)$$

Meanwhile the length of the craft tow line calculated according to this dependence shall be not less than the following value depending on the craft design category:

120 m for craft of design category **A**;

100 m for craft of design category **A1** and **A2**;

70 m for craft of design category **B**;

40 m for craft of design categories **C, C1, C2, C3** and **D**.

4.4.3.3 Tow line may have an eyesplice on one end and on the other end relevant whipping or other measures preventing detwisting are to be applied.

4.4.3.4 Tow line may be used as a hawse for slewing anchor.

4.5 MOORING AND TOWING CABLES

4.5.1 Mooring and towing cables may be produced from the fibre or synthetic fibre. Tensile strength of cable in general shall correspond to the values set forth in Table 4.5.1.

Table 4.5.1

Characteristics of cables made of synthetic fibres

1. Characteristics and trademarks			
Letter identification	Polyamide PA	Polyether PES	Polypropylene PP
Trademark	Perlon Nylon	Trevira Diolen Tervlcne	Poly Polyprop Uostalen
Density, kg/dm³	1,14	1,38	0,19
Breaking elongation, %	35 — 50	20 — 40	20 — 40
Melting point, °C	225 — 250	260	163 — 174
Light stability	good	very good	good at UV-stabilization

2. Mechanical properties of three stranded twisted cables					
Polyamide[1]		**Polyether[1]**		**Polypropylene[1]**	
Nominal diameter, in mm	Minimal tensile strength[2], in kN	Nominal diameter, in mm	Minimal tensile strength[2], in kN	Nominal diameter, in mm	Minimal tensile strength[2], in kN
6	7,35	6	5,80	6	5,90
8	13,20	8	10,50	8	10,40
10	20,40	10	16,80	10	15,30
12	29,40	12	24,00	12	21,70
14	40,20	14	33,70	14	29,90
16	52,00	16	43,40	16	37,00
18	65,70	18	54,80	18	47,20
20	81,40	20	68,20	20	56,90
22	98,00	22	82,00	22	68,20
24	118,00	24	98,50	24	79,70
26	137,00	26	115,50	26	92,20

[1] Complying with the requirements in 6.2, Part XIII "Materials" of the Rules for the Classification and manufactured according to standards approved by the Register.

[2] It is necessary to consider that the minimal tensile strength is reducing in the following cases:
splicing (about 10 %);
action of solar radiation;
internal heating during operation;
external heating due to friction (deck organizers, gipsy head of capstan).
If there are kinks it is necessary to take into account the reduction of strength by 50 %.
Wetting reduces the towing capacity of the polyamide ropes by 10 — 15 %.

Steel ropes manufactured according to standards agreed with the Register may be used.

4.5.2 Diameter of the mooring or tow cable shall not be less than 10 mm.

4.5.3 High quality materials complying with the relevant applicable standards shall be used for production of mooring and towing cables.

4.5.4 In relation to the type and where necessary, cables made of synthetic fibre may contain coating protecting from the UV radiation.

4.5.5 Any treatment preventing putrefaction of cable and enabling water-resistant qualities shall not impair other characteristics, reduce strength or significantly increase mass.

5 SPARS AND SAILING RIGGING

5.1 GENERAL

5.1.1 Scope of application.

5.1.1.1 The requirements of this Section refer to rig of sailing craft, saling-motor craft and motor-sailing craft.

5.1.1.2 The requirements of this Section are applicable provided the craft operation complies with the good seamanship which implies that the number and area of lifted sails do not exceed the values set by the design of craft for the design wind force.

5.1.1.3 The requirements of this Section are applicable to the craft with the Bermuda rig which is most extensively used on the pleasure craft.

Application of the requirements of this Section to the craft with the square or gaff rig or rig of another type shall be substantiated by the designer and agreed with the Register.

5.1.2 Definitions and explanations.

5.1.2.1 The following definitions and explanations are used in this Section.

Wind on the bow is the course of the sail boat relative to the wind direction at which its longitudinal centre-plane makes an angle less than 90° to the line of wind taking from the craft bow.

Bowsprit is the horizontal or sloped spars, fixed on the craft bow and prostrating in front of stem.

Shrouds are the ropes of the standing rigging which attach the masts and topmasts to craft sides.

Lower shrouds (lowers) are shrouds holding the mast column (from deck to the lowest node).

Hounds are metal plates on the outer side of craft, with the set of which the lower rigging srew of shrouds and back stays is fastened

Gaff is the inclined spars, one end of which ("heel") is resting on the mast and it serves for setting the four-cornered trysail and topsail.

Sail boom is the horizontal spars permanently fixed in the low part of the mast and serving for fixing the lower boltrope of trysail.

Permissible load is the conditional load which will not cause the structural damage.

Jib is the forward triangle sail set above bowsprit.

Mast column is the lower part of mast from saucer to the lowest node (cross piece, spreader etc.).

Safety factor is a fraction at division of the breaking load by the permissible load.

Incomplete forward triangle (small rig) is the type of rigging when the point of fixing the forestay is at 0,75 — 0,9 height of mast.

Fig. 5.1.2.1
Main dimensions of sails

5.1.2.2 Main types of pleasure craft.

Yawl is the type of the two mast rigging with the main mast and after mast if the after mast is located behind the of the rudder stock head.

Ketch is the type of the two mast rigging with the main mast and after mast if the after mast is located in front of the rudder stock head.

Sloop is the type of the single mast rigging with the main mast and staysail.

5.1.2.3 Sailing rig.

The height of the forward triangle I is the distance from point of stay fixing to the mast to the point of intersection of the line of the forward edge of mast with deck or deckhouse or extension, if necessary.

Base of the forward triangle J is the distance from the point of fixing the stay to the line of intersection of the line of forward edge of mast with deck or deckhouse or extension, if necessary.

Length of the lower leech of main sail E is the distance along the sail boom from the front to aft end.

Mainsail hoist P is the distance along the mast from the upper edge of sail boom close to mast or lowest point of the main sail to the upper point of main sail.

Sail area is the compound of sails intended for sailing at a conditional wind force and compliance with the requirements in respect of craft stability and loads applied to the elements of sails. In respect of wind force the permissible square of sails is usually divided into the main, reduced and storm one.

Main sail area is the compound of sails intended for sailing by the wind at wind force 4 — 6 except sailing at the light weather.

Reduced sail area is the compound of sails intended for sailing by the wind at wind force 6 — 7.

Storm sail area is the compound of sails which are hoisted to sail by the wind at wind force 8 and more.

Mast span is the part of mast between two consecutive nodes.

Mast hole is a hole in deck specially fitted for passage of a mast.

Breaking load is the conditional load which causes damage to the structure in the form of rupture, bending, shear, loss of form, etc.

Spars is a set of appliances serving for hoisting and holding sails etc. (masts, topmasts, cross trees, gaffs, sail booms, bowsprit, booms boomkins, etc.).

Cross-tree (a frame made of spreaders) is crossed bars on a mast which reinforce it at joint operation with shrouds.

Staysail is a triangle sail which is hoisted on the forward boltrope on a stay.

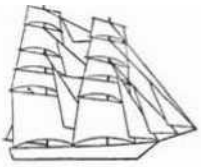
Topmast is spars, which extend the main part of mast.

Rigging is the general name for all rigging serving for proper holding the spars and for hoisting, lowering and rotating some of the rigs as well as for setting and hauling in of some sails.

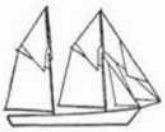
Running rigging is not rigidly fixed and the hauling end has an unrestricted motion.

Standing rigging holds the spars in proper position.

Type of sailing rig is special features of spars' design and forms of sails, as well as rigging which determine the type of sails as shown in the figure below.



Square sails



Gaff

Bermuda

Topsail is the triangle sail set above the gaff.

Trysail is the triangle and square sail which one boltrope is set along the mast.

Mast node is the place where the standing rigging is fixed to the mast.

Quarter backstays are standing rigging which supports the topmast sidewise and extend till the chain plates.

Stay is the standing rigging which serves for fixing masts in the direction of craft ends and holding sails (stay-sails and jibs).

5.2 PERMISSIBLE LOADS

5.2.1 Wind pressure to the underwater hull.

Permissible load to craft rigging shall be calculated on the basis of the mean wind force p, in kN/m², calculated for the acceptable square of sails, for at least three main options: main, reduced and storm one according to Formulae (5.2.1.1-1) — (5.2.1.1-2), (5.2.1.2).

5.2.1.1 Monohull craft.

Wind pressure on the monohull craft:

$$p = k_p \cdot D \cdot l_{max}/S \cdot Z \qquad (5.2.1.1\text{-}1)$$

where k_p = coefficient, which considers the square of sails:
k_p= 1,00 for the main square of sails;
k_p= 0,95 for the reduced square of sails;
k_p= 0,80 for storm square of sails;
S = square of projection of sails, spars and craft hull to the design waterline at an outlined square of sails, in m²;
Z = vertical distance from the centre of buoyancy to the geometrical centre of the square of sails S, in m;
γ = density of water, in kg/m³;
D = craft displacement, in KN;
l_{max} = largest value of the lever of the righting moment within the limits of the angle of slope up to 60°, in m.

For the purpose of the calculation one shall take such state of loading a craft at which the product of $D\ l_{max}$ is max the largest one. For craft which length is less than 15 m it is sufficient to take D as the design water displacement $\gamma\ g\ V$, and the largest value of the righting moment within the limits of the heel 90° for l_{max}.

$$S \cdot Z = \sum_{i=1}^{n} S_i Z_i \qquad (5.2.1.1\text{-}2)$$

where S = square *i*-th element;
Z_i = vertical distance from the centre of buoyancy to the centre of square of element S_i;
n = number of elements by which the square s is divided.

If full stability characteristics are known, an approximation can be used:

$$D \cdot l_{max} = k_{rm} \cdot M_{30} \qquad (5.2.1.1\text{-}3)$$

where $k_{rm} \cdot M_{30}$ according to 5.2.4,

or take an approximate value l_{max} in (5.2.1.1-1):

$l_{max} = 0{,}750\ h_0$ for sail boats with external ballast;
$l_{max} = 0{,}675\ h_0$ for other sail boats;
$l_{max} = 0{,}629\ h_0$ for motor sailers,

where h_0 = initial transverse metacentric height, in m.

5.2.1.2 Multihull craft.

Wind pressure applied to multihull craft, in kN/m²:

$$p = (M_m + \Delta M)\ /\ S \cdot Z, \qquad (5.2.1.2)$$

where M_m = maximum righting moment, in kNm, which is to be taken the largest one from the two maximum righting moments:
for craft with minimum stores and minimum crew;

for craft with full stores and maximum number of people onboard;

ΔM = possible increment of the maximum righting moment due to use of arrangements changing craft stability during motion, in kNm;

SZ according to 5.2.1.1.

5.2.2 Inertia loads due to craft oscillating motions.

For monohull craft it is necessary to take into consideration the inertia forces Q_i., in kN, which are perpendicular to the mast, during operation with trim or during navigation at motion:

for the main square of sails:

$$Q_f = 0{,}85\, G_f; \qquad (5.2.2\text{-}1)$$

for reduced and storm square of sails:

$$Q_f = (2{,}11\, z/\tau^2 + 0{,}68\, y/L_{WL} + 0{,}66) G_i \qquad (5.2.2\text{-}2)$$

where z, y = vertical and horizontal distances from the craft's centre of mass to the centre of mass of rigging elements, in m;

τ = period of transverse rolling, s, is taken τ < 10 s;

L_{WL} = craft length at waterline, in m;

G_i = weight of rigging elements, in kN.

5.2.3 Compression force due to action of shrouds.

In order to define the dimension of masts it is necessary to calculate the maximum compression force P in kN, originating due to action of shrouds. The force P_{st}, is calculated for as a minimum three variants of square of sails according to the formula

$$P_{st} = (\sum P_i \cdot h_i)/b \qquad (5.2.3)$$

where P_i = sloping force originating due to wind pressure and masses acting on the *i*-th node calculated by Formula 5.3.2.2-1 or 5.3.2.2-2;

h_i = vertical distance between the deck and the *i*-th node, in m;

b = horizontal distance from the mast axis to shroud cleats, in m.

5.2.4 Load applied to main mast with typical rigging.

Loads to rigging and spars of typical single mast craft or yawls and ketches with the Bermuda sails which is calculated at a permissible load squeezing the main mast due to action of shrouds in relation to force P_{sh}, calculated according to Formulae (5.2.4.1-1) and (5.2.4.2).

5.2.4.1 For monohull craft, force P_{sh}, in kN, is determined by the formula

$$P_{sh} = (k_{rm} \cdot M_{30})/b_1 \qquad (5.2.4.1\text{-}1)$$

where k_{rm} = coefficient of the righting moment:
k_{rm}= 1,50 for craft with external ballast and at $L_{WL} > 7$ m;
k_{rm} = 1,40 for craft with external ballast and at $L_{WL} \leq 7$ m;
k_{rm} = 1,35 for craft without external ballast;
k_{rm} = 1,20 for craft without ballast;

b_1 = horizontal distance from the main mast axis to the shroud cleats, in m.

M_{30} = righting moment at a heel of 30°, in kNm.

For craft with external ballast M_{30} it is calculated with the rigging but without stores and crew and for other craft M_{30} the greatest of two moments shall be taken: the moment for the outfitted craft without stores and crew M'_{30} or the moment for the outfitted craft with stores and crew M''_{30}.

If the value M''_{30} is unknown, it is allowed to take

$$M''_{30} = M'_{30} \cdot D'/D'' \qquad (5.2.4.1\text{-}2)$$

where D' = water displacement of an outfitted craft without stores and crew;
D'' = water displacement of an outfitted craft with stores and crew.

For craft with the external ballast and compromise design craft the value of M_{30} may be taken following an approximate formula

$$M_{30} = 0{,}44\, h_0\, D \qquad (5.2.4.1\text{-}3)$$

where D, h_0 = water displacement and metacentric height at relevant loading.

5.2.4.2 For multihull craft, force P_{sh}, in kN, is determined by the formula

$$P_{sh} = (M_m + \Delta M)/b_1 \qquad (5.2.4.2)$$

where M_m = maximum righting moment according to 5.2.1.2;
ΔM = possible increment of the righting moment according to 5.2.1.2;
b_1 = horizontal distance from the gross mast of the main mast to the shroud cleats, in m.

5.2.5 Load on after mast with the typical rigging

The force P_{st}, squeezing the after mast of the typical Bermuda yawls and ketches due to action of the shrouds is calculated by the formulae:

for monohull craft:

$$P_{st} = k_b\, (k_{\text{пр}}\, M_{30}/b_2); \qquad (5.2.5\text{-}1)$$

for multihull craft:

$$P_{st} = k_b (M_m + \Delta M) b_2 \qquad (5.2.5\text{-}2)$$

where k_b = 0,222 (0,226), if the height of the after mast does not exceed 0,58 height of the main mast;
k_b = 0,226 (0,271), if the height of the after mast does not exceed 0,68 height of the main mast;
k_b = 0,313 (0,376), if the height of the after mast does not exceed 0,75 height of the main mast.
Values in brackets are applied to the masts, which have an additional load imposed by the preventer stay.
For the after mast with a height more than 0,75 height of the main mast the load is to be calculated in accordance with 5.2.3;
k_{rm} = coefficient of the righting moment according to 5.2.4.1;
M_{30} = righting moment at a slope of 30°, in kNm;
M_m = maximum righting moment according to 5.2.1.2;
ΔM = possible increment of the righting moment according to 5.2.1.2;
b_2 = horizontal distance from the after mast to the shroud cleats of the after mast, in m.

5.2.6 Other loads.

If steps are fitted to climb on the mast, each step shall withstand a load of at least 200 kg.

5.3 RIGGING DIMENSIONS

5.3.1 General.

5.3.1.1 Projection of angle p between the shrouds and the mast (refer to Table 5.3.3.1-1) on the plane perpendicular to the centreline plane shall not be less than 10°. Application of the rigging with angles β < 10° shall be substantiated by the designer.

5.3.1.2 For the craft with designed displacement less than 1200 kg, the rig without check stays and backstay may be used. In this case, the projection of angle a between the lower shrouds and the mast (refer to Table 5.3.3.1-1) on the centreline plane shall not be less than 5°.

5.3.1.3 It is allowed to replace the fore lower shrouds with an inner forestay. The angle between this inner forestay and the mast shall not be less than 5° for rigging types "*a*" and "*b"* (refer to Table 5.3.3.1-1) and 7,5° for a fractional rig.

5.3.1.4 For the fractional rig, when using single aft lower shrouds without the inner forestay (refer to Table 5.3.3.1-1, rig type "*c3*"), spreaders shall be deviated aft of the midcraft plane for an angle, which projection on the horizontal plane is from 20° up to 32°.

The length of the spreaders shall be such that the projection of angle a (between the upper shrouds inclined aft and the mast) on the centreline plane is not less than 5° and the projection of angle p (between these shrouds and the mast) on the plane perpendicular to the centreline plane is not less than 10°. The lower shrouds shall also be inclined aft in such a way that the projection of angle a (between these shrouds and the mast) on the centreline plane is not less than 5°.

For the crafts with "*a*" and "*b*" rigging types (refer to Table 5.3.3.1-1), the angle of deviation of the spreaders from the midcraft plane shall be substantiated by the designer.

5.3.2 Dimensioning of the rigging by the general method.

5.3.2.1 To determine permissible external loads on the mast, equivalent areas of sails F shall be outlined as follows:

.1 for Bermudian rig the equivalent area $F = 0{,}5\,S$, which falls at the mast and is taken in the form of a right triangle (refer to Fig. 5.3.2.1.1);

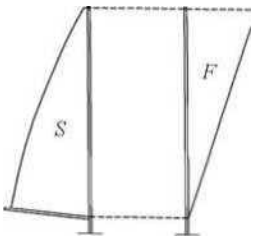


Fig. 5.3.2.1.1

.2 for gaff rig the area of sail S is divided into three parts S_1, S_2 and S_3;

The equivalent area F falling at the mast (refer to Fig. 5.3.2.1.2) consists of the following:

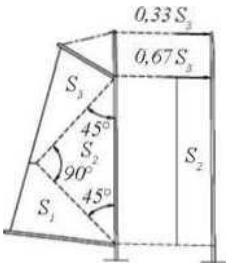


Fig. 5.3.2.1.2

area S_2 in the form of the right triangle;

area $0{,}67\,S3$ concentrated at the place of a gant-line block;

area $0{,}33\,S1$ concentrated at the place of a gaff halyard block;

.3 for a jib, equivalent area F falling at the mast is concentrated at the stay fixing point and is determined by the formula

$$F = Sb / (a + b) \qquad (5.3.2.1.3)$$

where a and b = distance from the fittings up to the sail area centre (refer to Fig. 5.3.2.1.3);

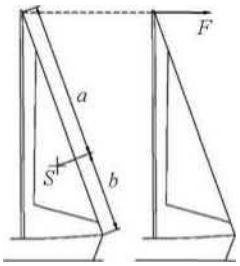


Fig. 5.3.2.1.3

.4 for a square sail, equivalent area of sail F is concentrated at the place of hanging the yard (refer to Fig. 5.3.2.1.4) and $F = 0{,}675\,S$.

Other ways of distributing areas of the rig are also allowed.

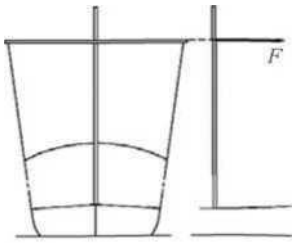


Fig. 5.3.2.1.4

5.3.2.2 Permissible external load on the mast is determined by action of force P_i, in kN, applied at the points of action, i.e. in the mast knots. The force shall be determined for, at least, three variants of the sail area by the formulae:

for monohulls:

$$P_i = F_i p + Q_i; \qquad (5.3.2.2\text{-}1)$$

for multihulls:

$$P_i = F_i p \qquad (5.3.2.2\text{-}2)$$

where F_i = equivalent area of the sails, in m², which falls at the node and is determined according to 5.3.2.1;
p = average wind pressure for this variant of the rig, which is determined according to 5.2.1;
Q_i = inertial force determined in 5.2.2 and equivalent to *i*-th node.

5.3.2.3 Force N_i occurring in the shrouds under load P_i shall be determined for, at least, three variants of the sail area (main, reduced and storm) by the methods generally recognized in the mechanics. It is also allowed to determine loads on the shrouds by a graphic method or by calculations equivalent to drawing of Cremona diagram using simplifications (for example, the rigging of a lee side is not taken into account and the mast knots are considered to be hinges).

5.3.2.4 Dimensions of each shroud shall be determined by such variant of the sail area, at which it will be acted upon by the maximum force N_i.

Breaking load R_i, in kN, is determined by the formula

$$R_i = k_n N_i \qquad (5.3.2.4)$$

where k_n = safety factor:
k_n = 3,0 for the lower shrouds;
k_n = 2,5 for other shrouds;
N_i = force, in kN, occurring in the shroud under action of the permissible load, which is determined according to 5.3.2.3.

5.3.2.5 Breaking load for the stays R_{st}, in kN, shall be determined according to the wind pressure influence on the relevant jib by the formula

$$R_{st} = 8{,}125\ (S \cdot p)_{max} \qquad (5.3.2.5\text{-}1)$$

where S = area of the jib lifted on this stay, in m²;
p = average wind pressure according to 5.2.1.

It is necessary to take the greatest of possible values $S \cdot p$ determined for different permissible variants of the sail area.

However, force R_{st} cannot be less than that determined depending on the breaking force of the strongest shroud R:

$$R_{st} \geq k_w R \qquad (5.3.2.5\text{-}2)$$

where k_w = stay strength factor:
$k_w = 1{,}00$ for the lowest stay and inner forestay;
$k_w = 0{,}75$ for a topmast stay and quater backstay.

5.3.2.6 Breaking load R_a, in kN, for the backstay, check stay, quarter backstay and topmast shrouds shall be determined by the formula

$$R_a \geq k_a k_r R_{st}\ (\sin\beta_{st} / \sin\beta_a) \qquad (5.3.2.6)$$

where k_a = backstay coefficient:
$k_a = 1{,}0$ for the checkstay, quarter backstay and topmast shrouds;
$k_a = 1{,}15$ for the backstay;
$k_a = 1{,}20$ for the backstay, if using a boom for the jib;
$k_a = 1{,}25$ for the backstay, if using a trysail with the foot length more than 1,3 J, see Fig. 5.1.2.1;
k_r = load distribution factor:
$k_r = 1{,}00$ for one backstay, as well as for check stays;
$k_r = 0{,}58$ for double backstays;
$k_r = 0{,}38$ for quarter backstay and topmast shrouds;
R_{st} = breaking force of the relevant stay determined according to 5.3.2.5;
β_{st} = angle between the stay and the mast;
β_a = angle between the mast and: the backstay or check stay or quarter backstay or topmast shroud.

5.3.2.7 If using a tensioner inducing stress N_n in the rope, the breaking force of this rope R_{st} shall not be less than determined by the formula

$$R_{st} = 2{,}6\ N_n. \qquad (5.3.2.7)$$

5.3.2.8 For lugsails and gaff sails, it is necessary to check that forces occurring in the backstays, check stays, quarter backstay and topmast shrouds under the wind pressure at the heading:

$p = 0{,}250$ kN/m² for the main sail area;

$p = 0{,}572$ кН/м² for the reduced sail area do not exceed 0,5 times of the breaking force of the used ropes.

5.3.3 Rigging of some typical single-masters.

5.3.3.1 If the rigging of a single-master is typical and complies with Tables 5.3.3.1-1 and 5.3.3.1-2 fulfilling the condition

$$IJ/PE \leq 1{,}6; \qquad (5.3.3.1\text{-}1)$$

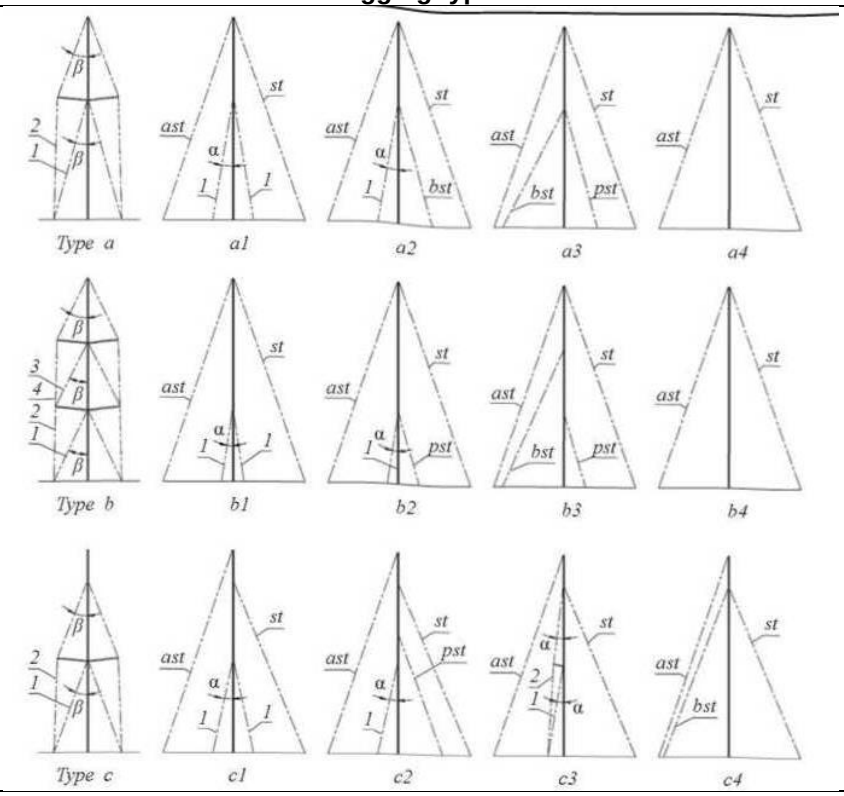
breaking forces R in the shrouds, stays and backstays may be determined by the formula

$$R = kP_{sh} \qquad (5.3.3.1\text{-}2)$$

where k = coefficient from Table 5.3.3.1-2;
P_{sh} = force compressing the mast under the action of the shrouds according to 5.2.4;
I = foretriangle height, in m;
J = foretriangle lower base, in m;
E = mainsail foot length, in m;
P = height to which the mainsail is risen, in m, see Fig. 5.1.2.1.

Table 5.3.3.1-1

Rigging types



Symbols: ast — afterstay; bst — backstay; st — stay; pst — post stay.

Table 5.3.3.1-2

Values of coefficients k for the mainmast rigging

Rigging type	Shroud 1 single	Inner forestav *(pst)*	Shroud 1 double	Shroud 2	Shroud 3	Shroud 4	Stay (*st*)
Type *a*	1,4	1,3	1,3	1,15	—	—	1,2
Type *b*	1,3	1,25	1,25	1,5	0,8	1,15	1,2
Type *c*	1,4	0,8	1,3	1,2	—	—	1,1

5.3.3.2 If the lower shrouds are located in the mast plane (shroud stay; rigging types "*a3*" and "*b3*"), the back-stays shall be installed to ensure enough tension of the post stay.

5.3.3.3 If angle β between the shrouds and the mast in the projection on the plane perpendicular to the craft centreline plane exceeds 10°, it is allowed to take coefficients k' determined by the formula below instead of the relevant coefficients k specified in Table 5.3.3.1-2 to determine breaking loads for the shroud:

$$k' = k\ (\sin 10°/\sin \beta). \qquad (5.3.3.3\text{-}1)$$

If angle α between the inner forestay and the mast exceeds 5° for the masthead rig or 7,5°— for the fractional rig, it is allowed to take coefficient k" determined by the formula below instead of coefficient k specified in Table 5.3.3.1-2:

$$k" = k\ [\sin 5°\ (\text{or } 7{,}5°)\ /\ \sin \alpha]. \qquad (5.3.3.3\text{-}2)$$

Coefficient k" shall not be taken less than 0,8 k.

5.3.3.4 If tension of the backstay is over the breaking load of the forestay R_{fst}, in kN, it is necessary to take the greatest of the two values, determined according to 5.3.3.1 and by the formula

$$R_{fst} = 2{,}25\ (\sin \beta_{fst}/\sin \beta_{fst}) N_n \qquad (5.3.3.4)$$

where β_{fst} = angle between the backstay and the mast;
β_{fst} = angle between the forestay and the mast;
N_n = backstay stress under tension, in kN.

5.3.4 Rigging of typical yawls and ketches.

5.3.4.1 Calculations for the mainmast rigging of Bermudian yawls and ketches may be made in the same way as for the single-master according to 5.3.3.

5.3.4.2 If the rigging of the mizzenmast is standard and corresponds to the specified in Fig. 5.3.4.2, breaking loads R in the rigging may be determined by Formula (5.3.3.1-2), taking relevant values of the coefficients from Table 5.3.4.2 and the value of force P_{st} for it may be determined according to 5.2.5.

Table 5.3.4.2

Values of the coefficients for the mizzenmast rigging

Shroud 1 single	Shroud 1 double	Shroud 2	Shroud 3	Stay
1,26	0,66	0,60	0,95	1,20

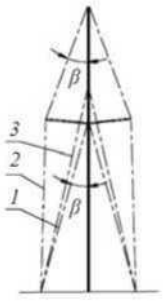


Fig. 5.3.4.2
Standard rigging of Bermudian yawls and ketches

5.3.5 Bowsprit rigging.

5.3.5.1 If a bowsprit is under forces equal to 0,625 times of the stay breaking loads in the craft centreline plane, the force in the ropes or chains of whisker stays shall not exceed 0,9 times of their breaking forces and if using rods — the limit of plasticity shall not be exceeded.

5.3.5.2 Transverse load on the bowsprit shall be 0,165 times of the relevant stay breaking load. Internal forces occurred in waterbackstays under this load shall not exceed 0,9 times of the breaking loads of the accepted rope or chain and if using rods — the limit of plasticity shall not be exceeded.

5.3.6 Rigging screw and fitting.

Breaking force of the required rigging screw and fittings R_0, in kN, shall be determined by the formula depending on the breaking load of the relevant rope:

$$R_0 = k_0 R \qquad (5.3.6)$$

where k_0 = coefficient of the rigging screw and fittings:
k_0 = 1,20 for the shroud rigging screw;
k_0 = 1,35 for the stay rigging screw;
k_0 = 1,35 for the shroud foot points;
k_0 = 1,50 for the stays;
k_0 = 1,10 for the fittings on the masts;

R = design breaking force of the relevant rope, in kN

Under load equal to 0,9 times of the design breaking force of the relevant rope, the plexuses and compressed ends on the ropes shall not be torn.

5.4 SPARS CALCULATIONS

5.4.1 Masts.

5.4.1.1 For the craft with a standard rigging complying with 5.3.1.1, the moments of cross sectional area inertia of mast unsupported spans if bending athwart-craft I_x, in cm⁴, as well as the moment of cross sectional area inertia of the mast unsupported spans if bending in the craft centreline plane I_y in cm⁴, shall not be less than determined by the formulae

$$I_x = k_1 m P_{sh} l^2 \; ; \qquad (5.4.1.1\text{-}1)$$

$$I_y = k_2 m P_{sh} h^2 \qquad (5.4.1.1\text{-}2)$$

where k_1 = unsupported span coefficient specified in Table 5.4.1.1;

k_2 = stay coefficient determined by Fig. 5.4.1.1-1 or according to 5.4.1.2;

k_3 = coefficient of mast fastening;
k_3 = 1,0 for the masts extended through a deck;
k_3 = 1,22 for the masts installed on a deck;

m = coefficient taking into account material characteristics;
m = 0,034 for steel
m = 0,100 for aluminium alloy;
m = 0,725 for timber (pine, spruce);

$m = 7060/E$ for other materials, where E is Young's modulus, in MPa;

l = length of the unsupported span considered, in m;

h = vertical distance from the deck or mast bottom, if the mast is supported by the deck, to the fixing point of the lowest stay, which carriers sails, in m;

P_{sh} = force compressing the mast under action of the shrouds , determined according to 5.2.3, 5.2.4 or 5.2.5; when determining the moments of inertia for the upper unsupported spans of the mast, force P_{sh}, shall be reduced by the value:
0,14 of the breaking force of the double lower shrouds;
0,23 of the breaking force of the single lower shroud;
0,20 of the breaking force of other shrouds, which are below the unsupported span considered and do not load it; shrouds of the freeboard shall also be considered.

Table 5.4.1.1

Values of unsupported span coefficients k_i

Rigging type	Mast column	Other unsupported spans
Without spreaders	$2{,}5k_3$	
One cross-tree (pair of spreaders)	2,5 (2,4) k_3	3,5 (3,6)
Two cross-tree and more	$2{,}7k_3$	3,8
Values in the brackets refer to the rigging of "*c*" type.		

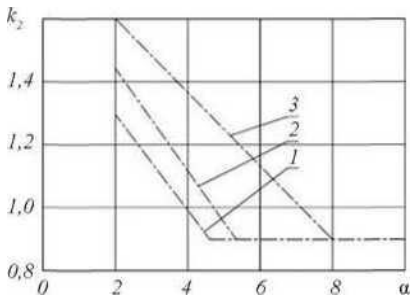


Fig. 5.4.1.1-1
Stay coefficient k_2 for rigging types *a*1, *a*2, *c*1 and *c*2

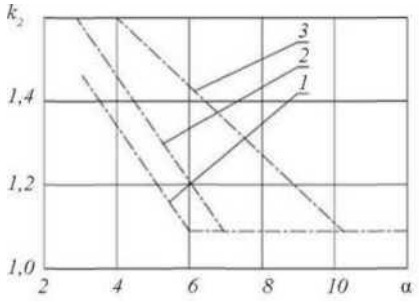


Fig. 5.4.1.1-2
Stay coefficient k_2 for rigging types *b*1 and *b*2

N o t e s : In Fig. 5.4.1.1-1 and 5.4.1.1-2:
1 — single (side) lower shrouds;
2 — double (side) lower shrouds;
3 — mast post stays.

When using stays and backstays of a higher strength, which take forces caused by tensioner action, force P_{sh} shall be increased determining an increment ΔP_{sh} to force P_{sh} by the formula

$$\Delta P_{sh} = 0{,}208\,\Delta\,R_1\,[\sin(\beta_1 + \beta_2) + \sin\beta_1] \qquad (5.4.1.1\text{-}3)$$

where ΔP_1 = taken increase of the rope breaking force caused by the action of the tensioner fixed on it, in kN;
P_1 = angle between shroud 1and the mast (refer to Table 5.3.3.1-1);
P_2 = angle between shroud 2 and the mast (refer to Table 5.3.3.1-1);

When using the single (side) lower shrouds and inner forestay, the greater of the two coefficients k_2 shall be taken for calculations.

5.4.1.2 In case of the single lower shrouds located in the mast plane $\alpha = 0°$), if the inner forestay and check stays are available, the stay coefficient k_2 = 1,65 for the rigging type "*a3*" or k_2 = 1,85 — for the rigging type "*b3*" shall be taken for calculating the moments of inertia I_y.

If the single lower shrouds are used without the mast post stays and back stays (types "*a4*", "*b4*" or "*c4*"), the stay coefficient κ2 = 2,25 shall be taken for calculating the moments of inertia I_y. The stay coefficient k_2= 1,25 shall be taken for the rigging type "*a3*".

For the rigging with a great number of the spreaders (cross-trees), coefficient k_2 shall be taken the same as for the rigging type "*b*".

5.4.1.3 For craft with non-typical standing rigging, the following models shall be taken for mast calculations:

if bending athwart-craft — a girder elastically fixed at one end and simply supported at the other end, with a rigid support at the lower shroud fixing point, refer to Fig. 5.4.1.3-1.

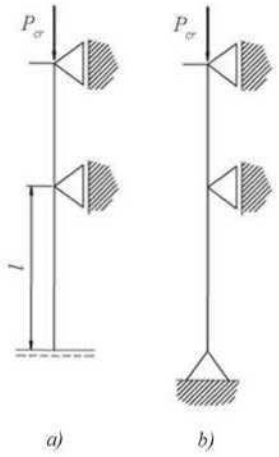


Fig. 5.4.1.3-1

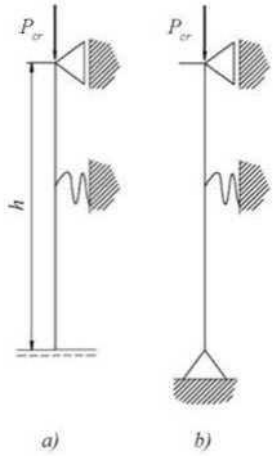


Fig. 5.4.1.3-2

Elastic fixing in a mast hole section is taken into account by the mast housing influence (refer to Fig. 5.4.1.3-1 *a* and 5.4.1.3-2 *a*). For the mast, which stands on the deck, a simple support shall be used instead of the elastic fixing in the mast hole section (refer to Fig. 5.4.1.3-1 *b* and 5.4.1.3-2 *b*).

For calculations, a value of critical force P_{cr}, in kN, determined by the formula shall be taken:

$$P_{cr} = 1{,}6\ (P_{sh} + 0{,}385\ P_c) \qquad (5.4.1.3)$$

not less than

$P_{cr} = 2{,}96\ P_{sh}$ for the masts loaded with the stay, which carries a sail;

$P_{cr} = 2{,}32\ P_{sh}$ for the remaining masts

where P_{sh} = force, in kN, compressing the mast under action of the shrouds determined according to 5.2.3, 5.2.4 or 5.2.5;

P_c = sum of components of the stay and backstay breaking forces, in kN, directed along the mast axis.

5.4.1.4 For the masts with constant cross section retaining at least up to 0,7 times of their height, which moment of cross section inertia near the masthead is not less than 0,6 times of the moment of cross section inertia of the part with constant cross section, it is allowed not to calculate the moments of inertia I_x of the unsupported spans located above the post, if their length does not exceed the post length.

5.4.1.5 For the masts with variable cross section or with more taper than specified in 5.4.1.4, each unsupported span shall be divided into two or three equal parts and the moments of inertia I_x and I_y, shall be calculated on the basis of their average values I, in cm⁴, determined by the formulae:

$$I = 1/6\ (I_1 + 4\ I_2 + I_3),$$ if the unsupported span is divided into two parts; (5.4.1.5-1)

$$I = 1/8\ (I_1 + 3\ I_2 + 3I_3 + I_4),$$ if the unsupported span is divided into three parts, (5.4.1.5-2)

where $I_1,\ I_2, I_3$ and I_4 = values of the moments of inertia I_x or I_y at the points of unsupported span division without taking account of local forces and stresses.

The moment of inertia of the weakest section shall not be less than 0,3 times of the moment of inertia of the strongest section.

5.4.1.6 When using the fractional rig, it shall be checked that the mast bending strength factors W_x and W_y in cm³, at the intersection of the stay or shroud fixing point are not less than determined by the formulae:

$$W_x = (1000/\sigma) \cdot M_{30} \cdot (z_x / P);$$ (5.4.1.6-1)

$$W_y = (1000\ /\ \sigma) \cdot\ R\ \cdot z_y \cdot \sin \beta_{st}$$ (5.4.1.6-2)

where
σ = permissible stresses for the mast material, when bending, in MPa;
M_{30} = righting moment according to 5.2.4;
z_x = distance, in m, from the masthead to the shroud fixing point, see Fig. 5.4.1.6;
P = mainsail hoist, in m, according to 5.3.3.1;
R = breaking force for the stay, in kN, according to 5.3.3.1;
z_y = distance, m, from the masthead to the stay fixing point, refer to Fig. 5.4.1.6;
β_x = angle between the mast and the stay.

Bending strength factors on the masthead shall not be less than 0,2 times of the relevant factor at the stay or shroud fixing point. If a stay/jackstay providing equal strength of the mast is used, calculation according to Formula (5.4.1.6-2) is not required.

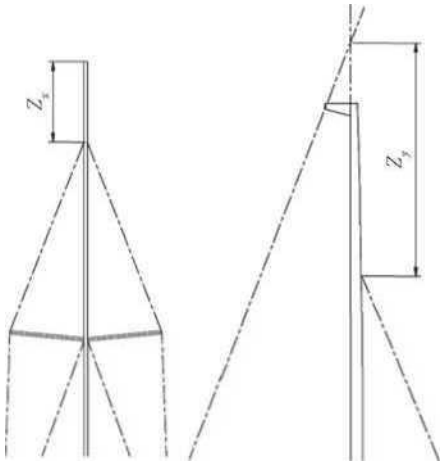


Fig. 5.4.1.6
Masthead sizes

5.4.1.7 Criterion of the previous choice of the mast cross sectional area is:

reaching the minimum mass, i.e. the use, as a rule, of hollow-built wooden masts and tubular masts of light metal alloys;

reaching the most possible rigidity of the mast in the direction of the stay action, which is determined by the moments of inertia of its cross sectional area relative to the craft centreline plane.

walls of the hollow-built wooden masts shall not be thinner than 18 per cent of the relevant cross section size. It is recommended to take the wall thickness equal to 20 per cent of the relevant cross section size.

5.4.2 Spreaders.

5.4.2.1 The moment of inertia of the spreader cross sectional area I_{cr}, in cm⁴, related to the *x* and *y* axes shall not be less than calculated by the formula

$$I_{cr} = m_m \cdot R_{cr} \cdot l_{cr}^2 \qquad (5.4.2.1)$$

where m_m = material coefficient:
m_m = 0,06 for steel;
m_m = 0,18 for aluminium alloys;
m_m = 1,00 for timber (ash, oak);
m_m= 12700/E for other materials, where E is Young's modulus, in MPa;
R_{cr} = force compressing the spreader, in kN;
l_{cr} = spreader length, in m.

5.4.2.2 Spreader stability and compression strength and strength of the spreader fittings shall be tested under load equal to 1,25 R_{cr}.

5.4.2.3 Fitting structure shall ensure fixing of the shroud and the spreader shall not move along the shroud.

5.4.3 Booms.

5.4.3.1 For sail booms with a mast edge, the cross section bending moduli, in cm³, related to horizontal W_y and vertical W_z axes shall not be less than determined by the formulae

$$W_y = m_g \cdot P_{st} \cdot l_g; \qquad (5.4.3.1\text{-}1$$

$$W_z = 0{,}66\, W_y \qquad (5.4.3.1\text{-}2)$$

where m_g = coefficient taking into material characteristics:
m_g = 0,125 for carbon steel;
m_g = 0,250 for aluminium alloys with ultimate tensile strength R_m = 200 MPa;
m_g = 0,610 for timber (pine);
m_g = 50/R_m for other materials R_m, in MPa;
P_{st} = force, in N, compressing the mast under the action of the shrouds determined according to 5.2.3, 5.2.4 or 5.2.5;
l_g = boom length, in m.

5.4.3.2 When designing the booms, the way of fastening and reefing the sails shall be taken into account. When designing a boom fitting, its effective fastening to the mast and fastening of a sheet and topping lift to it shall be considered. Fitting of a front boom end shall meet the conditions of the hinge, i.e. rotation of the boom about three axes shall be possible.

5.4.4 Gaffs.

5.4.4.1 Choice of the gaffs is done by the designer.

5.4.5 Bowsprits.

5.4.5.1 If an angle between the bob stay and the bowsprit axis is 14° and more, bowsprit compression stresses under load equal to 0,625 times of the stay breaking force shall not be more than:

0,68 times of the ultimate compression strength — for wooden bowsprits;

0,9 times of the yield point — for metal bowsprits.

5.4.5.2 If an angle between the bob stay and the bowsprit axis is less than 14°, bowsprit bending and compression stresses shall be determined under load equal to 0,625 times of the stay breaking force. The sum of the stresses shall not exceed:

0,85 times of the ultimate compression strength — for wooden bowsprits;

yield point — for metal bowsprits.

5.5 SPAR AND RIGGING MATERIAL

5.5.1 The materials of spars, rigging, bindings and rigging fittings shall meet the requirements of Part XI "Materials". The spar and rigging products shall be manufactured in compliance with the technical normative documents recognized by the Register.

5.5.2 In manufacture of standing rigging use shall be made of stainless steel wire ropes without fiber. The standing rigging wires shall have zinc coating in compliance with the recognized standards.

In case of need rod steel and pudding chains may be used.

5.5.3 In running rigging use shall be made of a vegetable and synthetic fiber. For craft not fitted with rigging winches it is recommended to use synthetic ropes with a wrapped multistrand twisted core.

Steel wire ropes will be permitted in the running rigging in case that provision was made for the relevant winches.

5.6 MOUNTING AND OPERATION OF RIGGING

5.6.1 A mast passing through the deck shall be properly fixed in the mast hole. The following fixation is recommended:

wedging — for wooden masts;

using rubber gaskets around the mast — for thin-walled metal masts.

In rigging of type "*a3*" or "*b3*", refer to Table 5.3.3.1-1, bow-to-stern movement shall be possible and athwartships movement shall be limited.

The heel of a keel-stepped mast shall be securely fastened to the mast step or adjoining structure.

5.6.2 It is recommended to tension the rigging so as to:

preclude mast deflection in a direction perpendicular to the craft centreplane, at the same time, relevant mast deflections from the straight line in the craft centreplane are permitted;

ensure that the windward shrouds are not sagging at the heel of 35° that corresponds to the initial tension equal to 0,16 — 0,18 of the breaking strength for the wire rope used (rigging shrouds of type "*a3*" or "*b3*", refer to Table 5.3.3.1-1, shall be eased well);

ensure that the shroud sagging does not exceed 0,04 of their length under the conditions of craft sailing by the wind, loads from the sails acting on the stays.

5.6.3 It is recommended to use hinges on all ties, as well as on both ends of forestays.

5.6.4 Rigging fittings shall be of appropriate construction precluding occasional ease of tension.

5.6.5 Wooden masts with electric wires therein shall be protected against possible ingress and accumulation of water inside the mast.

5.6.6 The mast of a sailing craft or sailing motor craft shall have at least two halyards capable of maintaining the sail.

5.7 SAILS

5.7.1 Selection of sails.

5.7.1.1 Each craft shall have a set of sails ensuring its operation in the prescribed navigating conditions.

5.7.1.2 Each craft shall have a mandatory set of storm sails satisfying the requirements of Table 5.7.1.2.

Table 5.7.1.2

Mandatory set of storm sails

Type ot sails	Design category of boat						
	A, A1 and **A2**	**B**	**C**	**C1**	**C2**	**C3**	**D**
Trysail	+	+	-	-			
Storm staysail	+	+	-	-	-	-	-
Reduced staysail	+	+		-1-	-	-	-
Mainsail reefing	+	+	+	+	+	-	-

5.7.1.3 For craft having a length of the hull of up to 12 m of design categories **C, C1** or **C2** a patent reef and staysail furling device may substitute for a reduced staysail and mainsail reefing.

5.7.1.4 Alternatively to 5.7.1.3, for craft of design categories **C, C1** or **C2,** a trysail may be provided for instead of a mainsail reefing.

5.7.1.5 For craft fitted with an effective wing mast try sail is not required.

5.7.2 Dimensions and construction of sails.

5.7.2.1 Trysail.

The trysail area shall not be greater than 0,175 PE, where *P* is the mainsail hoist; *E* is the mainsail foot length.

The trysail shall be capable of being sheeted independently of the boom. The storm trysail shall have neither headboard nor battens.

5.7.2.2 Storm staysail.

The storm staysail area shall be not greater than 0,05, with the luff maximum length 0,65 I; where I is the height of the foretriangle. The storm staysail shall be capable of being set independently of the luff-groove device.

5.7.2.3 Reduced staysail.

The reduced staysail area shall not be greater than 0,135 I^2; where I is the height the foretriangle.

5.7.2.4 Possibility of mainsail reefing.

It should be possible to reduce the mainsail area by reefing. Moreover, the length of the reefed mainsail luff shall be not greater than 0,6 P in the most reefed condition

5.7.3 Sails material.

5.7.3.1 The present requirements to cloth used in fabrication of sails apply to the craft with deadweight of 150 tons and less.

Special synthetic cloth may be used instead of sailcloth subject to availability of the relevant manufacturer's certificate confirming its intended purpose.

The heavy-weather staysail shall not contain aromatic polyamides, carbon fibers and similar fibers.

It is recommended that every storm sail should either be of highly visible colored material or should have a highly visible colored patch of red, orange or yellow added on each side.

5.7.3.2 In manufacture of sails the following cloth types are recommended:

Gaff sails and forestaysails — cloth No. 3.

Outer and inner staysails — cloth No. 4.

Topsail and staysail — cloth No. 5.

Heavy-weather staysails — cloth Nos. 2 and 1.

6 SIGNAL MASTS

6.1 GENERAL

6.1.1 The requirements given in this Section refer only to the signal masts, i.e. the masts which are intended for carrying the signal means: navigation lights, signal shapes, aerials, etc. Where the masts or their parts carry derrick booms or other cargo handling gear in addition to the signal means, such masts or their parts shall comply with the requirements of the Rules for the Cargo Handling Gear of Sea-Going Ships.

The requirements of 6.2 to 6.4 do not apply to berth-connected ships. The signal masts of berth-connected ships shall be designed to carry signal means.

6.1.2 Arrangement, height and provision of signal means on the signal masts shall comply with the requirements of 11.3.

6.1.3 If the signal masts are collapsible, special machinery shall be installed for their operation or provision shall be made for appropriate connection with other deck machinery. The drive of the machinery may be hand-operated provided the machinery is self-braking and the load on the handle is not more than 160 N at any moment of jackknifing or hoisting the mast.

6.2 STAYED MASTS

6.2.1 The outside diameter d and the plate thickness t, in mm, at the heel of the masts made of steel having the upper yield stress from 215 up to 255 MPa and stayed by two shrouds on each side of the ship, shall not be less than

$$d = 22\,l; \qquad (6.2.1\text{-}1)$$

$$t = 0{,}2\,l + 3 \qquad (6.2.1\text{-}2)$$

where l = mast length, in m, from the heel to the shroud eyeplates.

The diameter of the mast may be gradually decreased upwards to a value of 0,75 d at the shroud eyeplates, while the thickness of the mast plates is maintained constant throughout the length l.

The mast length from the shroud eyeplates to the top shall not exceed $1/3\,l$.

The mast shall be stayed by the shrouds as follows:

.1 horizontal distance a, in m, from the deck (or bulwark) stay eyeplate to the transverse plane through the mast stay eyeplate shall not be less than

$$a = 0{,}15\,h \qquad (6.2.1.1)$$

where h = vertical distance, in m, from the mast stay eyeplate to the deck (or bulwark) stay eyeplate;

.2 horizontal distance b, in m, from the deck (or bulwark) stay eyeplate to the longitudinal plane through the mast stay eyeplate shall not be less than

$$b = 0{,}30\,h; \qquad (6.2.1.2)$$

.3 the value a shall not exceed the value b.

6.2.2 The actual breaking strength F of the ropes, in kN, used for the mast shrouds as specified in 6.2.1, shall not be less than

$$F = 0{,}49\,(l^2 + 10\,l + 25). \qquad (6.2.2)$$

In other respects, the ropes for shroud shall comply with the requirements of 3.15, Part XIII "Materials" of the Rules for the Classification.

The loose gear of shrouds (shackles, turnbuckles, etc.) shall be such that their safe working load is not less than 0,25 times the actual breaking strength of the ropes referred to above.

6.2.3 Where:

the mast is made of high tensile steel, light alloys, glass-reinforced plastics or wood (the wood shall be of the 1st grade);

the mast is stayed in a way other than that specified in 6.2.1;

in addition to a yard arm, lights and signal shapes, the mast is fitted with other equipment having considerable weight, such as radar reflectors with platforms for their servicing, "crow's nests", etc., proceed as specified in 6.4.

6.2.4 The wires of shrouds shall have a zinc coating according to recognized standards.

6.3 UNSTAYED MASTS

6.3.1 The outside diameter d and the plate thickness t, in mm, at the heel of masts made of steel having the upper yield stress from 215 to 255 MPa shall not be less than

$$d = 3l^2(0{,}674l + a + 13)\left(1 + \sqrt{1 + \frac{51{,}5 \cdot 10^4}{l^2(0{,}647l + a + 13)^2}}\right) \cdot 10^{-2}; \quad (6.3.1\text{-}1)$$

$$t = 1/70d \quad (6.3.1\text{-}2)$$

where l = length of the mast from heel to top, in m;
a = elevation of the mast heel above centre of gravity of the ship, in m.

The outside diameter of the mast may be gradually decreased upwards to a value 0,5 d at the distance 0,75 l from the heel.

In no case the thickness of the mast plate shall be less than 4 mm.

The mast heel shall be rigidly fixed in all directions.

6.3.2 Where:

the mast is made of high tensile steel, light alloys, glass-reinforced plastics or wood (the wood shall be of the 1st grade);

in addition to a yard arm, lights and signal shapes, the mast is fitted with other equipment having considerable weight, such as radar reflectors with platforms for their servicing, "crow's nests", etc.,

proceed as specified in 6.4.

6.4 MASTS OF SPECIAL CONSTRUCTION

6.4.1 In the cases specified in 6.2.3 and 6.3.2, as well as where bipod, tripod and other similar masts are installed, detailed strength calculations of these masts shall be carried out. These calculations shall be submitted to the Register for consideration.

6.4.2 The calculations shall be performed on the assumption that each part of the mast is affected by a horizontal force F, in kN:

$$F_i = [m_i \, 4\pi^2/T^2 \, (\theta \, z_i + r \cdot \sin\theta) + m_i g \cdot \sin\theta + pA_i \cdot \cos\theta] \cdot 10^{-3} \qquad (6.4.2)$$

where m_i = mass of each part, in kg:
z_i = elevation of the centre of gravity of each part above that of the ship, in m;
A_i = projected lateral area of each part, in m²;
T = rolling or pitching period, in s;
θ = amplitude of roll or pitch, in rad;
r = wave half-height, in m;
g = 9,81 m/s² – acceleration due to gravity;
p = specific wind pressure, in Pa, taken according to a ship category.

The calculations shall be carried out both for rolling and pitching of the ship; and θ, in rad, being taken as corresponding to an angle 40° corner at roll and of 5° corner — at pitch.

6.4.3 Under the loads specified in 6.4.2, the parts of the mast shall comply with the requirements of 5.4.1.

7 RAILING AT OPEN DECKS

7.1 GENERAL

7.1.1 Exposed spaces of decks where people may stay shall be protected along the perimeter by bulwark or guard rail, rope or tube rail of sufficient strength with a height of at least 900 mm above the deck and a distance between the rails not exceeding 300 mm, unless provided otherwise in 7.1.3 and 7.1.4. Distance between the lower rail of pulpit and craft structure (deck) shall not exceed 360 mm. On board of all craft with intermediate rails, the height of the lowest rail above the working deck shall not exceed 230 mm.

Adjacent surfaces shall also be safe for people moving in all prescribed situations.

Intervals between the guard rail bars shall not exceed 2,2 m.

When the entire guard line is interrupted by side or aft passages, these passages shall be fitted with safe closures.

7.1.2 On board craft, where accommodation of children is provided by the design, the guard rail shall be fitted with a net with mesh diagonal size not exceeding 100 mm.

7.1.3 Berth-connected craft shall have guard rail of at least 1100 mm height, therewith a distance between intermediate rails shall not exceed 250 mm and a distance between the deck and the lowest intermediate rail shall not exceed 230 mm.

7.1.4 On sailing craft it is allowed to install railing of a height not less than indicated in Table 7.1.4 when the rail of 900 mm height interferes with rigging operations.

Table 7.1.4

Design categories	Height of guard rail, in mm	Remarks
A	600	For craft with L_H ≥8,0 m [1] [2] [3] [4]
A1, A2 and **B**	600	For craft with L_H ≥8,0 m [1] [2] [3] [4]
	450	For craft with L_H < 8,0 m [1] [3]
C	450	[3]
C1, C2, C3 and **D**	450	For decked craft (see types A, B and C in 1.2. Part IV “Stability, Coefficient of Buoyancy and Freeboard”) [3]
C2, C3 and **D**	[5]	For decked craft with L_H < 6,0 m
[1] At each craft side of a passage of sufficient width with antiskid surface and an extension to meet the requirements of 7.1.8 shall be available. [2] At each craft side the rails running to cockpit shall meet the requirements of 7.3 and 7.4. [3] Bow pulpit is recommended. [4] Stern pulpit is recommended. When stern pulpit is not provided, guard rail shall be installed from the bow pulpit to the stern edge of the cockpit and around the cockpit back. [5] Guard rail is not required when other safety precautions complying the craft type, such as handrails and canhooks at deckhouses.		

7.1.5 On the craft with a cockpit open to stern the appropriate safety guard rails shall be installed so as to avoid vertical openings exceeding 500 mm.

7.1.6 On a sailing craft with a stay the continuous or netted bow rail shall be installed in front of and around the stay at least at the same height as the adjacent railing.

Netted guard-rail with mesh diagonal size above 250 mm shall not be installed.

To access a bowsprit or perform mooring operations an opening in the front part of railing is allowed. In this case safety rails capable to closing this opening and installed as per 7.1.5 shall be provided.

7.1.7 Ladders to internal craft spaces, companion hatchways and catwalks shall be fitted with handrails.

7.1.8 On craft of **A, A1, A2** and **B** design categories in places of guard rail a deck extension shall be provided by the board of at least 25 mm in height to prevent sliding of a foot overboard.

7.1.9 Rails and rail stanchions on all craft shall be securely fastened. When they are fitted with sockets and pins, they shall be fixed by through bolts, pasted-in or welded. Fastenings of rail (rails) or rail stanchions shall keep them mechanically without rails. Rails and/or rail stanchions without sockets or pins shall be fixed by through bolts, pasted-in or welded.

7.1.10 Rails shall be made of multicore stainless steel rope of a diameter not less than specified in Table 7.1.10.

Table 7.1.10

Craft hull length, in m	Minimum rope diameter, in mm
L_H ≤8,0	3,0
8,0 <L_H ≤13,0	4,0
4L_H>13	5.0

7.2 GUARD RAILS

7.2.1 Rails and rail stanchions shall be securely fastened at craft deck. When rope rails are used, rope end restraint shall be strong, safe and make use of traditional patterns based on eye-splice and dead eye pleaching or using special steel snaps to be fit on the rope with dead eye installed in the eye-splice.

7.2.2 For rail tension it is recommended to use special pulling turnbuckles made of stainless steel.

Rope turnbuckle from synthetic rope is permitted on all craft for rail tensioning, provided their overlap area does not exceed 1000 mm. All ropes, components and fastening points, as well as lanyards, shall form a continuous guard rail system, bursting strength of which at every point is at least equal to those of rope required for rails.

7.2.3 All fixing arrangements and components being a part of rope guard rail shall have bursting strength 1,2 higher the strength of rail rope.

7.2.4 Rails shall be permanently supported by rail stanchions and shall not pass from outside the rail stanchions.

7.2.5 Rail stanchions and rails in rails fixing points shall be fitted with relevant arrangements or openings to ensure secure fastening of the rail.

7.2.6 Overall height of the rail or pulpit in the bow and stern of the sailing craft shall not be less than specified in Table 7.2.6.

Table 7.2.6

Rail height at the craft's ends

Length of the craft, in m	Design categories	Minimum height, in mm	
		With a single-row rail	With a double-row rail[1]
L_H <8 m	**A, A1** and **A2**	Not applicable	610/305
	B		560 280
	C and **C1**	460	560/280
$L_H \geq$ 8 m	**A**	Not applicable	610/305
	A1 and **A2**		
	B		
	C and **C1**		

[1] Height till the axis of the intermediate rail is fraction separated.

7.2.7 Axes of rail stanchion bases shall not be spaced inward the side edge of work deck apart 5 per cent of the maximum hull width or 150 mm, whatever is greater. Bases of rail stanchions shall not be located outside the work deck.

The rail stanchions are strength tested during manufacture. During bench tests in the direction perpendicular to the axis the stanchions shall withstand load of 560 N without destruction.

During the installation aboard the craft, the deviation of rail stanchion axis shall not exceed 10° from vertical in any point over 50 mm above the deck, when test load of 280 N is applied to the rail stanchion in horizontal direction perpendicularly to the rail.

7.2.8 Base of stanchion or rail shall consist of a bush or socket for the stanchion or the rail, but shall not include the base plate by means of which it is connected with deck or hull.

7.2.9 Bases of rail stanchions and pulpit shall have modulus of resistance at the base, in cm³, not less than

$$W = (300\,a - 250)h/\sigma_{0,2} \qquad (7.2.9)$$

where a = interval between the stanchions, in m;
h = stanchion height, in m;
$\sigma_{0,2}$ = yield point of material, in MPa.

Bases of rail stanchions and pulpit shall be fixed by through bolts or welded.

Inserted stanchions shall be fixed at the base.

7.2.10 When the craft is equipped by a bowsprit, the pulpit in way of bowsprit may only be fitted with rigid medium rail, however, in this case an arrangement shall be provided for installation of the upper rail to ensure the pulpit integrity on the level in stormy weather conditions.

7.2.11 When terminating the cable ends, the following

shall be provided:

.1 insulation of rope yarns and wire strands in place of contact with the component part (dowel pin) it rubs against. This is ensured by a deadeye;

.2 at least minimum rope bending radius allowable for particular diameter and material.

7.3 STORM SAFETY RAILS

7.3.1 In the outfit of sailing craft **A, A1, A2** and **B** design categories storm safety rails shall be provided, as well as the appropriate places and attachments for their installation. It is recommended to install these rails on sailing craft of **C** and **C1** design categories.

Storm safety rails are intended for movable fixing of crew and craft passengers' individual safety belts.

7.3.2 Storm safety rails are installed on craft's deck at each side in way of waterways or near the bulwarks from the inner side of rail stanchions.

7.3.2.1 Each storm safety rail shall be fitted with an individual fastener in bow (in stay area) and stern (in way of stern rail stanchions above cockpit) parts of the craft.

7.3.2.2 In ways of exits from internal spaces to deck the storm safety rail shall be arranged so that a person has a possibility to clip to it before appearing on deck. A person shall be fastened to storm safety rail even during transverse movements on deck in ways of craft ends, as well in the middle part of the craft, when it is necessary to operate the rigging.

7.3.2.3 For storm safety rail the use shall be made of stainless steel rope of at least 8 mm in diameter and yield point of at least 220 MPa, or a synthetic one of equal strength.

7.3.2.4 Length of storm safety rail shall be selected in compliance with particular craft size and equipment installed but no less than those required for normal movement of people, fastened by safety lanyards to storm rails, on craft deck.

7.3.2.5 When the craft is fitted with a bow guard with an open head, storm safety rails shall be installed frontward to protect people working outside the pulpit guard, for instance at bow sprit.

7.4 FASTENINGS FOR SAFETY BELTS

7.4.1 Effective means for fastening safety belt lanyards shall be provided on the open deck, including storm rails on the sides and ends of deckhouses.

7.4.2 Fastening points of safety belts shall be arranged regarding the probable necessity of work on and above the deck. In general, the following fastening points shall be provided:

.1 at exits to the deck;

.2 on cockpit sides.

7.4.3 When it is not otherwise specified, the rails (fixed or movable) shall be located on both sides of the craft to ensure moving of crew members along the upper deck in unfavorable weather conditions.

7.5 BULWARK

7.5.1 On craft of **A, A1, A2** and **B** design categories all around the main deck the bulwark of at least 900 mm from deck shall be installed. On craft of design categories **C, C1** and **C2** the bulwark may be installed only in the bow part of the craft. On sailing craft of **B, C, C1** and **C2** design categories the bulwark may be omitted.

7.5.2 When, by any reason, a lesser height of the bulwark is assumed, the cap rail of the bulwark shall be fitted by guard rail to ensure the required height. Bulwark shall be equipped with a continuous cap rail except the areas where mooring and towing arrangements are located.

7.5.3 When water is accumulated at bulwark on open decks, the effective measures shall be provided for drainage (freeing ports and scuppers). Total area of freeing ports and scupper at one side shall ensure effective drainage of the bulk of water from the deck at zero list during maximum 15 s.

7.5.4 Bulwark, regardless the place of installation at main deck shall not be spaced at the value of 5 per cent of the maximum craft's hull width from sheerstrake or 150 mm, whatever is the greater.

7.5.5. Bulwark strength shall meet the requirements of Part II "Hull".

7.6 RAILS OF SAILING CRAFT

7.6.1 General.

For the purpose of this Chapter, a term "guard-rail" may be used instead of a term "rail" or "railing".

For multihull craft, any deviations of deck guardrail height, guardrail intervals, guardrail fixing shall be substantiated by the designer.

7.6.2 Permanent railing.

7.6.2.1 Permanent bow railing (onward forestay) and stern railing (unless the rails are installed as an equal alternative to stern railing) shall be provided on single-hull craft the of **A**, **A1, A2, B, C** and **C1** design categories.

Fort craft up to 8,5 m in length, bow rail may be situated to the stern from forestay, provided that upper forward strap of the rail is within 405 mm from the forestay.

7.6.2.2 Main hull of trimaran, regardless the design category, shall be fitted with bow railing. On each side this railing shall be connected with upper and lower rails surrounding the main hull and supporting by stanchions. Rails may be discontinued where the nets or transverse wings are located outside the main hull.

7.6.2.3 Catamaran, regardless the design category, shall be fitted with bow and/or stern railing which ends the rails.

7.6.2.4 Onboard all craft the height of upper hand-rails of rails above the working deck shall not be lower than upper rails, the height of which shall be basically the same as the height of the upper rail at the front part of cockpit.

7.6.3 Rails.

7.6.3.1 It is allowed not to fix rails to bow railing when they are fixed to or passing through sufficiently braced stanchions installed inside bow railing and overlapped by bow railing so that clearance between the upper rail and bow rail does not exceed 150 mm.

For craft with hull length of 5,5 m and less, guard rail and stern railing are recommended, however, bow railing is mandatory.

7.6.3.2 On all craft the rails shall be fitted with permanent supporting arrangements and shall not pass through the outer side of rail stanchions.

7.6.3.3 On all craft the rails shall be sufficiently tensioned. When a deflecting force 50 N is applied to a rail between the stanchions, the rail shall not be deflected for more than 50 mm.

7.6.4 Supporting backstays and ends on monohull craft.

Provided that closed guard rail is supported by stanchions and railing, the bases of which are located within working deck, rail ends and supporting backstays may be secured on the hull to the aft from working deck.

7.6.5 Nets-trampolines, rails, stanchions and railings of all multihull craft

7.6.5.1 Nets-trampolines shall be made of firmly interlaced watertight cloth or woven nets with a mesh not exceeding 50,8 mm (2 inches). Their fixing points on the yacht structure shall be located so as to avoid wear. Connections between trampolines or nets or craft shall prevent sticking of a man foot in them.

7.6.5.2 Net-trampoline shall be firmly secured at longitudinal and transverse lines at regular intervals and tightly sewed to boltrope. Lines which are used for net tensioning shall be tensioned separately or no more than four fixing points may be connected to one connecting line.

7.6.5.3 Net-trampoline shall withstand total weight of the crew both in normal conditions of navigation and in case of craft capsizing.

7.6.5.4 Trimaran with two transverse beams shall be equipped with a net covering the space between the main hull and each auxiliary side/float hulls.

On trimaran the net in the bow part of each side is fixed in the fixing point of bow railing of main hull and a middle part of a bow transverse beam. In the aft part from each side it is recommended to fix the net in the vicinity of cockpit or control station, whichever is located farther to aft and a crossing point of the aft transverse beam and auxiliary float hull.

7.6.5.5 When net extends into the railing base, additional rail shall be provided from the top of the railing till the middle of bow transverse beam or to the outside of it.

7.6.5.6 Aboard trimarans fitted with one transverse beam between the main hull and each side hull/float hull the net shall be located at least between two straight lines going from crossing point of transverse beam with the float hull, one up to stern end of bow rail of the main hull in the bow part of the yacht, the other one up to rightmost stern part of cockpit or control station (depending on what is located farther to stern) in the stern part of the yacht.

7.6.5.7 Aboard trimarans, where the control station is fitted on the float hull, even in case it is used not often (for example, as an emergency control station) regardless the availability of cockpit, such float hulls shall be equipped with rails running till the control station and protecting it through 3 m radius arc and with a center in the control station. When measuring a distance between rails, the dimensions shall be taken with the rails tensioned.

7.6.5.8 Total net surface of catamarans shall be terminated:

.1 on each side — by hulls;

.2 in the longitudinal direction — by a section going through the stay base and a section going through the backmost point of boom when the boom is in the center plane.

Catamaran with a central cabin not touching water surface may meet the requirements for the trimaran.

7.6.5.9 Each catamaran hull shall be equipped with rails running from bow to transom.

Catamarans not fitted with bow or stern transverse beam shall be equipped with transverse rails on net ends fore and aft. These rails shall be connected to bow and aft handrails or stanchions. Strapping, bond or robe of at least 6 mm in diameter in a form of zigzag shall connect rails and net.

8 MAIN, ESCAPE AND EMERGENCY EXITS

8.1 GENERAL

8.1.1 Each hull of the craft with living accommodation shall be provided with, at least, two exits: main and emergency irrespectively of the craft design category.

Each hull of a multihull of **A, A1, A2, B, C, C1** and **C2** design categories having living accommodation, shall be provided with a hatch for entrance into the hull and exit from it in the case of capsize.

Each living accommodation, which is used either for sleeping/resting or is exposed to the increased risk of fire, shall be provided with two exits: main and emergency.

Only in exceptional cases, one main exit leading to an open air may be allowed, when installation of a second exit negatively influences the general safety of the ship. The length of such accommodation shall not exceed 8 m.

8.1.2 Exits shall be permanently accessible and their closing appliances — be permanently operational to be opened from the inside and outside without using a special instrument.

8.1.3 The exit located in an upper part of the accommodation shall be equipped with a ladder, steps or other permanently fixed footholds with the distance between the upper foothold and the centre of an opening not above 1,2 m.

8.1.4 All exits other than the main shall be appropriately marked and labeled "Exit" or "Emergency Exit".

8.1.5 When the only exit from the accommodation specified in 8.1.1 is provided, effective smoke detectors and an appropriate system warning of fire, which may cut off a way to the only exit from the accommodation for people being there, shall be obligatory installed on the ship.

8.1.6 All monohull sailing craft of 8,5 m in length and above shall be provided with, at least, two exits (main and emergency) from the craft hull irrespectively of the craft design category. One exit shall be located before the fore mast, except for the case, when structural features do not allow to install it.

8.1.7 Each escape hatch shall be capable of being opened both from the outside and inside.

8.1.8 In case of craft capsize, an escape and rescue hatch shall not be under water.

8.1.9 Minimum dimensions of exits.

Hatches shall have the following minimum clear characteristics:

circular shape — minimum clear diameter of 450 mm;

any other shape — minimum dimension of 380 mm and minimum area 0,18 m² of coaming clearance and hatch coaming clearance shall have such configuration as to allow for a 380 mm diameter circle to be inscribed. Some examples are shown in Fig. 8.1.9.

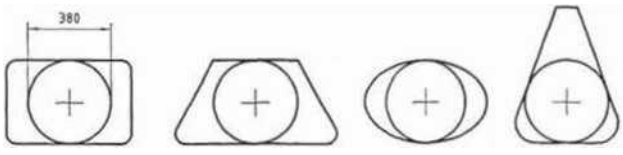


Fig. 8.1.9

8.1.10 Structure of closing appliances.

8.1.10.1 Escape hatch covers shall be capable of being easily opened from the inside and outside, when closed but not battened down.

8.1.10.2 Hinge or hinges of a cover of the escape hatch, which is opened from the inside, shall be such as to prevent tearing out of the hatch cover by a wave slap, when the hatch is partly or completely open.

8.1.10.3 When movable shields or storm boards are used to close a vertical opening, they shall be installed and fixed in such a way as to exclude their displacement at any list (heel) or trim of the ship.

8.2 ESCAPE ROUTES ON CRAFT 15 M IN LENGTH AND UNDER

8.2.1 The distance to the nearest exit to the open air shall not exceed 5,0 m. Where the exit route passes beside an engine space, the distance to the nearest exit shall not exceed 4,0 m.

The distance shall be measured in the horizontal plane as the shortest distance between the centre of the exit and the farthest point where a person can stand at the midpoint of the height (minimum height 1,6 m).

8.2.2 Where only one escape route is provided, this shall not pass directly over a cooker or heating appliance.

8.2.3 Where living or sleeping accommodation is separated from the nearest exit by a partition with a door or in other similar way and leads directly past a cooker or engine space, an alternative exit shall be provided.

8.3 ESCAPE ROUTES ON CRAFT ABOVE 15 M IN LENGTH

8.3.1 General requirements.

8.3.1.1 Where there are two escape routes only one may pass through, over and beside an engine space.

8.3.1.2 Where the distance between a cooking or open-flame heating-appliance burner and the nearest side of an escape route is less than 750 mm, a second escape route shall be provided.

8.3.1.3 In an enclosed galley, the second escape route is not required where its dead end beyond the cooker is less than 2,0 m.

8.3.1.4 No escape route shall pass directly over a cooking or open-flame heating appliance.

8.3.2 Open-accommodation arrangement.

Where living or sleeping accommodation is not separated from the nearest exit, i.e. people can move around without passing through any door, excluding toilet or shower compartment doors, the following shall apply:

.1 the distance to the nearest exit shall not exceed $L_H\ /3$, in m;

.2 the distance shall be measured in the horizontal plane as the shortest distance between the nearest part of the exit and the farthest point where a person can stand at the midpoint of the height (minimum height 1,6 m).

8.3.3 Enclosed accommodation arrangement.

Where living or sleeping accommodation is separated from the nearest main exit by bulkheads and doors, escape routes and exits from accommodation areas shall be arranged to meet the following conditions.

8.3.3.1 Each accommodation section shall have more than one escape route leading finally to the open air, unless it is a single cabin or compartment intended to accommodate no more than four persons and the exit leads directly to the open air without passing through or over engine spaces or over cooking appliances.

8.3.3.2 For individual cabins intended to accommodate no more than four persons, and not containing cooking or open-flame heating devices, escape routes may form shared escape ways for up to 2,0 m, measured to a two-way escape route from the door or entrance.

8.3.3.3 Shower and toilet compartments are regarded as part of the compartment or passageway that gives access to their doors and therefore do not require alternative escape routes.

8.3.3.4 With multilevel arrangements, the exits shall lead to a different accommodation section or compartment, as far as practicable.

9 HATCHES, DOORS, SIDE SCUTTLES, WINDOWS, COVERS AND MANHOLES

The requirements of this Section apply to all types of closing appliances installed on small pleasure craft. Materials used in closing appliances shall comply with the requirements of Part X "Fire Protection".

9.1 DEFINITIONS AND EXPLANATIONS

9.1.1 For the purpose of this Section, the following definitions and explanations have been adopted.

Watertightness is the capacity of an appliance or a device to prevent ingress of water inside the craft.

Entry door is a door or another closing appliance closing the passage to crew spaces.

Side scuttle of non-opening type is a side scuttle provided with a fixed glass of non-opening type.

Closing appliance is a device used to cover openings in hull or superstructure, including windows, side scuttles, deadlights, hatch covers, doors, sliding appliances, emergency hatches.

Escape hatch is an appliance intended to provide an exit and designated means of saving life in the event of accident or inversion.

Window is a glazed appliance. The term "portlight" is generally used for a small window.

Flush deck scuttle is a side scuttle of non-opening type installed on the exposed deck plating to ensure access of light into the space.

Deck hatch is a device fitted on decks and inclined sides of superstructures and deckhouses.

Appliance location area is one of the outer hull areas as stated below and shown in Fig. 9.1.1:

Area I is a part of hull sides situated below the waterline, including inner sides of multihulls and transom.

Area II (IIa or IIb) are exposed parts of the deck, as well as the sides of superstructures and deckhouses of the first tier situated forward of 0,25 of the craft's length L from the forward perpendicular;

Hull side situated above the waterline, including the inner sides of multihulls and transom;

Exposed parts of the deck, superstructures and deck-houses of the first tier, cockpit soles, as well as outer sides of the superstructure and deckhouse of the first tier at an inclination of less than 25° to the horizon in a longitudinal direction, and at an inclination of less than 25° to the horizon in the transversal direction respectively for multihulls and motor sailers.

Area III are the outer sides of superstructures and deckhouses of the first tier not belonging to area II.

Area IV are the decks and outer sides of superstructures and deckhouses of the second tier and upper. Parts of area III protected from the direct impact of waves. Cockpit sides, rear faces of superstructures and deckhouses of all tiers.

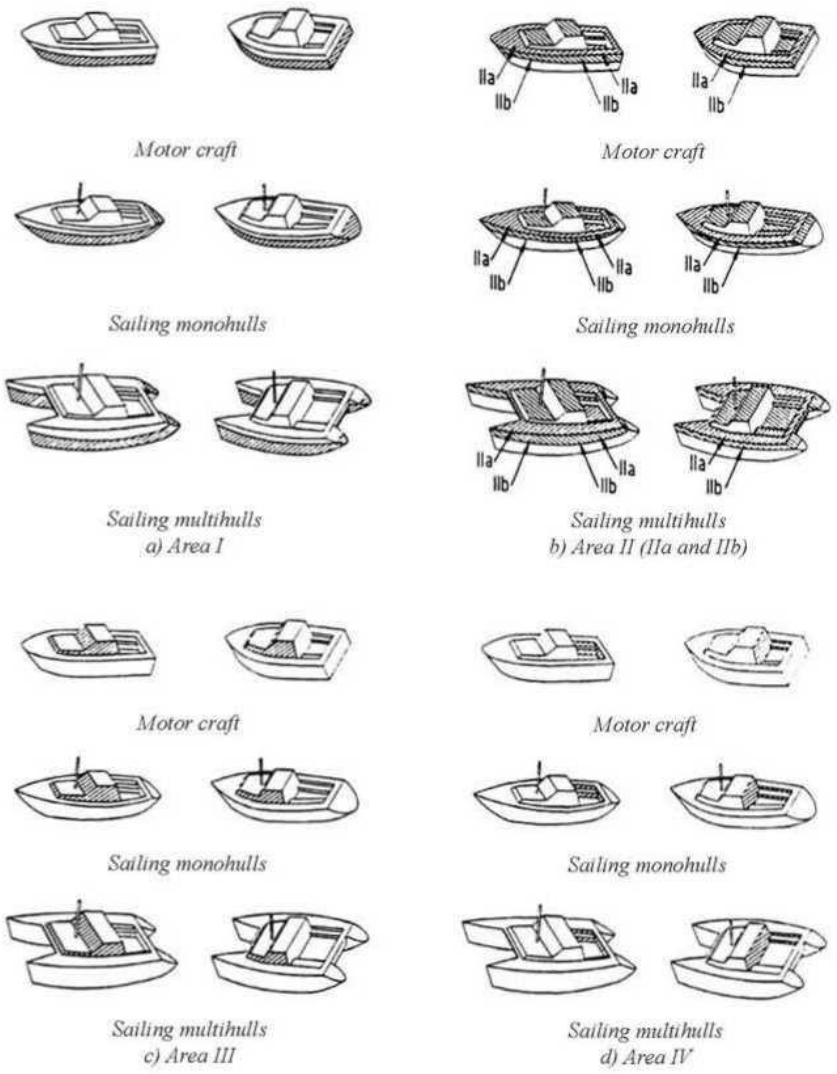


Fig. 9.1.1
Typical appliance location areas on pleasure craft. Areas are schematically shown as hatched spots

Sliding appliance is an appliance that can slide in a rabbet or a frame.

Framed plate sliding appliance is a plate mechanically connected to a frame that slides in a rabbet.

Frameless plate sliding appliance is a plate without frame that slides in a rabbet or a frame.

Pivotedsidescuttle is a side scuttle with an opening glass ensuring access of air to spaces.

Degree of watertightness is the capacity of an appliance or fitting to resist ingress of water according to the following conditions of exposure to water:

degree 1 — tightness is ensured under the water head in the submerged condition.

Structural components or closing appliances of hull openings shall be deemed watertight if they are so fitted as to prevent any ingress of liquid inside the craft when they are subjected to the specified pressure for the unlimited time;

degree 2 — tightness under the effect of waves (temporary submersion, actions of waves and other possible effects) is ensured.

Structural components or closing appliances in the underwater hull shall be deemed watertight if they are so fitted as to prevent any ingress of water inside the craft when they are subjected to a pressure corresponding to a head of water of 10 m for one minute, or a jet of water at a pressure of at least 100 kPa for 10 min applied over the entire surface and structural components or closing appliances from a distance of not more than 1,5 m;

d e g r e e 3 — weathertightness is ensured.

Structural components or closing appliances of the underwater hull shall be deemed watertight if they are so fitted as to prevent any ingress of water inside the craft when they are subjected to a jet of water at a pressure of at least 100 kPa applied over the entire surface and structural components or closing appliances from a distance of not more than 3,0 m.;

d e g r e e 4 — spray tightness is ensured.

A closing appliance shall be deemed spray proof, if under the effect of divergent jet of water at a pressure of at least 100 kPa applied over the entire surface and closing appliances from a distance of not more than 3,0 m, it allows only a small quantity of water to enter the craft.

D e a d l i g h t is a secondary watertight closure fitted to a window, a hatch or a door, and which may be fitted outside and inside the plate.

9.2 GENERAL

9.2.1 Watertightness.

9.2.1.1 To avoid flooding, all appliances shall be manufactured and fixed to meet the minimum degree of watertightness when closed.

9.2.1.2 The degree of watertightness of the manufactured appliance shall be tested by the appliance manufacturer before installation on the craft.

9.2.1.3 The degree of watertightness of any appliance installed on the outside surface of the craft shall be checked in compliance with the requirements of 9.2.2.1.

9.2.1.4 The degree of watertightness of any closing appliance installed on a non-outside surface of the craft shall be tested for a chalky imprint on the seal.

9.2.2 Minimum degree of watertightness.

9.2.2.1 The required minimum degree of watertightness of a closing appliance depends on the area of its location onboard and area of navigation. The required minimum degree of watertightness is shown in Table 9.2.2.1.

Table 9.2.2.1

Minimum degree of watertightness

Type of craft	Appliance location area	Type of appliance	Design category			
			A, A1, A2 and **B**	**C** and **C1**	**C2** and **C3**	**D**
All craft	Area I	Any	1	1	1	1
	Area II	Any	2	2	3	4
		Sliding companionway hatch		3	4	
	Area III	Any		2		
Sailing monohulls	Area IV	Any	3	3		
Motor craft		Any		4		
All multihulls						

Note. The above degrees of watertightness relate not only to closing appliances. The degree of watertightness of any device, which is not built into the appliance, for example a ventilation system, shall comply with the requirements of these Rules. Watertightness of closing appliances and component parts fitted in cockpits shall comply with the present requirements.

9.2.2.2 The required degree of watertightness of any appliance, after installation on the craft, shall meet the requirements of 9.2.2.1.

If the shipyard tests closing appliances and component parts before installation on the craft, the method required in 9.1.1 shall be used.

9.2.3 Additional requirements related to watertightness.

9.2.3.1 Sliding appliances shall not be used in Area I.

9.2.3.2 Hatches fitted on the decks of trimaran outrigger hulls shall not be sliding appliances.

9.2.4 General requirements to openings and their closing appliances in hull, upper deck, superstructures and deckhouses.

During installation of appliances requirements specified in Tables 9.2.4-1 and 9.2.4-2 are to be met:

Table 9.2.4-1

Appliance	Design category	
	A, A1, A2 and **B**	**C, C1, C2** and **C3**
Deck hatch covers	[1][3]	[2] [3]
Cockpit covers	[1]	[2] [3]
Sliding covers	[2] [3] [9]	[2] [3]
Access to cabin	[2] [5]	[2] [4]

Appliance	Design category	
	A, A1, A2 and **B**	**C, C1, C2** and **C3**
Ventilation duets for accommodation spaces	[2] [7]	[2] [3]
Ventilation ducts for engine room	[2] [3] [6] [7]	[2] [3] [6]
All pipes	[2] [3] [6]	[2] [3] [6]
Keel box	[1]	[2] [8]
Chain locker pipe	[2]	[2]

[1] — Closing appliance ensuring watertightness degree 2.
[2] — Sprayproof closing appliance.
[3] — For craft using no sails for propulsion:
all closing appliances (openings) submerged to the water at an inclination of 0 to 50°, as appropriate, shall be weathertight so as to ensure stability limit of up to 50°;
craft with the stability limit less than 50° shall not be exempted from this requirement.
For craft which may use sails for propulsion:
all closing appliances (openings) submerged to the water at an inclination of 0 to 90°, as appropriate, shall be weathertight so as to ensure stability limit of up to 90°;
craft with the stability limit less than 90° shall not be exempted from this requirement.
[4] — The coaming shall be at least 50 mm high. Removable coamings on craft of design category **C2** shall meet requirement [5].
[5] — The coamings of doors to underdeck spaces shall have a height not less than the values specified in Table 9.2.4-2.
[6] — May be located only above the main deck in enclosed spaces so as to ensure engine operability as long as possible, even in foul weather.
[7] — Possibility should be provided to arrange weathertight closure (i.e. tarpaulin cover) in the event of a stormy weather.
[8] — Safety distance from the effective waterline to the lowest point, where watertightness is not ensured, shall be at least 100 mm. The parts of keel box above this level may be sprayproof.
[9] — May be located on superstructure or deckhouse deck only. Hatches with sliding covers in the bow of the craft shall have coaming height of at least 150 mm above the superstructure or deckhouse deck.

Table 9.2.4-2

Location	Height of coamings, in mm	
	Motor craft	Sailing craft
In lateral and rear sides accessible from the main deck	150	150
In lateral and rear sides accessible from the cockpit	380 from the cockpit sole	460 form the cockpit sole
Anywhere, if this access leads directly to underdeck spaces	460	460

Note. Removable coamings of doorways shall allow fitting the doors in places of installation

9.2.5 Additional requirements to appliances located in Area II.

9.2.5.1 The lower edge of any opening appliance shall be placed above the waterline at a distance not less than that specified in 6.4.2 — 6.4.5, Part IV "Stability, Buoyancy and Freeboard".

The smallest unsupported dimension of appliance shall not exceed 300 mm.

The above requirements do not apply to escape hatches of sailing craft.

9.2.5.2 All opening appliances shall open inwards, with the exception of deck covers and escape hatches of sailing craft.

9.2.5.3 On craft of design categories **A, A1, A2, B, C** or **C1** no part of the plate framing shall extend outside the local vertical tangent to the hull, deck, rubbing strake, fixed fender, or of a built-in fairing which is an integral part of the hull.

9.3 WEATHERTIGHTNESS

9.3.1 General requirements to hatch covers.

Hatches leading to inside spaces of the craft shall be fitted with sprayproof covers. The hatch covers may pivot on hinges, sliders or rollers, though, in any case they shall be permanently secured to the craft and provided with essential locking devices, which maintain them in a closed position at potential heel and trim in the prescribed areas of navigation. The hatches with pivoted covers located forward of the foremast shall have hinges fitted only on the fore edge of the hatch.

9.3.2 Hatches open on the way.

Generally, when at sea, all access hatches shall be closed. Though, the hatch, which can be open at sea for a long time, shall meet the following requirements:

.1 have minimum possible dimensions (area of vertical opening shall not exceed 0,4 m² in the plan);

.2 be located on CL, or as close to CL as possible;

.3 be installed on craft of design categories **A, A1, A2, B, C** or **C1** so as to be opened at a height of at least 300 mm above the upper deck adjacent to the opening side.

9.3.3 Rabbet depth.

The depth of the rabbet shall be sufficient to prevent any disengagement of the plate. For unframed plates made of plastics or materials with similar modulus of elasticity, this depth shall be at least 12 mm.

9.3.4 Stops.

The sliding appliance shall be fitted with stops at each end of its stroke to prevent any disengagement of the sliding part of the frame.

9.3.5 Locking system (locking devices).

Any appliance shall have a locking device which maintains it in a closed position, operable at least from inside.

On doors, this system shall be operable from both sides.

In craft of design categories **A, A1, A2, B, C** or **C1**, if the companionway door is used together with a companionway hatch, the locking device need only be efficient when both the door and the hatch are closed together. In this case, if the companionway door is made with washboards, the locking device may only act between the upper panel of the washboard and the hatch.

9.4 EXTERNAL DOORS

9.4.1 All external doors may be installed only above the freeboard deck or cockpit sole.

Watertightness of the external doors shall be 2, 3 or 4 according to the place of their installation.

9.4.2 Bow doors.

Arrangement of bow doors shall be permitted only if the water, which occasionally passed through them, shall in no case penetrate inside the spaces below the freeboard.

9.4.3 Side and stern doors.

9.4.3.1 The coamings of side and stern doors on craft of design categories **A, A1** and **A2** shall be at least 300 mm high. For craft of design categories **B, C** or **C1** this height may be reduced to 230 mm.

9.4.3.2 On craft of design categories **C2** or **C3** the coamings of hatchways, companionways and access openings to superstructures and deckhouses shall be not less than150 mm.

9.4.3.3 On craft of design category **D** the coamings of hatchways, companionways and access openings to superstructures and deckhouses shall be not less than 50 mm.

9.4.3.4 The doors shall be hinged inside.

To ensure opening, closing or securing of doors having watertightness degree 2 or 3 provision shall be made for quick-acting appliances, which may be operated from both sides.

All external doors shall open outwards; installation of the doors opening inside the superstructure or deckhouse is allowed in case they are weathertight.

9.4.3.5 The number of securing devices on each edge of the door having watertightness degree 2 or 3 shall be not less than two; a securing device shall be provided in the vicinity of each door corner. The distance between securing devices shall not exceed 1,5 m.

9.4.4 External doors having watertightness degree 2 or 3 shall be made of metal.

External doors having watertightness degree 4 may be made of wood or other non-metal materials.

9.4.5 The freeboard superstructure doors or deckhouse doors opening the direct access to engine room or underdeck spaces shall be watertight, and the height of their coamings shall be not less than 460 mm above the deck.

9.4.6 Doors made with removable sections: washboards.

Doors made with removable sections, usually called "washboards" may be installed on craft of design categories **C1, C2, C3** or **D**, and shall be:

.1 fitted with a device to keep them in position, when in use, and to be at least operable from inside;

.2 stored inside the craft in the vicinity of the door opening;

.3 easily reached without use of tools;

.4 removable sections of washboards, when not in use, shall have places of permanent storage and securing.

9.5 SIDE SCUTTLES

9.5.1 The number of side scuttles in the shell plating below the freeboard deck shall be reduced to a minimum consistent with the structure and operational conditions of the craft, to exclude their damage during possible mooring alongside other craft.

No side scuttles shall be permitted in shell plating in way of engine room.

9.5.2 Side scuttles in the shell plating below the freeboard deck shall be of non-opening type and round-shaped.

Side scuttles in the engine room skylight shall be of non-opening type.

If it was permitted to install pivoted side scuttles in the above area, the requirements of 6.4.2 and 6.4.3 shall be met, as well as the requirements of 2.6, Part IV "Stability, Buoyancy and Freeboard".

9.5.3 Side scuttles may be round or rectangular. In any case the side scuttles shall have dimensions relevant to the design category and ensure watertightness.

9.5.4 On craft of design categories **A, A1** or **A2** side scuttles shall be located so as to prevent their lower edges from being below the line parallel to the freeboard deck and having its lowest point at a distance of 500 mm above the summer load line.

For craft of design categories **B** or **C** this distance may be reduced to 300 mm, while for craft of design categories **C1, C2, C3** or **D** — to 150 mm.

9.5.5 The side scuttles in shell plating below the freeboard deck and in fore sides of enclosed superstructures and deckhouses of the 1st tier, and also in fore sides of enclosed superstructures and deckhouses of the 2nd tier situated forward of 0,25 of the craft length L_H from the forward perpendicular shall be:

of a heavy type and fitted with efficient deadlights hinged inside — on craft of design categories **A, A1** or **A2**;

of normal type and fitted with efficient deadlights hinged inside — on craft of design categories **B, C** or **C1**;

of light type and fitted with no deadlights — on craft of design categories **C2, C3** or **D**, though they shall be watertight and of non-opening type, i.e. non-pivoted.

The windows of superstructures, deckhouses and companionways of craft of design categories **C1, C2, C3** or **D** located below the freeboard deck, may only be weathertight and pivoted.

9.5.6 The side scuttles in enclosed superstructures and deckhouses of the 1st tier, except those specified in 9.5.5, shall be:

of normal type and fitted with efficient deadlights hinged inside — on craft of design categories **A, A1** or **A2**;

of light type and fitted with efficient deadlights hinged inside — on craft of design categories **B, C** or **C1**.

9.5.7 Side scuttles in enclosed superstructures and deckhouses of the 2nd tier, except those specified in 9.5.5, shall be as required in 9.5.6, provided these side scuttles give direct access to an open stairway leading to spaces situated below.

In cabins and similar spaces of enclosed superstructures and deckhouses of the 2nd tier it is allowed that instead of side scuttles specified in 9.5.6 the side scuttles or windows could be fitted without deadlights.

9.5.8 The side scuttles and windows of superstructures, deckhouses and companionways on craft of design categories **C1, C2, C3** or **D** located below the freeboard deck may only be weathertight and pivoted, though the glass should be safe with the thickness of at least 6 mm.

9.5.9 The side scuttles installed on the craft hull below the upper deck shall be watertight, and their strength shall be not less than that of the hull structure in places of their installation.

9.5.10 It is not permitted to install side scuttles in the main hull of multihulls below the upper deck, if the strength of glass or the means of its attachment to the frame is not equivalent to that required for structural components on which they are fitted.

9.5.11 On craft of design categories **A, A1, A2, B, C** or **C1** provision shall be made for caps (amounting to 50 per cent of the number of craft windows of each size), which may be securely attached to the window place in case of glass fracture.

9.5.12 Glass of side scuttles and windows.

9.5.12.1 Glass, generally, shall be made of tempered or annealed safety glass ("ESG"). It is permitted to use laminated glass ("MSG"), plates of acrylic and polycarbonate or other equivalent material.

On craft of design categories **A, A1, A2, B, C** or **C1** plastic window glasses shall be made of material resistant to ultraviolet rays (UV).

9.5.12.2 Window glasses of silicate ("ESG", "MSG") shall have metal frames tightened to the craft hull. The glass bearing area as against the frame shall be at least 6,0 mm wide.

9.5.12.3 Windows of acrylic or polycarbonate plates shall be attached by means of frames. They also may be attached directly to the shell plating or outer side, provided that bolt fixture will be capable to withstand the emerging stresses and ensures long-term watertightness. The width of the glass bearing area shall be 3 per cent of the shortest side of the glass, but not less than 20 mm.

Other structural solutions ensuring equal safety are permitted. The strength shall be confirmed by tests and/or calculation.

9.5.12.4 Sections with rubbers may be used only on craft of design categories **C2, C3** or **D**, if the shortest side of the window does not exceed 300 mm and circle radius is at least 50 mm.

9.5.12.5 Thicknesses of the window glass shall be determined by the formula

$$t = n \cdot \sqrt{(F \cdot F_b)/y} \qquad (9.5.12.5)$$

where F = surface area of the glass, in m²;
F_b = freeboard, in m;
y = height of the window center, in m, above the surface of effective waterline corresponding to F_b;
n = coefficient adopted in compliance with Table 9.5.12.5-1.

Table 9.5.12.5-1

Values of coefficient n

Type of glass and its location	Material	n		t_{min}, in mm
		Design categories		
		A, A1, A2 and **B**	**C, C1, C2, C3** and **D**	
Windows in hull and in fore sides of superstructures	Annealed safety glass (ESG)	12,0	11,0	6
	Polycarbonate (PC)	15,6	14,0	5
	Acrylic laminated glass (MSG)	18,0	16,0	5
Windows in rear sides or in recesses of superstructure sides	Annealed safety glass (ESG)	9,6	8,6	4
	Polycarbonate	12,5	11,0	5
	Acrylic laminated glass (MSG)	14,4	13,0	5

Depending on the area of location onboard the minimum glass thickness shall not be less than that given in Table 9.5.12.5-2.

Table 9.5.12.5-2

Minimum glass thickness

Material	Acronym	Safety factor, γ	Plate thickness t_{min}, in mm			
			Design categories			
			Any		*)	**)
			Area of installation onboard			
			Area I	Area II	Areas III and IV	
Poly(methyl) methaerylate	PMMA	3,5	6 + 0,1 $(L_H - 4)$	6	5	4
Polycarbonate	PC	3,5	6 + 0,1 $(L_H - 4)$	6	5	4
Monolithic tempered glass[1]	TG	4.0	5 + 0,1 $(L_H - 4)$	4	4	3
Laminated glass[1]	LG	4,0	5 + 0,1 $(L_H - 4)$	4	4	3

*) — **A, A1, A2** and **B.**
) — **C, C1, C2, C3 or **D.**
[1] Glass is only allowed in Area I if it is highly resistant to impact, or if equipped with a deadlight.

9.5.12.6 For skylight scuttles and deck hatch covers only acrylic or polycarbonate plates may be used. The thickness of glasses made of these materials shall be 25 per cent more than that of the hull scuttles or fore side scuttles according to 9.5.12.5, but not less than 7,0 mm.

9.6 DEADLIGHTS

9.6.1 Deadlights shall meet the requirements of Part III "Equipment, Arrangements and Outfit" of the Rules for the Classification. Deadlights of windows fitted in area I shall be permanently attached to the appliance, its framing, or the craft structure, and be operative even in the case of rupture of the opening part of the window.

9.7 COMPANION HATCHES, SKYLIGHTS AND FLUSH DECK SCUTTLES

9.7.1 Outward deck openings designed for installation of companion hatches to underdeck spaces shall be protected with covers permanently attached to the coamings.

Covers having watertightness degree 2 or 3 shall be made of metal.

Covers having watertightness degree 4 may be made of wood or other non-metals.

Where the covers are made of metal, the thickness of their plate shall be 0,01 times the spacing of stiffeners, but not less than 2 mm.

9.7.2 Skylight shall be effectively sprayproof and shall be located in the craft CL or as close to the CL as possible, if not designed as means of evacuation from underdeck compartment.

If an opening-type skylight is fitted, it shall be provided with a reliable device capable of maintaining it in a closed position.

The skylight serving as means of evacuation shall be capable of being opened from any side (from the deck and from the space).

If the strength of glass or of its attachment to the frame is not equivalent to that required for the structural components, to which they are attached, provision shall be made for a removable cap, which may be securely attached to this place in case of the glass rupture.

The glass thickness shall be equal to that required in 9.5.12 with due consideration of loads from the deck cargo.

9.7.3 Flush deck scuttles shall be of non-opening type. Flush deck scuttles fitted in Areas I and II shall be provided with deadlights hinged or attached by other method (for example, by means of a chain) and capable of being easily and efficiently closed and secured.

9.7.4 The largest dimension of the flush deck scuttles shall not be over 200 mm, with the glass being at least 15 mm thick. Moreover, the glass shall be tempered. The flush deck scuttles shall be attached to the metal deck plating by means of frames.

9.7.5 The strength of glass or of its attachment to the frame shall be equal to that of structural component in which it is fitted.

9.7.6 When secured, the deadlights of the flush deck scuttles shall be weathertight. The tightness shall be ensured by a rubber or other suitable gasket.

For the same purpose, along their contour the glasses of the flush deck scuttles shall be provided with a gasket made of rubber or other suitable material.

9.8 REQUIREMENTS TO MATERIALS

9.8.1 Plate materials.

9.8.1.1 General requirements.

Appliance plates shall be made of a transparent glazing material, such as poly(methyl)methacrylate (PMMA), polycarbonate (PC), tempered glass, chemically reinforced glass or laminated glass, refer to Table 9.8.3.1-1; or

a non-transparent plate material, such as plywood (PW), glass-fiber reinforced thermosetting plastic (GRP), aluminum alloy, steel, etc.; or

any other material of strength and stiffness equivalent to those cited above.

9.8.1.2 Mechanical properties of materials are given in Table 9.8.3.1-2.

9.8.2 Acrylic sheet materials.

Poly(methyl)methacrylate (PMMA) made with a technique other than the casting procedure shall have mechanical properties and resistance to ageing at least equal to those of cast PMMA.

9.8.3 Glass.

9.8.3.1 Restrictions to usage.

Glass shall not be used in Area I on sailing craft of all design categories and on motor craft of design categories **A, A1, A2** and **B**, unless the plate is made of high-impact-resistance glass, or if the appliance is equipped with a deadlight.

In Area II on motor craft, the usage of monolithic or laminated glass is accepted without restriction.

On sailing craft, neither monolithic nor laminated glass shall be used forward of the foremast, unless the plate is made of high-impact-resistance glass, or if the appliance is equipped with a deadlight. Properties of high-impact-resistance glass are given in Table 9.8.3.1-2.

The restriction need not be considered if the plate is protected against shocks by an approved device, for example, outside grid network, protection bars.

Table 9.8.3.1-1

High-impact-resistance glass types

Glass type	Requirements
laminated glass (faces AG, TG or CG)	Minimum thickness of faces 4 mm. minimum interlayer thickness 2,3 mm
Bullet-resistant glass	Class FB2 to FB7 tested in accordance with EN 1063
Impact-resistant glass	Class 4 tested in accordance with EN 356
N o t e . AG = annealed glass; TG = tempered glass; CG = chemically reinforced glass. Other glass types can be accepted if a 400×400 mm flat plate can bear an impact energy of 300 J yielded by the fall of a hard object (steel ball) and have a degree of watertightness 1, 2 or 3, when tested.	

Table 9.8.3.1-2

Average mechanical properties of typical materials

Material	Abbreviation	Ultimate flexural strength σ_u, in MPa	Modulus of elasticity E, in MPa
Poly (methyl) methacrylate	PMMA	110	3000
Polycarbonate	PC	90	2400
Tempered glass	TG	200	72600
Chemically reinforced glass	CG	300[1]	72600
Annealed glass	AG	40	72600
[1] This value corresponds to a case depth (chemical reinforcement depth) of 30 μm. AG = annealed glass; TG = tempered glass; CG = chemically reinforced glass.			

9.8.3.2 Monolithic glass.

Monolithic glass shall only be made of tempered glass or chemically reinforced glass.

9.8.3.3 Laminated glass.

The glass plies used in laminated glass can be made of any type of glass.

9.8.4 Specific requirements.

9.8.4.1 Type of end connection.

These Rules do not prescribe any specific types of end connection, though, it is suggested to use type connections of ISO 12216:2002, namely:

.1 simply supported plates are the plates fastened without glue or gasket to the frame rabbet or to the craft face by elastomer joint;

.2 flexibly connected plates are the plates fastened to the frame rabbet on elastomer or fastened to the edge of side opening by elastomer joint like a car windscreen;

.3 semi-fixed plates are the plates fastened directly to the craft side or a frame exclusively by means of glue, glue and bolts (screws) or by means of glue, bolts and a counter frame. This type of end connection can be achieved by one of the following means:

connected with a counter-frame. The edge fixity is achieved by pinching the plate at its periphery between the craft shell or a frame and a counter frame. The counter frame shall be mechanically fastened and/or glued to the structure of the craft;

connected by gluing. The edge fixity is achieved by gluing the plate at its periphery to the craft shell, to the structure of the craft or to a frame. This gluing can either be in a rabbet or a face, edge gluing or any combination of these gluing methods;

connected by direct fastening. The edge fixity is achieved by fastening the plate inside its periphery to the shell, the structure of the craft or to a frame by correctly spaced and sized mechanical fasteners. These fasteners may be bolts, rivets, self-tapping screws or any adequate mechanical fasteners.

N o t e . Even with the best fastening system, full edge fixity of a non-stiffened plate at its periphery can never be achieved. Plates are therefore considered at best as semi-fixed.

9.8.4.2 Location on the craft.

9.8.4.2.1 Simply supported plates.

Simply supported plates shall not be used in Area I and II on craft of design categories **A, A1, A2, B** or **C**.

On craft of other design categories and in other Areas, simply supported plates may be used provided that all the following requirements are met:

the material used is PMMA or PC;

the plate thickness is equal to 1,3 times the one required by 9.5.12.5;

the fixing devices of the plate (hinged bolts, fixing knob, etc.) are not spaced more than 250 mm.

The above restrictions of use need not be considered if the appliance is equipped with a deadlight.

9.8.4.2.2 Flexibly connected plates.

Flexibly connected plates may only be used on motor craft of design categories **C1, C2** or **C3** in Areas III and IV.

9.8.4.2.3 Semi-fixed plates.

Semi-fixed plates made of materials other than glass may be used in craft of all design categories and in all location areas provided that the requirements of 9.8.3 are met.

Semi-fixed plates made of glass may be used on sailing craft of any design category and on motor craft of design categories **A, A1, A2, B** or **C** provided that high-impact-resistant glass is used or if the appliance is equipped with a deadlight. Besides, metal to glass contact shall be avoided.

9.8.4.3 Fastening requirements.

9.8.4.3.1 Fastening of plates and frames.

Plates and frames can be fastened by mechanical means, glue or elastomer joints (rubber resin). All types of fastening shall ensure watertightness of the plate or frame, and resistance to loads due to normal operating pressure.

9.8.4.3.2 Fastening of semi-fixed plates.

Mechanical fasteners shall not induce stress concentration due to deflection or temperature changes. For instance, bolts in sharp angle counterbores and countersunk screw heads in conical bores shall not be used.

9.8.4.3.3 Fastening of glued plates.

Glued joints shall be resistant to (or protected against) sunlight (UV, heat etc.) and all environmental effects and cleaning chemicals normally encountered in the manufacture and use of the craft.

Glued joint shall fulfill the requirements of one of the following items:

.1 the inside pressure test according to ISO 12216:2002 (D3.2);

.2 the separation test according to ISO 12216:2002 (D3.3);

.3 the manufacturer's gluing procedure and conditions are followed and the bond strength checked by calculation to meet test pressure according to ISO 12216:2002 (D3.2.2).

the above requirements shall be verified after any change in material or gluing procedure.

9.9 MANHOLES

9.9.1 The height of coamings of manholes is not regulated by the Register.

9.9.2 Covers of manholes shall be made of metal.

The thickness of the covers shall correspond to that of the plating on which they are fitted.

9.9.3 The covers of manholes shall be efficiently attached to the coaming or doubling ring by means of bolts or pins with nuts.

9.9.4 When secured, the covers shall be tight both for water and liquid stores for which the tanks or compartments are intended under the inner pressure corresponding to the test pressure of the tank or compartment under consideration.

The tightness shall be provided by a rubber or other suitable gasket. The gasket shall be resistant to the liquid stores referred to above.

10 COCKPITS

The requirements of this Section apply to cockpits of "watertight" or "quick-draining" design as to its drainage by gravity without using any pumps or other means of outboard discharge of water.

10.1 DEFINITIONS AND EXPLANATIONS

10.1.1 For the purpose of this Section, the following definitions and explanations have been adopted.

Quick-draining cockpit is a cockpit or recess having its characteristics and drainage rate in accordance with all the requirements of this Section for a craft of particular class.

Cockpit top is the upper deck or outer side upper edge in way of cockpit over which the cockpit may be flooded from the side.

Watertight cockpit is a cockpit which satisfies the requirements of this Section in respect of watertightness and sill height, but not in respect of the drain.

Cockpit bottom height, H_B is the height of the cockpit bottom above the water line, the craft being upright and fully loaded.

Sill height, h_s is the height of sill, either the top of a fixed sill, or of the mobile part, when closed, of a semi-fixed sill.

Cockpit water-retention height, h_c is the height of water contained in the cockpit measured between the cockpit bottom and the point of overflow outboard, the craft being upright and fully loaded.

Notes: 1. This term corresponds to the lowest point where the overflow area, expressed in square metres, exceeds $0{,}005L_H \cdot B_{max}$ and is usually the lowest point of the cockpit coaming.

2. For assessing hC, every closing appliance, including the companionway door(s) is assumed to be closed.

Companionway door is a door or closing appliance intended to close a companionway opening.

Cockpit bottom is the lowest surface of the cockpit where water collects before being drained. A cockpit bottom may have one or more levels.

Note. Devices raising the standing level(s) from the rigid part of the cockpit, e.g. grating, stands, bridge decks are not considered as part of the cockpit bottom.

Drain is an outlet of the cockpit enabling any water contained to be discharged outboard by gravity. A drain can be:

a pipe discharging overboard above or below the waterline;

a part of the cockpit allowing direct discharge overboard;

scuppers and freeing port, etc.

Washboards are the closing appliance for companionway opening made of several mobile boards that, when closed, are stacked one on top of each other.

Notes:1. This is a very frequent device on sailing and non-sailing craft.

2. Boards are added as the weather worsens to constitute a higher sill.

Closing appliance is a device used to cover an opening in the cockpit, hull or superstructure, for instance, a hatch cover, window, door, engine cover, washboards, etc.

Cockpit is an open device built in the deck, which is intended to accommodate the crew and all the means of craft control.

Note. This device is mainly applied on board sailing and non-sailing craft.

For the purpose of this Section, this is any area that may retain water, however briefly, due to rain, waves, craft heeling, etc.

This means that

a cockpit may be located amid crafts or in the after part of the craft;

in some cases, the cockpit structure may include nearly all the craft;

a cockpit may open aft to the sea;

bulwarks may create a cockpit or recess.

Sill is a structure serving as a border around an opening in a deck, platform, bulkhead, enclosure, etc.

Cockpit sill is a barrier, above which water in the cockpit may enter companionway openings and downflood the craft.

Note. The lids to cockpit lockers or any opening other than the companionway opening, and leading into non-quick-draining parts of the craft are not considered to be sills if the closing appliance covering them fulfils the watertightness requirements of 10.6.

Cockpit volume coefficient, K_C is the ratio between the cockpit volume and the reserve buoyancy, as determined from the formula

$$K_C = \frac{V_C}{L_H B_{max} F_M}.$$

Minimum cockpit bottom height, $H_{B_{min}}$ is the minimum value of H_B required by these Rules.

Minimum sill height, $h_{s_{min}}$ is the minimum value of sill height required by these Rules.

Bridge deck is the area above the cockpit bottom, onto which people normally step before entering the accommodation.

Cockpit volume, V_C is the volume, in cubic metres, of water that can be instantaneously contained in the cockpit before discharge, which is the volume below h_c.

Cockpit sole is essentially horizontal surface(s) of the cockpit on which people normally stand.

Semi-fixed sill is any closing appliance movable, but permanently attached to the craft, which when in place, constitutes a sill higher than the fixed sill, for instance, sliding or hinged doors, hatches, sliding sills, but excluding washboards. A lanyard is not regarded as a permanent attachment.

Companionway opening is an opening (hatchway or doorway) giving way to accommodation. There may be several companionway openings.

Fixed sill is a sill being a fixed, integral and permanent part of the cockpit or hull.

Recess is a local cavity, groove or indentation generally in a bulkhead of the hull. In some craft with the engine located aft, it may be an afterpeak bulkhead enclosure provided for the engine, while the forward section of such an enclosure may be lifted to deck level.

Self-draining cockpit is a cockpit from which water may be drained overboard in some of the craft conditions without precise drainage rates or heights of cockpit bottom or sills.

Degree of water tightness is ability of a closing appliance, fitting or surface to resist the ingress of water. The degree of water tightness is summarized as follows:

degree 1. Degree of tightness providing protection against effects of continuous immersion in water;

degree 2. Degree of tightness providing protection against effects of temporary immersion in water;

degree 3. Degree of tightness providing protection against splashing water;

degree 4. Degree of tightness providing protection against water drops falling at an angle of up to 15° from the vertical.

N o t e . For details, see Section 9.

10.1.2 For the purpose of this Section, the following symbols have been adopted.

Symbol	Unit	Meaning
L_H	m	Length of hull
B_{max}	m	Maximum beam
F_M	m	Freeboard amidcrafts
d	mm	Drain diameter in millimetres
D	m	Drain diameter in metres
h_c	m	Cockpit water retention height
H_B	m	Cockpit bottom height above the waterline
$H_{B_{min}}$	m	Minimum cockpit bottom height above the waterline
h_s	m	Sill height
$h_{s_{min}}$	m	Required minimum sill height
k_c	-	Cockpit volume coefficient
t_{max}	min	Maximum allowable draining time
V_c	m³	Cockpit volume
N o t e . Heights measured above the cockpit bottom have symbols beginning with h, whereas heights measured above the waterline have symbols beginning with H.		

10.1.3 For the purpose of this Section, the following arithmetic symbols have been adopted for the drawings:

1 — waterline;
2 — cockpit bottom;
3 — overflow point;
4 — cockpit top;
5 — seats;
6 — drain;
7 — access companionway;
8 — top of fixed part;
9 — top of mobile part;
10 — bridge deck;
11 — sole or grating;
12 — grating flowing section;
13 — companionway closed by washboards.

10.2 GENERAL

10.2.1 The cockpit shall be an integral part of the craft hull to ensure strength.

The cockpit shall be watertight, i.e. all the openings therein lying below the overflow point shall be provided with watertight closing appliances except for those mentioned under 10.4.2.2. In open transom cockpits, the lower edge of the access companionway sill shall not be located below the cockpit top.

10.2.2 Craft condition.

The requirements of this Section shall meet the craft loading conditions corresponding to full displacement with the craft upright in smooth water.

10.2.3 Watertight cockpits and recesses.

10.2.3.1 Watertight cockpits and recesses shall:

have sills in accordance with the requirements of 10.5.1;

show a degree of watertightness in accordance with the requirements of 10.6.

10.2.3.2 When assessing craft stability and reserve of buoyancy in accordance with the requirements of Part IV "Stability, Reserve of Buoyancy and Freeboard", watertight and self-draining cockpits/lockers shall be considered full of water.

10.2.4 Quick-draining cockpits and lockers.

10.2.4.1 Quick-draining cockpits and lockers shall:

have the bottom height in accordance with the requirements of 10.4;

have the draining devices in accordance with the requirements of 10.7 — 10.13;

have sills in accordance with the requirements of 10.5.2;

show a degree of watertightness in accordance with the requirements of 10.6.

10.2.4.2 When assessing craft stability and reserve of buoyancy in accordance with the requirements of Part IV "Stability, Reserve of Buoyancy and Freeboard", watertight and self-draining cockpits/lockers fully complying with the requirements for quick-draining cockpits may be considered empty.

10.2.5 Self-draining cockpits and lockers.

Self-draining cockpits that are not quick-drainig cockpits shall be considered as watertight cockpits.

10.2.6 Closing appliances fitted in watertight cockpits and quick-draining cockpits, and giving access to the craft interior shall comply with the requirements of Sections 9 and 10.6.

10.2.7 The Owner's manual shall include a description of cockpits and/or lockers provided on board with indication of their type, as well as information on draining of cockpits and/or lockers and possibility of access to the closing appliances.

10.3 TYPICAL STRUCTURES AND MAIN CHARACTERISTICS

10.3.1 Flat-bottomed cockpits.

10.3.1.1 Cockpit with a semi-fixed sill.

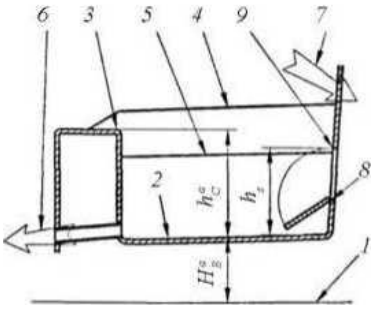


Fig. 10.3.1.1

H_B and h_c are measured from the centre of the bottom surface. The sill height h_s is measured from the closest point of the bottom.

10.3.1.2 Cockpit with open transom and semi-fixed sill.

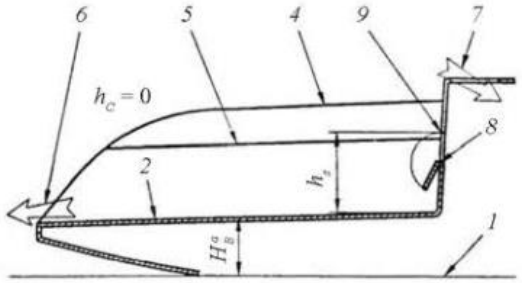


Fig 10.3.1.2

If there is no cockpit water retention ($h_c = 0$), drainage may be omitted, but the requirements for the minimal sill height (h_s) shall be complied with.

10.3.1.3 Cockpit with an opening in the transom.

An additional drain on the port side may be required.

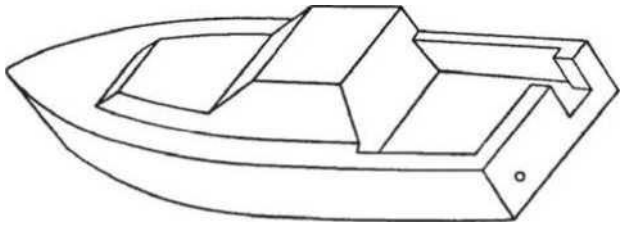


Fig. 10.3.1.3

10.3.1.4 Cockpit having a transom door with a bottom gap.

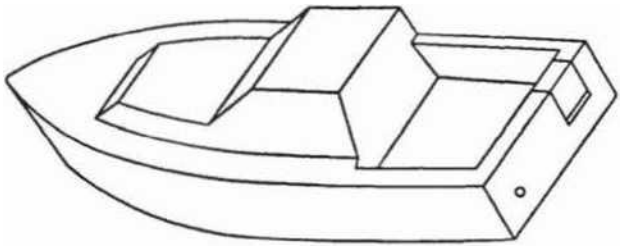


Fig. 10.3.1.4

The door shall be considered closed. The gap between the door and its lower sill is considered to be a drain freeing port. Its dimensions may be sufficient for draining time requirements. However, 90 per cent of cockpit shall drain at 10° heel, which may require an additional drain on the port side.

10.3.1.5 Cockpit with a bridge deck, grating and washboards above the sill.

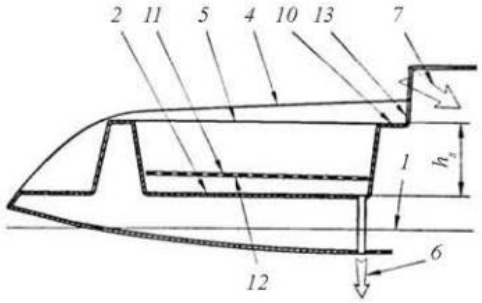


Fig. 10.3.1.5

A raised sole, such as a grating, does not alter the sill requirements above the cockpit bottom. The grating shall in no way impair the efficiency of the draining and shall have a total flow section at least 3 times the drain section.

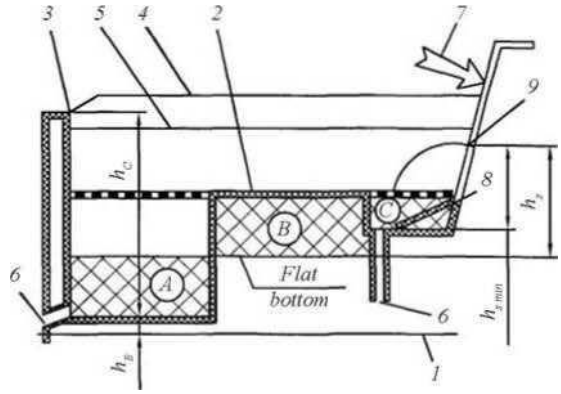


Fig. 10.3.2

10.3.2 Multilevel cockpits.

Multilevel cockpits shall comply with the general requirements and the requirements for flat-bottomed cockpits, with due regard for the following.

10.3.2.1 The cockpit bottom height, H_B, above the waterline shall be measured upwards from the waterline assigned in accordance with 10.2.2 to the centre of the lowest bottom level. In so doing, it is permitted to use the exceptions mentioned in 10.4.2.

10.3.2.2 Cockpit water-retention height, h_C, shall be measured between the point of overflow overboard and the point at which the height H_B is measured.

10.3.2.3 The cockpit volume is defined as a sum of volumes above each bottom level of the cockpit, which are determined by multiplying the plan area of the level in question by the retention height corresponding to that level. In so doing, the craft condition shall be in accordance with the requirements of 10.2.1.

10.3.2.4 The companionway sill height, h_s, is determined as the distance between the companionway lower edge and the nearest point on the symbolic plane of a single-level bottom. The symbolic plane of a single-level bottom shall be parallel to the horizontal plane of the waterline complying with the requirements of 10.2.1 and to correspond to the horizontal position for which conditional exclusions and additions of volumes above/below all the bottom levels would be balanced. The adopted height, h_s, of companionway sills shall be in accordance with the requirements of 10.5.

10.3.2.5 The minimum sill height, h_s required by 10.5 shall be invariably ensured for the bottom level nearest to the opening as well as for other levels. Elevations above the highest bottom level such as the bridge deck mentioned under 10.3.1.5 may be included in the required sill height.

10.3.2.6 For multilevel cockpits, the draining time stipulated under 10.8 shall be established proceeding from the total volume determined in accordance with 10.3.2.3. The draining time for particular levels shall not exceed that required by 10.8.

10.3.2.7 When making the drain cross-sectional area analysis at particular levels, as stipulated by 10.3.2.8, an allowance for the overflow from volumes lying above higher levels of bottom shall be made even where a separate drainage is provided for these. In the assumption of a uniform fall of water level, it is recommended that, for calculation purposes, the volume of water lying above higher levels shall be supposed to flow over to lower levels from a point lying in the mass centre of the volume in overflow.

10.3.2.8 In the bottom of a multilevel cockpit, provision shall be made for drainage on levels from which water cannot flow over to lower levels or overboard.

10.4 MINIMUM QUICK-DRAINING COCKPIT BOTTOM HEIGHT ABOVE THE WATERLINE

10.4.1 The minimum quick-draining cockpit bottom height, $H_{B_{min}}$, m, above the waterline shall not be less than stipulated in Table 10.4.1.

Table 10.4.1

Minimum bottom height

Design category	Height $H_{B_{min}}$, in m
A, AI and AII	0,15
B	0,1
C, CI, CII and CIII	0,075
D	0,05

Note. Greater heights than these minimum values may be required to fulfill the maximum acceptable draining time according to 10.8.

10.4.2 Exceptions to 10.4.1 for recesses or lockers.

10.4.2.1 Surfaces up to a total 10 per cent of the horizontal projection of the cockpit bottom may lie lower than required by 10.4.1. Among these surfaces, those containing water after the cockpit has drained will be considered full of water when assessing the fully loaded condition.

10.4.2.2 Lockers placed in the cockpit bottom and walls, which are intended for the storage of life rafts, ice, fish, baits, etc. are not regarded as part of the cockpit and are not required to comply with the requirements of 10.2.4, unless their closing appliances fulfill all the requirements of 10.6, provided they are watertight towards the interior of the craft.

In this case, they shall be considered full of water when assessing the fully loaded condition.

If the requirements of 10.2.4 and 10.6 are fulfilled, these lockers need not be considered full of water, but only filled with the maximum loading corresponding to the fully loaded condition.

10.5 SILL HEIGHT AND OPENINGS IN COCKPITS

10.5.1 Watertight cockpits.

In watertight cockpits, the sill height for openings shall exceed the cockpit water retention height h_C by 0,05 m at least, as determined for craft conditions in accordance with 10.2.1 and 10.3.

Watertight cockpits of a height less than the cockpit water retention height h_C shall have no openings to the craft interior except those mentioned under 10.4.2.2.

10.5.2 Quick-draining cockpits.

In quick-draining cockpits, the sill height h_s for openings above the cockpit bottom shall not be less than the height $h_{s_{min}}$, stated in Table 10.5.2.

For openings in quick-draining cockpits below the water retention height h_C, closing appliances according to the requirements of 10.6.2 shall be provided.

Table 10.5.2

Minimum sill height, $h_{s_{min}}$ m

Design category	Sill height, $h_{s_{min}}$, in m	
	Sailing monohulls	Sailing multihulls and non-sailing craft
A, AI and **AII**	0,3	0,2
B	0,25	0,15
C and **CI**	0,2	0,125
CII	0,15	0,1
CIII	0,1	0,075
D	0,05	0,05
Note. In order to ensure the required stability and subdivision of a particular craft as per Part IV "Stability, Reserve of Buoyancy and Freeboard" a sill height exceeding the stated value may be necessary		

When measuring the sill height, all closing appliances shall be considered closed with the exception of companionway door(s), and the semi-fixed parts of the companionway sill — secured in a position providing for a maximum sill height.

The sill height shall be measured vertically from the cockpit bottom to the lowest point on the sill edge that allows ingress of water.

If the cockpit bottom is not horizontal, the sill height shall be measured to the closest point of the cockpit bottom.

The parameter $h_{s_{min}}$ shall also be used when considering multilevel cockpits.

10.6 WATERTIGHTNESS REQUIREMENTS

10.6.1 Watertightness of cockpits.

All surfaces of watertight and quick-draining cockpits up to the water retention height h_C including the surfaces of spaces mentioned under 10.4.2.2 shall comply with the requirements for watertightness degree 1.

10.6.2 Watertightness of closing appliances.

The watertightness degrees of the closing appliances fitted on the surfaces of quick-draining cockpits except those mentioned under 10.4.2.2 shall comply with the requirements of Table 10.6.2.

Closing appliances located in the bottom, horizontal areas and sides of quick-draining cockpits up to the height $h_{s_{min}}$, shall be fitted with seals and sills at least 12 mm high and tested for watertightness in accordance with the requirements of Section 9.

Table 10.6.2

Watertightness of closing appliances

Location of closing appliance in cockpit	Degree of watertightness
Bottom and horizontal areas	2
Sides up to $h_{s_{min}}$	2
Sides between $h_{s_{min}}$ and $2h_{s_{min}}$.	3
Sides above 2 $h_{s_{min}}$	4
Note. In order to ensure the required stability and subdivision of a particular craft as per Part IV “Stability, Reserve of Buoyancy and Freeboard”, a watertightness exceeding the stated value may be necessary.	

Semi-fixed sills and washboards shall have a device maintaining them in place, when in use, which shall at least be operable from inside.

Semi-fixed sills and washboards shall meet the requirements of Section 9.

Semi-fixed sills shall only be detachable with the use of tools.

Where a closing appliance includes washboards as components, a 100 per cent reserve of these shall be carried which shall be stowed in the vicinity of the closing appliance, capable of being reached quickly and safely without the use of tools.

10.7 DRAINAGE OF QUICK-DRAINING COCKPITS

10.7.1 Draining shall be carried out only by gravity.

10.7.2 When the craft is upright, at least 98 per cent of the cockpit volume shall drain, excluding any recess in accordance with 10.4.2.

10.7.3 The requirements of 10.5.1 and 10.5.2 shall be fulfilled when the craft is heeled to both port and starboard, with due regard for the following:

.1 on sailing monohulls, drainage shall be provided for at least 90 per cent the cockpit volume V_C at the lesser heel angle of 30°, or when the deck at side begins to touch the water;

.2 on non-sailing craft and multihulls, drainage shall be provided for at least 90 per cent of the cockpit volume V_C at 10° heel.

10.8 DRAINING TIME

10.8.1 The draining time is the time needed to drain the cockpit from the full height of water, h_C, down to a remainder of 0,1 m above cockpit bottom.

Draining time requirements are established proceeding from the craft's navigation area and with due regard for the cockpit volume coefficient, K_C, the ratio between the cockpit volume and the reserve buoyancy of the craft, to be determined in accordance with 10.1. A large cockpit volume relative to the craft's reserve buoyancy shall require a correspondingly small draining time.

The draining time shall not exceed that stated in Table 10.8.1.

The draining time shall be measured or calculated with every appliance in the cockpit closed.

If the draining section, expressed in square metres, is greater than or equal to 0,05 V_C, draining time assessment is not required.

The cockpit volume, V_C, shall be measured from the cockpit bottom up to the top of h_C, with the eventual exception of 10.4.2, assuming that all closing appliances and drains are closed.

Table 10.8.1

Maximum acceptable draining time, t_{max}

Design category	t_{max}, min
A, AI and **AII**	$0{,}3/K_C$ but not greater than 5
B	$0{,}4\ /K_C$ but not greater than 5
C	$0{,}5\ /K_C$ but not greater than 5
CI	$0{,}6/K_C$ but not greater than 5
CII	$0{,}7\ /K_C$ but not greater than 5
CIII	$0{,}8\ /K_C$ but not greater than 5
D	$0{,}9\ /K_C$ but not greater than 5

Practically secured draining time shall be measured during the trials of the prototype craft which shall have a displacement close to full-load displacement and a trim in accordance with the design. The cockpit shall be filled with water up to h_C, and the draining time to empty the cockpit between h_C to 0,1 m of water remaining in the cockpit is measured. This latter height shall be measured above the centre of the bottom surface of the cockpit. It may be useful to indicate the point located 0,1 m above the centre of the cockpit bottom with a tape mark.

10.9 NUMBER OF DRAINS

10.9.1 Each quick-draining cockpit shall have at least two drains, one port and one starboard, unless one opening enables drainage when the craft is heeled to both port and starboard, as required in 10.7.

10.10 DRAIN DIMENSIONS

10.10.1 Internal dimensions of the drain.

The internal dimensions of the drain shall ensure the draining time of the cockpit, as required by 10.8. The internal dimensions of the drain shall be determined in accordance with 10.10.3 at the craft design stage.

The minimal internal diameter of drains with a circular cross section shall be 25 mm. Drains with other cross-sectional shapes shall have a cross-sectional area of at least 500 mm² and a minimum dimension of 20 mm.

The possibility of inadvertent closure of drains by loose equipment, rigging, etc. shall be ruled out.

10.10.2 Protective grids.

If the drains are equipped with protective grids or other devices preventing loose objects from falling into the draining system, one shall be aware that a grid of small holes is prone to be clogged.

The minimum passage dimension inside any part of these devices shall have a section of 125 mm² (or a diameter of 12 mm) at least, and a total entry cross section of 1,5 times the cross section of the drain at least. If the above conditions are not met, the head losses from the protective grid shall be considered.

10.10.3 Determination of drain cross section.

For craft design purposes, the internal cross-sectional area of openings that is necessary to drain the cockpit within the time required by 10.8 shall be determined by calculation which shall consider all the head losses in the drain system including inlet losses and outlet losses. With the drain outlet below the waterline, the head shall be measured upwards of the waterline of floatation determined with due regard for the requirements of 10.2.1.

The required cross section may be calculated by methods described in Annexes B, C, D and E of ISO 11812:2001 "Small Craft. Watertight Cockpits and Quick-Draining Cockpits".

10.11 CENTREBOARD CASINGS AND OTHER TYPES OF DRAIN

10.11.1 Centreboard casings and other types of aperture may be used as drains if they are designed for this purpose.

10.12 DRAIN PIPING

10.12.1 The scantlings and design of drains shall take into account all the loads to which they may be subjected during craft operation.

Drain piping shall be protected against damage from loose objects stowed in the craft and against being kicked and stepped on.

Drain piping shall not trap water and shall only be used for cockpit drainage. This requirement does not apply to drains fitted in centerboard housing or outboard wells and trunks.

It is recommended that the drain piping be designed without bends. Where the bends will be present, the piping shall be designed with a radial distance equal to 10 diameters at least in order to avoid clogging of bent sections.

Sea valves, drain fittings in the hull and piping sections shall comply with the requirements of Part V "Machinery Installations. Machinery. Systems and Piping".

10.13 DRAIN FITTINGS

10.13.1 The drain outlet running through the hull shall be located above the waterline. Where the cockpit is not an integral part of the hull and the drain outlet is located below the waterline or up to 0,75 $H_{B_{min}}$" above the waterline, it shall be fitted with a seacock in accordance with 10.12.

Fig. 10.13.1 shows a drain outlet integral with the hull, no seacock is required.

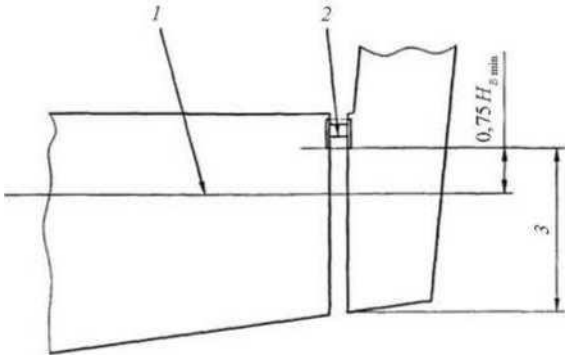


Fig. 10.13.1
Drain integral with the hull shell:

1 — waterline;
2 — top of integral penetration above 0,75 H_B no seacock required;
3 — in this area, the drain shall be integral with the hull shell

10.14 PERMANENTLY OPEN VENTILATION OPENINGS

10.14.1 The lowest point of non-closable ventilation openings leading to water ingress in the craft interior shall be at least at a height exceeding $2\ h_{s_{min}}$ or 0,3 m, whichever is greater, above the cockpit bottom.

Permanently open ventilation openings shall be equipped with devices to ensure watertightness to degree 4. In the case of a particular craft, watertightness above degree 4 may be necessary to ensure stability and reserve of buoyancy to be determined in accordance with Part IV "Stability, Reserve of Buoyancy and Freeboard".

11 SIGNAL MEANS

11.1 GENERAL

11.1.1 The requirements of this Section apply to the craft signal means.

The requirements of this Section only apply to inland navigation craft not classified by Resolution No. 30 of 12 December 1992 developed by the Working Group on Inland Water Transport of the UN Economic Commission for Europe and shall be used taking into consideration the navigation rules applicable to these inland waters.

11.1.2 The number of signal means, their major characteristics and location on board craft of inland navigation shall meet, depending on the navigation area, the requirements of:

International Regulations for Preventing Collisions at Sea (IRPCS-72);

European Code for Inland Waterways (CEVNI);

Main Regulations for the Danube Navigation; or

Rules of Navigation in the Russian Federation Inland Waterways.

11.1.3 The following definitions and explanations have been adopted in this Section.

White, red, green, yellow and blue lights are lights complying with the requirements of 11.1.4 and 11.2 and also with the requirements of IRPCS-72 or European Inland Navigation Rules depending on the craft's main navigation area.

Sidelights are a green light on the starboard side and a red light on the port side each showing an unbroken light over an arc of the horizon of 112,5° and so fixed as to show the light from right ahead to 22,5° abaft the beam on its respective side. In a craft of less than 20 m in length the side lights may be combined in one lantern carried on the fore and aft centerline of the craft.

Sternlight — a white light placed as nearly as practicable at the stern showing an unbroken light over an arc of the horizon of 135° and so fixed as to show the light 67,5° from right aft on each side of the craft.

Short blast is a blast of about one second's duration.

All-round light is a light showing an unbroken light over an arc of the horizon of 360°.

Floating installation is any floating installation, mostly related to berth-connected craft.

Floating craft is a floating structure intended for operations in water areas and having no propulsion machinery.

Flashing (rapidly scintillating) light is a light flashing at a rate of 120 light periods or more per minute.

Prolonged blast is a blast of approximately four seconds' duration, the interval between the two successive prolonged blasts being approximately 1 s.

Navigation areas are navigation areas, basins and/or water areas where the requirements of the following Rules may apply:

oceans and seas where IRPCS-72 apply;

inland waterways where European Inland Navigation Rules or Main Regulations for the Danube Navigation apply;

inland waterways where Rules of Navigation in the Russian Federation Inland Waterways apply;

inland waterways where craftping regulations applicable to oceans and seas covered by IRPCS-72 are adopted.

Light-impulsive flashing light is a device showing a white flashing light over an arc of the horizon of 112.5° in the direction ahead from the craft's beam (overlapping the fore and aft centre line by 22,5°) and 112,5° in the direction astern from the craft's beam (overlapping the fore and aft centre line by 22,5°). Flashing lights having the colours of the corresponding sidelights may be used.

A succession of very short blasts is a succession of at least six blasts, of about 1/4 second duration each, the pauses between the blasts being about 1/4 second.

Floating object is a raft, or other structure, object or assembly capable of navigation, not being a craft or floating equipment or establishment, for example, an assembly of a towed water craft with the towing craft (a craft, cutter or water cycle).

"Side-by side formation" is an assembly of craft coupled rigidly side by side, none of which is positioned in front of the craft propelling the assembly.

Masthead light is a white light placed over fore and aft centerline of the craft showing an unbroken light over an arc of the horizon of 225° and so fixed as to show the light from right ahead to 22,5° abaft the beam on either side of the craft.

Three-tone sound signal is a signal repeated three times and composed of a succession of sounds of different tones following immediately one after another; the total duration of a three-tone signal is about 2 s. The sound frequency shall be from 165 to 297 Hz, and the difference between the highest and the lowest tones shall be at least two complete tones. Each succession shall be started from the lowest tone and finished by the highest tone.

Flashing (scintillating) light is a light flashing at a rate of 50 to 60 light periods per minute.

Strong, bright and ordinary lights are lights the characteristics of which correspond to 11.1.5, 11.1.6 and 11.2, as well as to the requirements of IRPCS or to European Inland Navigation Rules, depending on the main area of navigation.

11.1.4 Colour of signal lights.

11.1.4.1 A five-colour signal system shall apply to the lights, comprising white, red, green, yellow and blue colours.

This system shall conform to the recommendations of the International Commission on Illumination, "Colours of Signal Lights", IEC publication No. 2.2 (TC-1.6) 1975.

11.1.4.2 The colour boundaries of signal lights shall be demarcated by the coordinates (given in Table 11.1.4.2) of the intersecting points of the chromatic diagram in IEC Publication Nos. 2.2 Publication of CIE (TC-1.6) 1975 (see chromaticity diagram in Fig. 11.1.4.2) as follows.

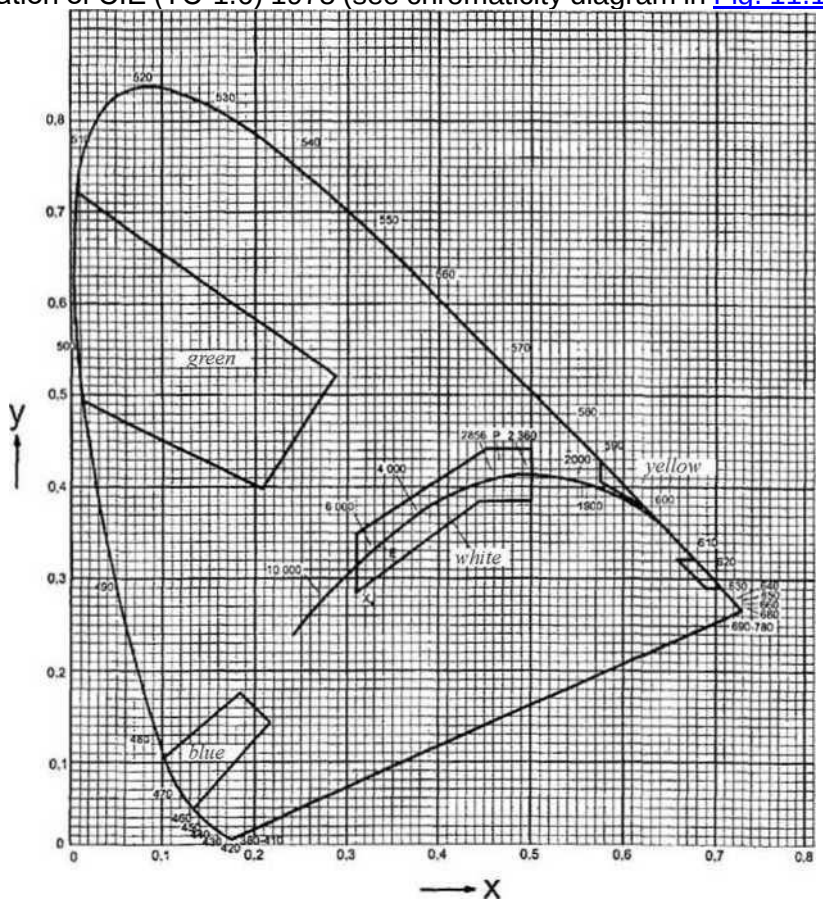


Fig. 11.1.4.2

IEC chromaticity diagram:

2360K corresponds to the light of a vacuum filament lamp;
2848K corresponds to the light of a gas-filled filament lamp

Table 11.1.4.2

Colour of signal light	Coordinates of the intersecting points						
White	X y	0,310 0,283	0,443 0,382	0,500 0,382	0,500 0,440	0,453 0,440	0,310 0,348
Red	X y	0,690 0,290	0,710 0,290	0,680 0,320	0,660 0,320		
Green	X y	0,009 0,720	0,284 0,520	0,207 0,397	0,013 0,494		
Yellow	X y	0,612 0,382	0,618 0,382	0,575 0,425	0,575 0,406		
Blue	X y	0,136 0,040	0,218 0,142	0,185 0,175	0,102 0,105		

11.1.5 Luminous intensity and visibility range of lights.

11.1.5.1 General.

11.1.5.1.1 Depending on their luminous intensity, signal lights may be classified as:
ordinary lights;
bright lights;
strong lights.

11.1.5.1.2 Relation between I_0, I_e and t:

I_0 = photometric luminous intensity, in candelas (cd), measured at normal voltage for electric lights;

Ie = operational luminous intensity, in candelas (cd);

t = range of visibility, in kilometers (km).

Taking into account, for example, the ageing of the light source, the degree of dirtiness of the optic and variations in the voltage of the on-board grid, Ie is taken as 25 per cent less than I_0.

Consequently, $I_e = 0.75 \cdot I_0$.

The relation between I_e and t of signal lights is given
by the following equation:

$$I_e = 0{,}2\, t^2\, q^4. \qquad (11.1.5.1.2)$$

The atmospheric transmissivity coefficient q is taken as 0,76, corresponding to a meteorological visibility of 14,3 km (approximately 8 nautical miles).

11.1.5.2 Intensity and range of the signal lights. Table 11.1.5.2 given below contains the permitted limits for I_0, I_e and t, according to the nature of the signal lights. The values indicated shall apply to the light flux emitted by the signal lanterns.

Table 11.1.5.2

Maximum and minimum values of I_0, I_e and t

Nature of signal lights		Colour of signal lights							
		White		Green and red		yellow		blue	
		min	max	min	max	min	max	min	max
ordinary	I_0	2,7	10,0	1,2	4,7	1,1	3,2	0,9	2,7
	I_e	2,0	7,5	0,9	3,5	0,8	2,4	0,7	2,0
	t	2,3	3,7	1,2	2,8	1,6	2,5	1,5	2,3
Bright	I_0	12,0	33,0	6,7	27,0	4,8	20,0	6,7	27,0
	I_e	9,0	25,0	5,0	20,0	3,6	15,0	5,0	20,0
	t	3,9	5,3	3,2	5,0	2,9	4,6	3,2	5,0
strong	I_0	47,0	133,0						
	I_e	35,0	100,0						

Nature of signal lights		Colour of signal lights							
		White		Green and red		yellow		blue	
		min	max	min	max	min	max	min	max
	t	5,9	8,0						
N o t e . $\boldsymbol{I_0}$ and $\boldsymbol{I_e}$ are given in cd and, t — in km.									

11.1.6 Signal light dispersion.

11.1.6.1 Horizontal dispersion of the luminous intensity.

11.1.6.1.1 The luminous intensities indicated in 11.1.5.2 shall apply to all directions of the horizontal plane passing through the focus of the optic or the luminous centre of gravity of the correctly adjusted light source of a vertically positioned signal lantern.

11.1.6.1.2 For the masthead lights, stern lights and side lights the luminous intensities prescribed shall be maintained throughout the horizontal arc within the sectors prescribed at least up to within 5° of the limits. As from 5° within the sector prescribed up to the limit, the luminous intensity may decrease by 50 per cent it shall subsequently decrease gradually in such a way that, as from 5° beyond the limits of the sector, only a negligible amount of light remains.

11.1.6.1.3 The side lights shall have the prescribed luminous intensity in the direction parallel to the axis of the craft forward. The intensities shall decrease practically to zero between 1° and 3° beyond the limits of the prescribed sectors.

11.1.6.1.4 For bi-coloured or tri-coloured lanterns, the dispersion of the luminous intensity shall be uniform so that 3° on either side of the prescribed sector limits, the maximum permitted intensity is not exceeded and the minimum prescribed intensity is reached.

11.1.6.1.5 The horizontal dispersion of the luminous intensity of the lanterns shall be uniform throughout the sector, so that the minimum and maximum values observed for the photometric luminous intensity do not differ by more than a factor of 1,5.

11.1.6.2 Vertical dispersion of the luminous intensity.

In the event of heeling of up to ± 5° or ± 7,5° from the horizontal, the luminous intensity shall remain at least equal to 80 per cent in the first case, and 60 per cent in the second case of the luminous intensity corresponding to 0° heeling, although it shall not exceed it by more than 1,2 times.

11.2 NAVIGATIONAL AND TECHNICAL REQUIREMENTS TO NAVIGATION LIGHTS AND SIGNAL SHAPES

11.2.1 Navigation lights.

11.2.1.1 The navigation lights permitted for installation on board craft shall comply with the requirements of this Section in respect to their construction, materials, way of installation and main characteristics. The navigation lights shall be manufactured in compliance with the conditions agreed with the Register.

11.2.1.2 Unless otherwise specified in this Section, signal lights shall emit continuous and stable light.

11.2.1.3 The light sectors and range of visibility of the navigation lights, depending on the craft's length, shall comply with the standards specified in Tables 11.2.1.3-1 and 11.2.1.3-2.

Table 11.2.1.3-1

Navigation lights of the craft navigating solely in the Russian Federation inland waterways

Nos.	Type and colour of light	Length of the craft in in	Nature of light	Arc of visibility in the horizontal plane, in deg.	
				Total angle	Position
1	Masthead, white	$L_H > 20$	Strong	225	112,5° from right ahead on either side from the fore and aft centerline of the craft
		$7 \le L_H \le 20$	Bright		
		$L_H < 7$	—		
2	Sidelight, green	$L_H > 20$	Bright	112,5	From right ahead to 22,5 abaft the beam on star- hoard side
		$7 \le L_H \le 20$	Ordinary		
		$L_H < 7$	—		
3	Sidelight, red	$L_H > 20$	Bright	112,5	From right ahead to 22,5° abaft the beam on port side
		$7 \le L_H \le 20$	Ordinary		
		$L_H < 7$	—		
4	Sternlight, white	$L_H > 20$	Bright or ordinary	135	67,5° from right aft on either side
		$7 \le L_H \le 20$			
		$L_H < 7$	—		
5	All-round: White	$L_H > 20$	Bright	360	All round the horizon
		$L_H \le 20$	Ordinary		
6	All-round: Red	Any	Bright or ordinary	360	All round the horizon
	Green			360	All round the horizon
7	Combined green and red lantern	$7 \le L_H \le 20$	Ordinary	225	112,5° on either side of the fore and aft centerline, right ahead: Starboard side green sector; Port side red sector
		$L_H < 7$	—		
8	Anchor light, white	Any	Ordinary	360	All round the horizon
9	Flashing light	$L_H > 20$ in the daytime	Strong	112,5 +	Ahead from the craft's beam, overlapping the fore and aft centerline by a sector of 22,5°, also astern
		$L_H > 20$ at night	Bright	+ 112,5	from the craft's beam, overlapping the fore and aft centerline by a sector of 22,5°
10	Light signal:			360	All round the horizon
	Blue	any	Ordinary		
	Yellow		Bright or ordinary		

Note. Lights complying with the requirements of IRPCS-72 are permitted.

Table 11.2.1.3-2

Range of visibility of navigation lights on craft navigating in water areas where IRPCS[1] apply

Nos.	Type and colour of light	Length of the craft L_H, in m	
		12-24	Less than 12
		Range of visibility, in miles	
1	Masthead, white	3/5[2]	2
2	Sidelight, green	2	1
3	Sidelight, red	2	1
4	Stem light, white	2	2
5	All-round lights: white, red, green or yellow	2	2
6	Combined tri-coloured light with a total light sector of 360°		1 (2 for the white sector)
7	Combined bi-coloured light (green red)	2	1

[1] The light and visibility sectors are the same as specified in Table 11.2.1.3-1.
[2] The masthead light range of visibility on craft of 20 m in length and more shall be 5 miles, on craft of less than 20 m — 3 miles.

11.2.1.4 The required sector of light visibility in a vertical plane of at least 10° shall be provided on either side from the horizontal plane going through the centre of the light source, while for motor-sailing craft navigating in areas where IRPCS-72 apply, such sector of light visibility shall be at least 25°.

11.2.1.5 All the craft navigation lights shall be reliable in operation under conditions specified in 2.2, Part VII "Electrical Equipment".

11.2.1.6 Navigation lights shall be manufactured of materials resistant to corrosion or have efficient anti-corrosive protective coating.

11.2.1.7 Electric lights shall be of safe watertight type (IP 56). Lights shall be provided with an arrangement to ensure natural drainage of condensate outward and sufficient ventilation which does not impair the required degree of protection from water.

11.2.1.8 The lights construction shall be such as to permit their quick closing and opening and lamp replacement without using special instruments. The light case shall be of such a design as to allow rapid change of electric or oil/kerosene lamps. Oil/kerosene lights shall be so constructed as to enable a lamp with its chimney fitted to be inserted into them.

11.2.1.9 Lamps of electric lights shall be fitted in a vertical position, so as to be placed in the focus of the lens and of the reflector. Provision shall be made to prevent the lamp and socket from their spontaneous loosening.

Double-filament lamps shall not be used in navigation lights.

11.2.1.10 Inner surfaces of navigation lights shall be covered with a protective coating resistant to the action of moisture and temperature and not affecting lighting and colour characteristics of lights.

11.2.1.11 Navigation lights required to be other than white may be fitted with glass or light filters coloured throughout their entire thickness or over the surface only.

Inner and outer surfaces of lenses and plain glasses shall be smooth, and the glass shall be free from foreign inclusions, blisters and chippings impairing the light characteristics.

Inner and outer surfaces of light filters shall be free from notches and indentations, at least, to the extent determined in the national standards agreed upon with the Register or in the specifications approved by the Register. The filter glass shall be free from blisters, foreign inclusions and drops.

11.2.1.12 Lenses, glass and light filters may be manufactured of plastics provided their characteristics (colour, temperature resistance, transmission coefficient, light distribution curves and durability) are not inferior to those of glass.

11.2.1.13 Removable light filters shall be provided with wire reinforcement along their entire perimeter or with another equal protection against fractures and mechanical damage likely to occur in operation.

11.2.1.14 Light filters in side navigation lights shall be so constructed as to prevent the possibility of placing the red filter instead of the green one into the starboard light and vice versa.

11.2.1.15 Reflectors used in navigation lights shall have spherical shape and polished surface. The reflector shall be so placed in the light that its focus is in the centre of the light source. The reflection factor shall be not less than 50 per cent. The reflectors diameters and capture angles shall be adjusted to the lamp geometrical parameters.

11.2.1.16 Navigation lights with coloured lights shall be painted in colour corresponding to the colour of the light.

11.2.1.17 Every light shall bear the Manufacturer's trademark, serial number, date of production, trade name, the stamp of the Register or another classification society recognized by the Register.

11.2.1.18 Portable lights shall be fitted with handles for transportation and hoisting.

Where lights shall be lifted one under the other, they shall be fitted with a second handle at the bottom.

11.2.2 Flashing lights.

11.2.2.1 A flash light shall be an electric one, be fitted with appropriate lenses and send separate or group flashing light signals in accordance with the International Regulations for Preventing Collisions at Sea, 1972, and European Code for Inland Waterways (CEVNI).

It is recommended to use automatic devices to control the flashing light signals.

11.2.2.2 A light accompanying sound signals shall be an electric one and send the light signal simultaneously with the actuation of the sound signal.

11.2.3 Signal shapes.

11.2.3.1 Signal shapes shall be provided with suitable devices for fixing them to halyards on which they are hoisted, and for joining with other shapes. Folding shapes shall be fitted with devices retaining them in open position during hoisting and preventing the shapes from spontaneous folding.

Devices for joining the shapes one to another (except the cones) shall provide maintaining the specified distances between them.

Signal shapes (cylinders, balls, cones and diamond shapes consisting of two cones having a common base) used on the craft navigating in inland waterways shall comply with the following requirements:

Their colour shall not be faded, nor there shall be dirt accumulation on them;

a cylinder shall have a height of at least 0,8 m, and a diameter of at least 0,5 m;

a ball shall have a diameter of not less than 0,6 m;

a cone shall have a base diameter of not less than 0,6 m and a height equal to its diameter;

a diamond shape or a shape consisting of two cones bases together shall have a height of not less than 0,8 m and a base diameter of not less than 0,5 m.

The cylinders, balls, cones and diamond shapes consisting of two cones having a common base specified in these Rules may be replaced by other arrangements showing the same image if seen from a distance.

11.2.3.2 Shields used on inland navigation craft shall comply with the following requirements:

unless specified otherwise, the shields shall be rectangular in shape;

the colour of the shields shall not be fade d, nor there shall be dirt accumulation on them.

It is recommended to fit the sidelights shields of such a length that the distance from the outer edge of the light lens or plain glass to the aft edge of the fore transverse screen is at least 0,6 m. In lieu of the shields, it is permitted to use side walls of the bridge or wheelhouse.

11.2.4 Signal flags, pennants and signal panel.

11.2.4.1 Signal flags shall be manufactured of woolen flag cloth (bunting) of sufficient strength and fast colour. The flags may be of synthetic materials.

11.2.4.2 Signal flags shall be of square shape. The square side size shall not be less than 500 mm.

For inland navigation craft the flag length and width shall be at least 1,0 m or at least 0,6 m for small craft, the length of the pennant shall be at least 1 m and its width at the base — at least 0,5 m.

11.2.4.3 Each craft shall be provided with a signal panel. The size of the panel shall be 1 m×0,8 m and it shall have the craft Register number, its name, port of registry and berth number.

11.2.5 Pyrotechnic signal means.

11.2.5.1 Pyrotechnic signal means intended for sending distress signals shall be safe in handling and stowage during all their guaranteed service life.

11.2.5.2 Pyrotechnic signal means shall be protected from moisture and mechanical damage. It shall be possible to open the boxes where pyrotechnic signal means are kept without any instruments.

11.2.5.3 All pyrotechnic means shall be indelibly marked with the information on the Manufacturer's trademark, date of issue, storage time, purpose of the object and application instructions. Signal rockets shall be marked with an arrow showing the direction of the rocket flight.

11.2.5.4 Signal rockets shall be constructed in such a way that they can be operated either by hand or with the help of a special device.

11.2.5.5 All pyrotechnic signal means shall be moisture- and vibration-resistant and not to die out under the action of wind of up to 30 m/s. They shall retain their properties throughout the temperature range from –45° to +45 °C and during the rain.

11.2.5.6 A rocket parachute flare shall:

be contained in a water-resistant casing;

be provided with a brief instruction or diagram marked on its casing to clearly illustrate the operating procedure for the rocket parachute flare;

have integral means of ignition;

be constructed in such a way as not to cause inconvenience to a person operating it in accordance with the Manufacturer's instructions.

11.2.5.7 A vertically fired rocket shall reach an altitude of not less than 300 m and, at or near the top of its trajectory, shall eject a parachute flare. A parachute flare shall have the following characteristics:

the flare will burn bright red in colour;

it will burn with an average luminous intensity of not less than 30000 cd;

the burning period should be not less than 40 s;

it should have a descent rate of not more than 5 m/s;

the parachute should not be damaged while burning.

11.2.5.8 A hand flare shall meet the following requirements:

it shall have brief instructions or diagrams illustrating its operation, printed on the outside;

it shall be contained in a water-resistant casing;

it shall have integral means of ignition;

it shall be constructed so that not to cause inconvenience to a person operating it and not to endanger the collective life-saving appliance by burning or glowing remnants after its use in accordance with the Manufacturer's instructions;

the hand flare shall burn with a bright red colour;

it shall have an average luminous intensity of not less than 15000 cd;

the burning period shall be not less than 1 min;

it should continue to burn after being immersed for a 10 s period under 100 mm of water.

11.2.5.9 A buoyant smoke float shall meet the following requirements:

it shall be contained in a water-resistant casing;

it shall not ignite in an explosive manner when activated in accordance with the Manufacturer's instructions;

it shall be indelibly marked with brief instructions or diagrams regarding its operation printed on the outside of the case;

it shall emit smoke of a highly visible colour at a uniform rate for a period of not less than 3 min when floating in calm water;

it shall not emit any flame during the time of the smoke emission;

the signal should not be swamped in a seaway;

it must be constructed in a manner so as to emit the smoke when submerged in water for a period of 10 s when under 100 mm of water.

11.2.6 Sound signal means.

11.2.6.1 The produced sound signals shall be clear and have no distortions.

11.2.6.2 The construction of sound signal means and materials used for their manufacturing shall provide the range of audibility not lower than specified in Table 11.2.6.2.

Table 11.2.6.2

Range of audibility of sound signal means

Type of sound signal moans	Range of audibility, in km	1/3-octave band level at 1 m in dB referred to 2×10^{-5} N/m²
Electric air siren	2,0	
Automobile-type electric signal device	1,5	
Bell	1,0	
Whistle	1,0	120

11.2.6.3 For craft of 12 m in length and more it is recommended to use automatic devices for making sound signals, although provision shall be made for sending the signals manually and for changing the time of sending signals at any moment of the craft's handling.

11.2.6.4 The bell shall give a loud and clear sound and be manufactured of material not requiring protection against corrosion. No painting of the bell is permitted. The diameter of the mouth of the bell shall be of not less than 200 mm. The mass of the striker shall be not less than 3 per cent of the mass of the bell.

11.2.6.5 Mechanical sound signal means used on board craft navigating in inland waterways shall produce sound signals with the following characteristics.

11.2.6.5.1 Frequency:

.1 the fundamental frequency of sound signal means on power-driven craft with the exception of those of less than 20 m in length shall be 200 Hz with the permitted deviation of +20 per cent;

.2 for non-power-driven craft and for craft of less than 20 m in length the sound frequency shall be higher than 350 Hz;

.3 for three-tone sound signals made by craft navigating in conditions of restricted visibility with the use of radars the fundamental sound frequencies shall be from 165 to 297 Hz with an interval of at least 2 full tones between the highest and the lowest tones.

11.2.6.5.2 Sound pressure level:

.1 for power-driven craft of more than 20 m in length the weighted level of sound pressure shall be 120 — 140 dB (A);

.2 for non-power-driven craft and for craft of less than 20 m in length the weighted level of sound pressure shall be 100 — 125 dB (A);

.3 for three-tone signals sounded by craft navigating in conditions of restricted visibility with the use of radars the weighted level of sound pressure of each sound shall be 120 — 140 dB (A).

These levels of sound pressure shall be measured or determined at a distance of 1 m ahead from the centre of the bellmouth and, as far as practicable, the measurement shall be carried out in the unobstructed space.

11.3 FITTING OF SIGNAL MEANS ON BOARD

11.3.1 Navigation lights.

11.3.1.1 Navigation lights shall be fixed in stationary places provided for them or shall be hoistable with proper devices fitted on running rigging for their hoisting.

11.3.1.2 All navigation lights shall be located as required for the area of navigation and in such a way that they can be distinctly visible within all prescribed arcs of visibility.

The detailed requirements regarding the necessary number and set of the navigation lights to be carried and exhibited are specified in the International Regulations for Preventing Collisions at Sea (IRPCS-72), European Inland Navigation Rules, Main Regulations for the Danube Navigation and Rules of Navigation in the Russian Federation Inland Waterways.

11.3.1.3 In all regular places where navigation lights are located, special devices shall be provided to ensure rapid and correct fitting and securing of the lights.

11.3.1.4 The accuracy of placing of the sector light lights shall be checked by their position in relation to the centre line plane of the craft.

Horizontal position of lights shall be checked when the craft is on even keel and has neither trim nor heel.

11.3.1.5 All masthead lights shall be protected by shields fitted below to preclude dazzling of people on the bridge and deck.

The shields shall be painted matt black.

11.3.1.6 Side lights shall be placed at the same height, in one line perpendicular to, and at the same distance from, the centre line plane of the craft.

11.3.1.7 Side lights at the side facing the centre line plane of the craft shall be protected by inboard shields with two transverse screens (fore and aft) perpendicular to the shield.

Shields shall be of such a length that the distance from the outer edge of the light lens or plain glass to the aft edge of the fore transverse screen is 0,6 m at least.

The breadth of the fore transverse screen shall be such that a line connecting its outer edge to the inner edge of the filament or the light burner is parallel to the craft centre line plane.

The aft transverse screen shall be of such a breadth as to mask completely the light from being seen across the stern, but not hinder showing its light to 22,5° abaft the beam.

The height of the shield and of the screens shall be less than that of the light case. Shields shall be painted matt black on the inside.

11.3.1.8 Lights of all-round visibility (360°) in the horizontal plane, except for anchor lights, shall be so located as not to be obscured by masts, topmasts or superstructures within sectors of more than 6°. In this case the light shall be considered as an all-round source of light with the diameter equal to the outside diameter of the source of light (filament of the lamp, flame of the burner).

When it is not feasible to fulfil this requirement by means of fitting of one all-round light, two all-round lights shall be installed. They shall be located or provided with shields in such a way as to be visible, as far as practicable, as one all-round light at a distance of 1 mile and over. All-round lights shall be screened by these shields less than 180°.

11.3.1.9 On power-driven craft intended for navigation or navigating in water areas where IRPCS-72 apply, a spare set of lights consisting of a masthead light, sidelights and sternlight shall be placed on board in regular positions provided for these lights, or electric lights with two sources of light shall be used (one source of light is fed from the craft's mains, the other — from the emergency source of power).

11.3.2 Signal shapes.

The location of signal shapes on board, depending on the craft's intended area of navigation, shall meet the requirements of either IRPCS-72, or European Code for Inland Waterways, and Main Regulations for the Danube Navigation, or Rules of Navigation in the Russian Federation Inland Waterways.

11.3.3 Sound signal means.

11.3.3.1 Stationary whistles or tyfons shall be fixed as high as possible above the uppermost deck and at least 0,5 m above superstructures and other structures on this deck which can obstruct the propagation of sound. Their bellmouths shall be directed straight ahead.

11.3.3.2 Control buttons to actuate the whistle or tyfon shall be located at the steering stations of the craft.

11.3.3.3 The bell shall be placed stationary on the clear part of the forecastle deck.

11.3.4 Storage of signal means on board.

11.3.4.1 The signal means not placed stationary shall be stored on board in special readily accessible storerooms, chests or lockers which should be located near the wheelhouse.

11.4 SUPPLY OF CRAFT WITH SIGNAL MEANS

11.4.1 Craft shall be provided with electric navigation lights. Craft having no own sources of electric power may be provided with lights using other sources of white light of the type approved by the Register.

11.4.2 When electric navigation lights are used they shall be capable of being changed over to the emergency source of power.

11.4.3 Sound signals used on craft shall be reliable in operation and shall produce the required sound intensity and duration as well as clear sounding of each blast.

11.4.4 Each craft of Categories **A, A1, A2** and **B, C**, **C1** shall be provided with the following spare parts and materials for lights:

.1 one light filter for each colour light unless the light is provided with a colour lens;

.2 one electric lamp for each electric light;

.3 fuel for spare oil lights in such a quantity that provides burning for the whole set of lights within a period of:

32 h — for craft of Categories **A, A1, A2** and **B**;

16 h — for other Categories of craft;

.4 one wick for each oil light;

.5 for lights other than electric ones, the set of spare parts shall be determined by the manufacturer of the product;

.**6** six lamp glasses if all oil lights have glasses of the same size, otherwise each light shall be provided with two glasses.

11.5 NAVIGATION LIGHTS AND SIGNAL SHAPES SUPPLY STANDARDS

11.5.1 All craft intended for navigation in the Russian Federation inland waterways and in water areas where the requirements of the European Code for Inland Waterways apply shall be equipped with navigation lights and be supplied with signal shapes in accordance with the Bermudian yawls standards specified in Tables 11.5.1-1 and 11.5.1-2.

Table 11.5.1-1

Type of the craft and its hull length L_H,. in m		Signal lights										
		Masthead light	Side lights		Stem tight	Light flashing lamp	All-round lights				Anchor	Signal cone
			Green	Red			White	Red	Green	Flashing		
Power-driven	$L_H \geq 20$	1	1	1	1	4	1	2	—	—	1[1]	—
	$L_H < 20$	1	1[2]	1[2]	1[3]	—	1	1	—	—	1[4]	—
	$L_H < 7$	—	—	—	—	—	1	—	—	—	1[4]	—
Sailing	$L_H \geq 20$	—	1	1	1	—	—	1[5]	1[5]	–	1[1]	—
	$L_H < 20$	—	1[6]	1[6]	1[7]	—	—	—	—	—	1[4]	—
	$L_H < 7$	—	—	—	—	—	2[8]	—	—	—	—	—
Craft proceeding under sail when also being propelled by machinery		1	—	—	1	—	—	—	—	—	—	1[9]
Berth-connected craft		—	—	—	—	—	—	—	—	—	—	—

[1] A craft moored to the shore shall carry a white all-round light visible over an arc of the horizon of 360° and placed on the side of the fairway at a height of at least 3 m. This light may be replaced by two usual white lights positioned in the forward and aft parts of the craft, visible over an arc of the horizon of 360° and placed on the side of the fairway.
[2] May be combined in one lantern positioned along the fore-and-aft centerline in the forward part of the craft.
[3] May not be provided on the craft, but in this case the masthead light shall be replaced by an all-round white light visible over an arc of the horizon of 360°.
[4] A small craft at anchor shall display a white all-round light positioned so that it can be seen from all sides.
[5] Recommended lights.
[6] May be combined in one lantern positioned in the forward part of the craft with the preservation of the sternlight, otherwise see footnote 5.
[7] Side lights and sternlight may be combined in one lantern positioned in the uppermost part of the mast.
[8] Sailing craft of less than 7 m in length may carry a white all-round light visible from all sides and display a second usual white light when other craft approach.
[9] Black conical shape, apex downwards.

Table 11.5.1-2

Additional signals made by craft navigating in inland waterway

Craft's characteristics	Signal lights				Signal shapes				
	All-round white	All-round green	All-round red	Flashing	Ball	Cone	Diamond shape mark	Flag	Pennant
Craft not under command	—	—	1(2)[1]	—	2[1]	—	–	1[1]	—
Craft restricted in their ability to manoeuvre	1[2]	—	2[2]	—	2[2]	—	1[2]	—	—
Craft with a length of the hull less than $L_H < 20$ m permitted to carry more than 12 passengers	—	—	—	—	—	—	1[3]	—	—

Craft's characteristics	Signal lights				Signal shapes				
	All-round white	All-round green	All-round red	Flashing	Ball	Cone	Diamond shape mark	Flag	Pennant
A craft at anchor in the open water area and not connected to the shore	2[4]	—	—	—	1[4]	–	—	—	—

[1] At night — one red light which may be replaced by a white light on craft of less than 20 m in length, or two red lights disposed vertically at a distance of 1 m apart.
In the daytime — a red signal flag, or two black balls disposed vertically at a distance of 1 m apart.
[2] At night — three all-round lights disposed vertically at a distance of 1 m apart, the upper and the lower lights are red, the middle one is white.
In the daytime — two black balls and a diamond shape mark between them at a distance of at least 1 m apart.
[3] In the daytime — a double diamond shape mark.
[4] At night — two all-round lights visible from all sides: the first one — in the forward part of the craft at a height of at least 4 m; the second — in the aft part of the craft at a height of at least 2 m lower than the first one.
In the daytime — a black ball in the forward part of the craft disposed so that it can be seen from all sides.

11.5.2 All craft intended for navigation and navigating in water areas where the requirements of IRPCS-72 apply shall be equipped with navigation lights and be supplied with signal shapes in accordance with the standards specified in Tables 11.5.2-1 and 11.5.2-2.

Additional signal means for craft restricted in their ability to maneuver are specified in Table 11.5.2-2.

Table 11.5.2-1

Supply standards for craft navigating in areas where IRPCS-72 apply

Nos.	Types of craft	Signal lights						Signal shapes		
		Masthead	Side lights[1]		Sternlight	All-round		Ball	Cone	Diamond shape mark
			Green	Red		White	Red			
1	Self-propelled craft:									
1.1	of 12 m in length and more;	1	1	1	1	1	2	3	One for a craft having sails	1[10]
1.2	of less than 12 m in length;	1[2,3]	1[3]	1[3]	1[2]	1[4]	—	1		—
1.3	of less than 7 m in length whose maximum speed docs not exceed 7-knots	1	1[5] 1[7]	1[5] 1[7]	1[2] 1[7]	1[6]	—	1[6]		—
2	Non-self-propelled craft	—	1[8]	1[8]	1[8]	1	2[9]	3[9]	—	1[10]

[1] On craft of less than 20 m in length they may be combined in one lantern.
[2] Only for craft being towed if the length of the tow exceeds 200 m. May be replaced by two cones bases together.
[3] May be replaced by one white all-round light.
[4] If centerline fitting of the masthead light or all-round white light is not practicable, it may be displaced from fore and aft centerline of the craft, provided that the sidelights are combined in one lantern which shall be carried on the fore and aft centerline of the craft or located as nearly as practicable in the same fore and aft line as the masthead light or the all-round white light.
[5] May be used instead of the masthead light and sternlight.
[6] Displayed if it is practicable.
[7] If a sailing craft proceeds under oars, the lights may be combined in one lantern.
[8] Required at anchor, only in the narrow passage, in the fairway, at the anchorage or in the vicinity of them, where other craft may normally navigate.
[9] Required if the craft is being towed alongside or by cable.
[10] Only for craft of 12 m in length and more.

N o t e . As the requirements of these Rules do not apply to tugs and pushers, the towing operations may be performed only in the daytime in conditions of good visibility.

Table 11.5.2-2

Additional signals supply standards for craft navigating in areas where IRPCS-72 apply

No.	Types of craft	Lights				Signal shapes	
		All-round			Flashing	Cone	Diamond shape mark
		White	Red	Green	Yellow		
1	Craft restricted in their ability to manoeuvre[1]	1	2	–	–	–	1
[1] Lights and shapes are not required for craft of less than 12 m in length.							

11.5.3 A craft of 20,0 m in length and more intended for navigation and navigating in water areas where the requirements of the European Code for Inland Waterways apply shall be supplied with one yellow ball — a signal shape which shall be used in case of its being towed by another craft.

11.6 PYROTECHNIC SIGNAL MEANS SUPPLY STANDARDS

11.6.1 Pyrotechnic signal means comprise rockets or shells throwing red stars, rocket parachute flares, hand flares showing a red light and smoke signals giving off orange-coloured smoke.

11.6.2 The navigational and technical requirements the pyrotechnic signal means shall comply with are specified in 11.2.5.

11.6.3 The supply of craft with pyrotechnic signal means shall be checked in accordance with the standards specified in Table 11.6.3.

Table 11.6.3

Standards of craft's supply with pyrotechnic signal means

Design category	Quantity					
	Rocket parachute flare[1]	Shell or sound signal rocket[1]	Hand flare, red	Hand flare, white[2]	One-star rocket, green[2]	One-star rocket, red[2]
A, A1, A2 and **B**[3]	6[4]	6	6[4]	6	6	6
C	3	—	3	3	—	—
C1	3	—	3	3	—	—
C2	3	—	3	3	—	—
C3[4]	—	—	—	—	—	—

[1] Craft engaged in international voyages shall be provided with 12 rocket parachute flares. Hand flares are also recommended.
[2] Recommended.
[3] Craft of design categories **A, A1, A2** and **B** are additionally sup-plied with two buoyant smoke floats. Besides, craft of design category A are additionally supplied with six rocket parachute flares.
[4] Craft navigating in inland waterways may be provided with rocket parachute flares (3) and red hand flares (3)

Pyrotechnic signal means shall be supplied to the craft navigating at sea or in water storage reservoirs.

11.6.4 For firing distress signal rockets, a special shooting tube should be arranged in the craft rail or bulwark with a cut-in. The angle of the shooting tube setting to the horizontal shall be 60 — 70°.

11.6.5 It is permitted to replace distress signal parachute rockets with six-star red rockets except on craft engaged in international sea voyages.

11.7 SOUND SIGNAL MEANS SUPPLY STANDARDS

11.7.1 All power-driven craft with a length of 12 m and more shall be supplied with a whistle and a bell for making sound signals.

11.7.2 Craft of less than 12 m in length navigating in areas to which the requirements of IRPCS-72 apply as well as inland navigation craft of 7 to 12 m in length shall be supplied with a means for making an effective sound signal by prolonged and short blasts.

11.7.3 On manned non-self-propelled craft a bell shall be fitted.

11.7.4 On sea-going craft and inland navigation craft of less than 12 m in length automobile-type signal means may be used.

11.7.5 When, according to the provisions of these Rules and other applicable provisions, other sound signals than strokes of the bell are prescribed, such signals shall be given:

.1 on board motor craft of 20 m in length and more as well as on all craft fitted with radars — by mechanical sound signal devices fitted at a height sufficient for the sound signals to propagate, without obstructions, ahead, and as far as possible, astern of the craft; the signal means shall meet the requirements of 11.2.6.5;

.2 on board non-motor craft and on craft of less than 20 m in length whose machinery is not provided with a device for sounding signals by means of a trumpet, these signals shall comply with requirements of 11.2.6.5.1.1 and 11.2.6.5.1.2.

11.7.6 Sound signals of motor craft of 20 m in length and more shall be supplemented with light signals synchronized with them. These light signals shall be of yellow colour and shall be visible all over the horizon. This provision does not refer to the light and radar sound signals sent by craft proceeding downstream, neither does it refer to bell strokes or continuous bell sounding.

11.7.7 If a craft proceeds in a convoy the prescribed signals shall be made, unless otherwise stated, only by the craft navigated by the head of the convoy.

11.7.8 A craft in distress shall give signals by repeated bell strokes or by prolonged blasts. These signals may be replaced or supplemented by visual signals.

11.7.9 For providing the sound signal audibility the weighted level of sound pressure in the wheelhouse at the height of the helmsman's head shall not exceed 70 dB (A) under normal operational conditions.

11.7.10 Continuous sounding of the bell shall last for about 4 sec. It can be substituted by a series of strokes of a metal object against another metal object of the same duration.

11.7.11 In addition to the requirements of these Rules every craft of 20 m in length and more shall, when necessary, give signals specified in 11.1.3.

Supply standards for craft navigating in inland waterways are specified in the Rules of Navigation in Inland Waters of the Russian Federation and in the regional navigation rules.

12 EMERGENCY OUTFIT, SPARE PARTS AND TOOLS

12.1 GENERAL

12.1.1 The items listed in Tables 12.2.1 and 12.2.2 available in the craft, but intended for other purposes may be included into the emergency outfit, provided these items have corresponding markings and their permanent storage places are situated above the bulkhead deck.

12.2 ITEMS REQUIRED

12.2.1 It is recommended that craft of more than 12 m in length except those of design categories **C1, C2, C3** and **D** shall be provided with emergency outfit. For craft of less than 12 m in length, the emergency outfit shall be chosen by the owner.

Table 12.2.1

Nos.	Item, unit	Size	Quantity
1	thrummed pad, pc	0,4×0,5 m	1
2	Set of rigging tools	As per Table 12.2.3	1
3	Set of titter's tools	As per Table 12.2.3	1
4	Pine plugs for craft with side scuttles, pc	Side scuttle diameter	2[1]
5	Pine plugs, pc	10×30×150 mm	2
6	Unbleached canvas, m²		2
7	Tarred tow, kg		10[3]
8	Hexagonal-head bolt, pc	M16×260 mm	2
9	Hexagonal nut, pc	M16	4
10	Washer for nut, pc	M16	8
11	Cement (quick-setting), kg		100[2]
12	Sand, natural, kg		100[4]
13	Accelerator for concrete setting, kg		5[5]
14	Minium, kg		5
15	Carpenter's axe, pc		1
16	Hack-saw, pc	600 mm in length	1
17	Bucket with a line, pc		1
18	Lantern of explosion-proof type, pc		1
19	Stop of telescopic type, pc		1

[1] For each standard size.
[2] For craft of less than 12 m in length, the required quantity is 50 kg.
[3] For craft of less than 12 m in length, the required quantity is 5 kg.
[4] For craft of less than 12 m in length, the required quantity is 50 kg.
[5] For craft of less than 12 m in length, the required quantity is 2,5 kg.

The recommended items required on craft are specified in Tables 12.2.1 and 12.2.2.

12.2.2 For glass-reinforced plastic craft, except those of design categories **C1, C2, C3** and **D**, the outfit specified in Table 12.2.2 recommended to provide, and the quantity of this outfit shall be determined in respect to each definite craft.

Table 12.2.2

Nos.	Item
1	Glass fabric
2	Glass roving
3	Resin binder with hardener

12.2.3 It is recommended that the sets of rigging and fitter's tools specified in Tables 12.2.1 shall include the items according to Table 12.2.3.

Table 12.2.3

Nos.	Item	Size	Quantity per set	
			Rigging	Fitter's
1	Tape measure	2000 mm long	1	
2	Bench hammer	0,5 kg	1	1
3	Sledge hammer	3,0 kg	–	1
4	Rigger’s mallet	–	1	–
5	Puncher (dumb iron)	–	1	–
6	Chisel	20×200 mm	1	1
7	Marline spike	200 mm	1	–
8	Carpenter’s chisel	20 mm	1	–
9	Screw auger	Ø18 mm	1	–
10	Tongs	200 mm	1	–
11	Hollow punch	Ø18 mm	–	1
12	Hollow punch	Ø25 mm	–	1
13	Triangular file	300 mm	–	1
14	Half-round file	300 mm	–	1
15	Multi-purpose tongs	200 mm	–	1
16	Screw driver	b = 10 mm	–	1
17	Adjustable wrench	Jaw width up to 36 mm	–	1
18	Wrench	Jaw width of 24 mm	–	1
19	Rigger's knife	–	1	–
20	Hack-saw frame	–	–	1
21	Hack-saw blade	–	–	6
22	Kit-bag	–	1	1

N o t e . For glass-reinforced plastic craft, the outfit items specified in 3, 8 — 10, 12 — 15, 19, 20 and 22 are not required.

12.2.4 For craft of design categories **A, A1, A2** and **B** an emergency fresh water supply of at least 9 l per person shall be provided in container(s) specially intended for this purpose.

12.2.5 For power-driven craft of design categories **C, C1, C2, C3** and **D** with a hull length of less than 6-m, a set of oars is required.

12.3 STORAGE OF EMERGENCY OUTFIT

12.3.1 The emergency outfit shall be stored at least in two emergency stations, one of which shall be situated in the machinery space. Emergency stations may be special spaces, boxes or places allocated on the deck or in spaces.

In the emergency station of the machinery space the outfit necessary for carrying out the emergency operations inside the space shall be stored; the rest of the emergency outfit shall generally be stored in the emergency stations located above the bulkhead deck; it is allowed to locate the emergency station below the bulkhead deck on condition that free access to this station is provided at all times.

12.3.2 On craft where it is impracticable to comply with the requirement of 12.3.1 it is allowed to store the emergency outfit only in one emergency station.

12.3.3 A free passage at least 0,6 m wide shall be provided in front of the emergency station.

The passages to the emergency stations shall be as straight and short as possible.

12.4 MARKING

12.4.1 Items of the emergency outfit and cases for their storage shall be painted blue either entirely or in a stripe. The cases for emergency equipment storage shall have a distinct inscription to indicate the name of the material, weight and warranted storage period.

12.4.2 The emergency stations shall be provided with distinct inscriptions: "Emergency Station".

12.5 SPARE PARTS FOR CRAFT'S ARRANGEMENT

12.5.1 Every craft shall be provided with spare parts required for reliable operation of craft's arrangements. The list of spare parts is given in Table 12.5.1. The Table specifies only the nomenclature of the parts, while their standard sizes and quantity are determined by the requirements of the corresponding sections of these Rules.

Table 12.5.1

Spare parts for craft's arrangements

Nos.	Items	Design categories		
		A, A1, A2 and **B**	**C**	**C1**
1	**Anchor arrangement**			
1.1	Spare end shackle	+	–	–
1.2	Spare connecting shackle	+	–	–
2	**Rudder and steering gear**			
2.1	Spare rudder stock bearing bush	+	+	–
2.2	Spare rudder pintle bearing bush	+	+	–
2.3	Emergency tiller	+	+	+
2.4	A set of steering tackle[1]	+	+	+

[1] For craft with steering gear fed from a power source. In this case item 2.3 is not required.

12.6 OPERATING INSTRUCTIONS

12.6.1 It is recommended to have operation and maintenance instructions for the craft's mechanisms and auxiliary equipment.

APPENDIX

RECOMMENDATIONS FOR STEERABILITY STANDARDIZATION

1 GENERAL

1.1 Definitions and explanations

For the purpose of these Recommendations the following definitions and explanations have been adopted:

Middle point of the craft is a point in the centre-line plane of the craft situated in the middle of the waterline of flotation.

Craft's speed v is for water-displacement power-driven craft a speed equal to at least 90 % of the craft's attainable speed or a speed when the power of the craft's engines is at least 85 per cent of the engine rated power.

Craft's manoeuvring speed v_m is for craft proceeding in either transient or gliding operating condition and also for high-speed craft — a speed at which safe manoeuvring of the craft is provided in a restricted water area. This speed, as a rule, corresponds to a displacement condition.

Turning circle is a manoeuvre either to starboard or port when the wheel is put 35° or at a maximum angle of turn allowable at the craft's speed during the trials.

Stable turning circle is a turning circle manoeuvre when the kinematic parameters of the craft's motion can be considered as unchangeable with time.

Stopping way is a distance passed by the middle point of the craft in the direction of the initial craft's course from the position at which the engine was worked full astern to the position where the craft stopped in respect to the water.

Active means of craft's steering is a special unit capable of producing thrust or traction force at an angle to the center line plane of the craft when the main engine is not functioning and/or the craft is not making her way through water.

Tack is the headings of a sailing craft with the wind kept on one side of the craft.

Turn of a sailing craft is the tack change.

Tacking is the turn in which the sailing craft's head is brought to the wind and across it so as to bring the wind on the opposite side of the craft.

Gybing is the turn in which the sailing craft is brought onto the other tack by bringing the wind around the stern.

1.2 General requirements

The methods and design parameters specified in 2.2 and 3.1 contain general recommendations without considering the craft's particulars, and can only be applied for determining the craft's general architecture at the first stages of design developing.

For the purpose of these Rules, the approach to the steerability standardization comprises the following provisions:

.1 it is recommended to assess the rudder blade area and the effectiveness of the rudder system at the design stage;

.2 the requirements to the maneuvering elements of the craft — turning circle, stopping way, course-keeping stability and steerability of sailing craft — are checked during the performance trials of the prototype craft;

.3 the decision about the craft's compliance with the requirements to steerability is taken on the basis of the trials results.

2 STEERABILITY OF POWER-DRIVEN CRAFT

2.1 Diameter of stable turning circle

2.1.1 The requirements of this Chapter apply to craft equipped with either permanently fixed or outboard engines. Thrusters and similar active means of craft's steering are regarded as auxiliary and are not to be considered when compliance with the requirements of this Section is decided upon.

2.1.2 The actual characteristics of the turning circle are checked during the craft's trials.

2.1.3 For water-displacement craft (operating at a rate of speed Fr < 0,5) the diameter of the stable turning circle to each side shall be:

$$D_C \leq 4\,L_{WL}$$

where D_C = stable turning circle diameter, in m;
L_{WL} = length of the craft on waterline, when the craft does not move, in m.

2.1.4 For high-speed craft in a transient ($1 < Fr_\Delta < 3$) or gliding (Fr_Δ > 3) operating conditions the diameter of the stable turning circle at a speed of manoeuvring shall be:

$D_C \leq 4\,L_{WL}$ for gliding and half-gliding craft;

$D_C \leq 6\,L_{WL}$ for hydrofoil craft, air-cushion skeg craft and for craft with underwater skegs.

2.1.5 The speed of manoeuvring and safe speeds of high-speed craft shall be specified in the Manual for the Owner of the Craft.

2.2 Rudder area

2.2.1 The requirements to the rudder area apply to craft equipped with permanently fixed engines and propellers. These requirements do not apply to craft with outboard engines, water-jet installations, box-type (nozzle) rudders and other similar means of steering.

2.2.2 The minimum required rudder area is determined according to the following formula:

$$A_{R_{min}} = \frac{0{,}02 A_{cl} k_{LBd}}{k_V k_t k_N k_{AR} k_C k_A} \qquad (2.2.2\text{-}1)$$

where $A_{R_{min}}$ = minimum rudder area, m²; for craft with two rudders, the A_R is the summated area of the rudders. If the rudder has a skeg, the area of the rudder A_R is calculated similarly to the value A_0 determined in 2.2;

A_{cl} = area of the submerged part of the centre-line plane, including the keel and deadwood, but excluding center-boards, bilge boards, brackets and protruding parts, in m²;

k_{Lbd} = coefficient taking into consideration the craft's basic dimensions calculated according to the formula

$$k_{Lbd} = \delta B / d_A \qquad (2.2.2\text{-}2)$$

where B = breadth of the craft;

d_A = averaged draft of the area of the submerged part of craft's centre-line plane (A_{cl}). It is calculated as the doubled distance from the construction waterline to the A_{cl} area of neutral inertia axis parallel to the construction waterline. For craft with a simple shape of the submerged part, d_A can be taken as equal to the craft's midlength draught;

δ = block coefficient of the craft;

k_V = coefficient considering the location of the rudder and propeller:
k_V= 1,2 for rudders installed behind the screw disk;
k_V= 1,0 for other location of the rudders;

k_N = coefficient of the quantity of rudders:
k_N= 1,0 if one rudder is installed;
k_N= 0,7 if two rudders are installed on each side of the craft;

k_t = coefficient taking into consideration the rudder type and the place where it is installed:
k_t= 1,0 for a rudder installed under the craft's bottom;
k_t= 0,7 for transom hanging rudder;

k_t= 0,5 for transom hanging rudder fixed behind the stern frame or skeg;

k_{AR} = height-breadth ratio of the rudder:
k_{AR}= 1,0 for a rudder with $h_R^2/A_R \geq 1{,}5$;
$k_{AR} = (0{,}5 \cdot h_R^2/A_R + 0{,}25)$ for rudders with $h_R^2/A_R < 1{,}5$;

h_R = average height of the rudder, in m;

k_A = coefficient considering the relative location of the geometric centre of the centerline plane submerged part area in respect to the craft's length:
$k_{AR} = (2\,X_A + L_{WL}) / L_{WL}$;

X_A = distance, m, from the geometric centre of the centerline plane submerged part area to the midcraft section of the craft, "+" means that the value is positive in the direction to the fore part of the craft;

k_C = coefficient of the relative location of the centre of buoyancy in respect to the craft's length:
$k_A = (2\,X_C + L_{WL}) / L_{WL}$;

X_C = distance, m, from the centre of buoyancy to the midcraft section of the craft, "+" means that the value is positive in the direction to the fore part of the craft.

2.2.3 The rudder area may be reduced in comparison with the required area if it is proved to the Register by calculations or experiments that the requirements specified in 2.1 are complied with.

2.3 Stopping way of the craft

The stopping way of the craft shall not exceed 15 L_{WL}.

2.4 Course-keeping stability

The trials shall demonstrate the ability of the craft to steer the direct course steadily, without putting the helm from starboard to port to compensate for the craft's yawing.

3 STEERABILITY OF SAILING CRAFT

3.1 CRITERION FOR RUDDER EFFECTIVENESS

3.1.1 The requirements to the criterion for the rudder effectiveness apply to sailing craft of more than $L_H > 6$ m.

3.1.2 The criterion for the sailing craft rudder effectiveness

$$E_R = k_N k_L k_{AR} \frac{l_R A_R}{z_{sc} SA} 10^3 \qquad (3.1.2)$$

where
k_N = coefficient of the quantity of rudders;
k_N = 1,0 if one rudder is installed;
k_N= 0,6 if two rudders are installed on each side of the craft;
k_L = coefficient of the rudder type and location:
k_L = 1,0 for a rudder fixed under the bottom as a console or with a skeg;
k_L= 0,7 for transom hanging rudder;
k_L= 0,5 for a rudder hanging on the stern frame;
k_{AR} = height-breadth ratio of rudder;
k_{AR} = 1,0 for a rudder with $h_R^2/A_R \geq 1{,}5$; $k = (0{,}5 \times h_R^2/A_R + 0{,}25)$ for rudders with the height-breadth ratio of $h_R^2/A_R < 1{,}5$;
l_R = distance from the geometrical centre of the rudder to the middle point of the craft, in m;
h_R = average height of the rudder, in m;
A_R = rudder area, in m²; for craft with two rudders, A_R is the summated area of the rudders. If the rudder has a skeg, the area of the rudder A_R is calculated similarly to the value A_0 determined in 2.2;
z_{sc} = is the height of the geometric centre of sails above the construction waterline, in m;
SA = area of main sails, in m².

3.1.3 The E_R value determined according to Formula (3.1.2) shall not be less than the $E_{R_{min}}$ minimum value determined as

$$E_{R_{min}} = (60/L_{WL}) + 1{,}5. \qquad (3.1.3)$$

3.2 STEERABILITY OF SAILING CRAFT WITH PERMANENTLY INSTALLED ENGINES.

3.2.1 The minimum craft's rudder area is taken as the largest of the areas calculated according to 2.2 for a motor craft and according to 3.1 for a sailing craft.

3.2.2 For a motor-sailing or a sailing-motor craft when it proceeds under engine the requirements to turning circle elements are the same as for motor craft specified in 2.1.

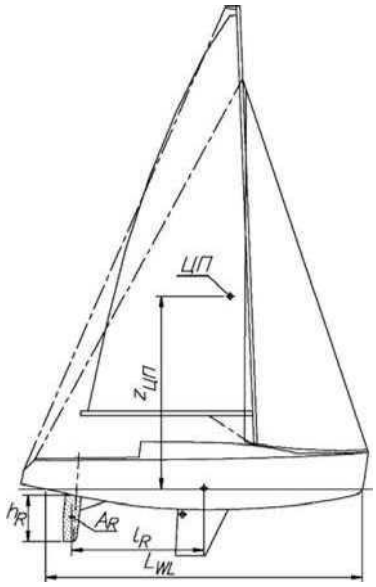


Fig. 3.1.2
Sailing craft elements

Russian Maritime Register of Shipping

Rules for the Classification and Construction of Pleasure Craft
Part III
Equipment, Arrangements and Outfit

FAI "Russian Maritime Register of Shipping"
7, Litera A, Millionnaya Ulitsa,
St. Petersburg, 191186
Russian Federation
www.rs-class.org/en/