RUSSIAN MARITIME REGISTER OF SHIPPING

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Corr.

RULES
FOR THE CLASSIFICATION AND CONSTRUCTION OF PLEASURE CRAFT

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Saint-Petersburg
2012

Rules for the Classification and Construction of Pleasure Craft developed by Russian Maritime Register of Shipping have been approved in accordance with the established procedure and come info force since 1 April 2012.

The Rules take into consideration the requirements of Directive 94/25/EC of the European Parliament and of the Council of 16 June 2003.

The requirements contained in the Rules apply in full to the documentation of ships, ship machinery, devices, equipment and materials to be submitted for review by Russian Maritime Register of Shipping after the enforcement of the Rules.

In all other cases, the requirements of the Rules apply as far as reasonable and practicable which is subject to special consideration by the Register.

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GENERAL REGULATIONS

1 APPLICATION

1.1 The scope of application of the present Rules for the Classification and Construction of Small Pleasure Craft[1] of Russian Maritime Register of Shipping[2] is established with regard to the applicable provisions of the Directive 94/25/EC of the European Parliament and of the Council of 16 June 1994 on the Approximation of Laws, Regulations and Administrative Provisions of the Member States Relating to Recreational Craft and the Directive 2003/44/EC of the European Parliament and of the Council of 16 June 2003 amending Directive 94/25/EC[3].

1.2 The requirements of the present Rules shall apply to pleasure craft from 2, 5 m up to 24 m hull length determined in 3.2, with passenger capacity not more than 12, as well as their components thereof.

1.3 The requirements of the present Part shall not apply to:

boats intended for sports purposes and ships of war, racing boats, including training boats;

canoes, kayaks, gondolas, pedalos and other types of rowing boats;

water skis, water sled, "banana" and similar types of towed craft;

boards for surfing and wind surfing, including powered ones;

inflatable and framed cloth boats;

personal watercraft;

ram-wing craft;

submersibles;

antique historical craft and replicas thereof;

experimental craft, as well as small craft used as ship's equipment (life and rescue boats, rafts) carried on board craft which are not pleasure craft.

1.4 The requirements of the present Rules shall apply to:

.1 self-propelled craft with hull intended for movement in displacement, transitional and/or planning modes with a speed less than 14 m/s regardless of the power output of the main engines;

.2 non-self-propelled and berth-connected craft, including craft fitted out with machinery and equipment of total prime propulsion movers power output 100 kW and upwards;

.3 materials and products intended for installation on board the above craft.

[1] Hereinafter referred to as "the present Rules".
[2] Hereinafter referred to as "the Register".
[3] Hereinafter referred to as "the Directive 94/25/EC" and "the Directive 2003/44/EC".

1.5 The present Rules consist of the following Parts:

I "Classification";

II "Hull";

III "Equipment, Arrangements and Outfit";

IV "Stability, Reserve of Buoyancy and Freeboard";

V "Machinery Installations. Machinery. Systems and Piping";

VI "Automation";

VII "Electrical Equipment";

VIII "Radio and Navigational Equipment";

IX "Life-Saving Appliances";

X "Fire Protection";

XI "Materials";

XII "Means for the Prevention of Pollution from Craft".

1.6 The requirements of the following Register Rules shall also apply to the small pleasure craft, where it is reasonable and appropriate:

.1 Rules for the Classification and Construction of Sea-Going Ships (Parts: X "Boilers, Heat Exchangers and Pressure Vessels"; XII "Refrigerating Plants"; XIII "Materials"; XIV "Welding"; XVI "Hull Structure and Strength of Glass-Reinforced Plastic Ships and Boats");

.2 Rules for the Equipment of Sea-Going Ships (for pleasure craft in design categories **A, A1** and **A2** mentioned in 3.2.1);

.3 Rules for the Classification and Construction of High-Speed Craft (for pleasure craft capable of developing speed in excess of 40,0 km/h);

.4 Rules for the Tonnage Measurement of Sea-Going Ships;

.5 Rules for the Tonnage Measurement of Inland Navigation Ships;

.6 Rules for the Cargo-Handling Gear of Sea-Going Ships;

.7 Rules for the Classification and Construction of Inland Navigation Ships (for European Inland Waterways);

.8 Rules for the Classification Surveys of Ships in Service.

1.7 In application of the present Rules, there shall be considered the relevant provisions of the General Regulations for the Classification and Other Activity.

1.8 The present Rules set forth the requirements upon compliance with which the craft may be assigned a class of the Register.

1.9 On agreement with the Register, the requirements of the present Rules may be applied for classification of craft not specified in 1.2 and 1.4.

On agreement with the Register, the requirements of the Rules may be applied to pleasure craft of more than

24 m in length and/or with passenger capacity above 12. These pleasure craft shall comply with the appropriate requirements of the Rules for the Classification and Construction of Sea-Going Ships.

1.10 Pleasure craft specified in 1.2 and 1.4 and intended for operation on the European inland waterways shall also meet the provisions of Chapter 21 of Directive 2006/87/EC of the European Parliament and of the Council of 12 December 2006.

1.11 The requirements of the present Rules cover all craft the designs of which are submitted to the Register for review after the date when the present Rules come into force.

Some requirements of the present Rules apply to craft in service independently of or depending on the date of construction if this is specified in the Rules.

Crafts being under construction at the time when the present Rules become effective are subject to the requirements of these Rules, if necessary, depending on the Register decision, as far as it is practicable and reasonable.

Craft which are converted or modernized after the present Rules have come into force are subject to the Rules requirements to the extent in so much as practicable and reasonable unless otherwise specified in the Rules.

In case of reclassification of a craft in service which was classed according to other Rules, the requirements of the present Rules are applied in order to justify the decisions regarding assignment of the Register class.

1.12 Confirmation of compliance with the requirements of the Rules is the Register prerogative and is performed in accordance with the procedure established by the Register.

Any statements on compliance of the item of the Register technical supervision with the requirements of the Rules, made or documented by an organization other than the Register, or not properly confirmed by the Register cannot be considered as a confirmation of such a compliance.

2 GENERAL DEFINITIONS AND EXPLANATIONS

2.1 For the purpose of the present Rules the following definitions and explanations have been adopted unless expressly specified otherwise in particular parts of the Rules.

"Banana" boat and similar craft are a non-self-propelled inflatable craft which are towed by a motor craft and are intended for water sports and entertainment trips of short duration with passengers sitting on well-appointed places on the top of the inflatable craft body.

Undecked craft is a craft which within 2/3 of its length from the forward end is a decked craft, and/or which has cockpits with the general volume factor $K_C \geq 1$ and/or does not comply with the requirements of Section 10, Part III "Arrangements, Equipment and Outfit".

Pedalo is a craft propelled by a human being who drives a propeller/propellers or a paddle wheel/wheels and intended to carry one or more persons who occupy special seats on the craft body.

Wave height is a characteristic of sea considered in the present Rules with definitions and symbols:

significant waves – $h_{1/3}$;

waves with 1 per cent probability of over-topping – $h_{1\%}$;

waves with 3 per cent probability of over-topping – $h_{3\%}$;

waves with 5 per cent probability of over-topping – $h_{5\%}$.

To evaluate comparability of these values, the following relationship may be applied:

$h_{3\%} = 1{,}33\ h_{1/3} = 1{,}08\ h_{5\%} = 0{,}87\ h_{1\%} = 0{,}66\ h_{max}$.

Significant wave height ($h_{1/3}$) is the mean height of the highest one-third wave spectrum, observed over a continuous long period (within quasi-stationary sea).

Wave height with 1 per cent probability of over-topping ($h_{1\%}$) is a design height of irregular waves which, being assumed, implies that over a continuous long period of observation, 1 per cent of the actual waves may have a height exceeding the design height.

Wave height with 3 per cent probability of over-topping ($h_{3\%}$) is a design height of irregular waves which, being assumed, implies that over a continuous long period of observation 5 per cent of the actual waves may have a height exceeding the design height.

Wave height with 5 per cent probability of over-topping ($h_{5\%}$) is a design height of irregular waves which, being assumed, implies that during a continuous long period of observation of 5 per cent of actual waves may have a height exceeding the design height.

Planing craft is a boat moving at ascertain speed and supported mainly by hydrodynamic forces . The planing mode corresponds to the boat speed at which the displacement-Froude number is:

$$Fr_\Delta = v / \sqrt{g \sqrt[3]{V}} > 1{,}5$$

where v – boat speed, m/s;
g – gravitational acceleration, m/s^2;
V – displacement volume at a certain water-line, m^3;
For a transitional mode, $0{,}5 < Fr_\Delta < 1{,}5$.

Sheltered acquatorium is a section of the costal aquatorium sheltered from waves and winds in a natural way or sheltered from waves by a hydraulic structure.

Catamaran is a craft consisting of two main load-bearing hulls connected by a bridge-deck nacelle.

L a u n c h is a motor craft with a hull length from 6,0 m up to 15,0 m inclusive, except for boats carrying sailing rig.

I n t e r n a t i o n a l v o y a g e is a voyage between ports of different countries.

P l a c e o f r e f u g e is any naturally or artificially sheltered acquatorium which may be used as a shelter by a craft under conditions likely to endanger the safety of the ship.

O p e n c r a f t is either a craft the hatch covers of which are not satisfactorily strong, rigid or watertight, or a craft the hatches of which may have no covers

D e c k e d c r a f t is a craft in which the horizontal projection of an area bounded by the side line consists of a watertight deck and/or superstructure and which has quick-draining cockpits complying with the requirements of Section 10, Part III "Arrangements, Equipment and Outfit" and Sections 2 to 4, Part IV "Stability, Buoyancy Reserve and Freeboard", and/or watertight cockpits complying with the requirements of Section 10, Part III "Arrangements, Equipment and Outfit", with a total volume less than $L_H \times B_H \times F_M/40$, and all hatch covers of which are satisfactorily strong, rigid and watertight complying with the requirements of Section 9, Part III "Arrangements, Equipment and Outfit".

P a s s e n g e r is any person on board pleasure craft, other than the Master and the members of the crew, or a child under one year of age;

P a s s e n g e r c a p a c i t y is the maximum amount of passengers that a particular craft is certified to carry.

P e r s o n a l w a t e r c r a f t is a pleasure craft less than 4 m with an internal combustion engine having a water jet pump as its primary source of propulsion and designed to move on the water surface in transitional or planing mode and to be operated by a person or persons sitting, standing or kneeled on, rather than inside the hull. Among such craft are water bikes, water scooters and similar craft.

W a t e r b o w e r is a self-propelled or non-self-propelled boat including a berth-connected boat intended for recreation and lodging purposes.

P l e a s u r e c r a f t is any craft of any type of navigation used on non-commercial basis and intended solely for recreation.

D i s t a n c e t o t h e p l a c e o f r e f u g e is the maximum permissible distance in nautical miles (or kilometers) which is measured along the shortest, navigationally safe path from any point on the route selected for sailing to the nearest accessible port or place of refuge.

M o t o r c r a f t is a craft propelled by a propulsion internal combustion engine (engines) with a power output not less than that determined according to Formula (1.2.3.2) of Part I "Classification".

M o t o r - s a i l i n g c r a f t is a motor craft with a sail area not less that that determined according to Formula (1.2.3.1) of Part I "Classification".

S a i l i n g c r a f t is a craft with sail area not less than that determined according to Formula (1.2.3.1) of Part I "Classification".

S a i l i n g - m o t o r c r a f t is a sailing craft with a propulsion internal combustion engine (engines) having power output less than that determined according to Formula (1.2.3.2) of Part I "Classification".

C r a f t w i t h a u x i l i a r y h y d r o f o i l / h y d r o f o i l s is a craft designed in such a way that in the course of moving, a considerable part of its mass is supported by hydrodynamic forces which are produced on the hydrofoil/hydrofoils.

T o u r i s t c r a f t is a pleasure craft the structure and seaworthiness of which enable the craft to make planned multi-day tours.

T r i m a r a n is a craft the middle hull of which connected by a bridge structure with two sidehulls.

D i n g h y (b o a t) is a general term used for rowing and motor small craft being part of equipment and installed on board craft for various purposes.

Y a c h t is a pleasure decked self-propelled craft, other than rowing craft, intended for water trips with persons lodged on board and having enclosed spaces used to accommodate all the persons the craft is certified to carry.

M o t o r y a c h t is a yacht with a propulsion internal combustion engine (engines) having power output not less than that determined according to Formula (1.2.3.2) of Part I "Classification".

M o t o r - s a i l i n g y a c h t is a motor yacht with a sail area not less than that determined according to Formula (1.2.3.1) of Part I "Classification".

S a i l i n g y a c h t is a yacht with sail area not less than that determined according to Formula (1.2.3.1) of Part I "Classification".

S a i l i n g - m o t o r y a c h t is a sailing yacht with a propulsion internal combustion engine (engines) having power output less than that determined according to Formula (1.2.3.2) of Part I "Classification".

3 CRAFT PRINCIPAL DATA

This Section based on the Directive No.94/25/EC, establishes uniformity of definitions of main dimensions and data on loading conditions of a pleasure craft in accordance with ISO 8666:2002 "Small Craft – Principal Data".

Symbols used in the present Rules are bracketed where differ from ISO 8666:2002.

3.1 DEFINITIONS AND EXPLANATIONS

3.1.1 For the purpose of the present Section of the Rules, the following terms and explanations apply:

Waterline, WL ($ВЛ$), is intersection between the flotation plane and the hull which appears as a straight line in either the sheer plan or the body plan, but in its true form in the half-breadth plan.

Reference waterline, WL_{ref} ($КВЛ$), is the waterline in the fully loaded ready-for-use condition.

Sheerline is intersection between deck and craft's hull, or, where no deck is fitted, the upper edge of the craft's hull (excluding bulwark).

Transom beam, B_T, is the maximum width of the hull at the upper edge of transom, but not higher than the sheerline, excluding extensions. Where spray rails act as chines or part of planing surface, they are included in the transom beam measurement.

For craft with a rounded or pointed stern or with a transom beam of less than half the maximum beam of the craft, the transom beam is the widest beam at or below the sheerline at the aft quarter length of the hull forward of the stern.

Displacement, (Δ), is the mass of water displaced by the craft. Displacement is expressed in kilograms or tones.

Loaded displacement, m_{LDC} (Δ_{max}), is the mass of water displaced by the craft when in the fully loaded, ready-for-use condition.

Displacement volume, V_D (V), is the volume of water displaced by the craft that corresponds to the displacement mass, as defined above, in m^3.

Tank capacity is the maximum possible volume of the tank used in operation of the craft.

3.1.2 The principal symbols, abbreviated terms and units used in various Parts of the present Rules are given in Table 3.1.2.

Table 3.1.2

Symbols, abbreviated terms and units

Symbol (abbreviated term)	Designation	Unit
A_s	Projected sail area	m^2
B_H (B)	Beam of the hull	m
B_{max}	Maximum beam	m
B_{WL} ($B_{ВЛ}$)	Beam at waterline	m
B_T	Transom beam	m
D_{max}	Maximum depth	m
$D_{LWL/2}$ (D)	Midship depth	m
F	Freeboard	mm
F_A	Freeboard, aft	mm
F_F	Freeboard, forward	mm
F_M	Freeboard, midship	mm
H_a	Air draught	m
L_H	Length of the hull	m
L_{max}	Maximum length	m
L_{WL} ($L_{КВЛ}$)	Waterline length	m
m_G	Gross shipping mass	kg, t
m_{LDC}(Δ_{max})	Loaded displacement	kg
m_{LCC} (Δ_{min})	Light craft mass	kg, t
m_N	Net shipping mass	kg, t
m_p	Performance test mass	kg, t
m_T	Mass of craft when towed on trailer	kg, t
m_{MTL} (DW)	Maximum load (Deadweight)	kg, t
T (d)	Draught	m
T_C (d_c)	Design draught	m
T_{max} (d_{max})	Maximum draught	m
T_{min} (d_{min})	Minimum draught	m
V_D	Displacement volume	m^3
V	Volume of the craft	m^3
V_H	Volume of the hull	m^3
V_S	Volume of the superstructure	m^3
WL ($ВЛ$)	Waterline	
WL_{ref} ($КВЛ$)	Reference waterline	
β	Deadrise angle	deg.

3.2 MEASUREMENTS

3.2.1 Measurements shall be established with the craft's position without heel and trim, at rest at the reference waterline, unless otherwise stated.

3.2.2 Craft dimensions shall be measured parallel to the reference waterline and craft centerline as the distance between two vertical planes, perpendicular to the centerline of the craft.

3.2.3 Maximum length, L_{max}.

The maximum length includes all structural and integral parts of the craft, such as stem, stern, bulwark and other units attached to the craft's hull.

Where appropriate, this length includes parts which are normally fixed, such as fixed spars, bowsprits, pulpits, rubbing strakes, permanent fenders, hinged rudders, outboard motor brackets, outdrives, waterjets and any other units, e.g. diving and/or boarding platforms.

Outdrives, waterjets and all movable parts shall be measured in their normal operating condition to their maximum lengthwise extension when the craft is underway.

This length excludes outboard motors and any other type of equipment which can be detached without the use of tools.

See Figs. 3.2.3-1 and 3.2.3-2 for monohull measurements and Fig. 3.2.3-3 for multihull measurements.

3.2.4 Length of the hull, L_H.

The length of the hull includes all structural and integral parts of the craft, such as wooden, plastic or metal stems or sterns, bulwarks and hull/deck joints.

This length excludes removable parts that can be detached in a non-destructive manner and without affecting the structural integrity of the craft's hull, e.g. spars, bowsprits, bulwarks, pulpits, stemhead fittings, rudders, outdrives, outboard motors and their mounting brackets and plates, diving platforms, boarding platforms, rubbing strakes and permanent fenders.

This length does not exclude detachable parts of the hull, which act as hydrostatic or dynamic support when the craft is at rest or underway.

With multihull craft, the length of each hull shall be measured individually. The length of the hull of such craft shall be taken as the longest of the individual measurements.

See Figs. 3.2.3-1 and 3.2.3-2 for monohull measurements and Fig. 3.2.3-3 for multihull measurements.

3.2.5 Waterline length, L_{WL}.

The waterline length shall be measured in accordance with 3.2.1 and 3.2.2 for a waterline corresponding to the fully loaded ready-for-use condition of the craft at rest.

3.2.6 Maximum beam, B_{max}.

The maximum beam shall be measured in accordance with 3.2.1 and 3.2.2 between planes passing through the outermost parts of the craft.

The maximum beam includes all structural or integral parts of the craft, such as extensions of the hull, hull/deck joints, bulwark, rubbing strakes, permanent fenders, liferails and also other parts extending beyond the craft's side.

3.2.7 Beam of the hull, B_H (B).

The beam of the hull shall be measured in accordance with 3.2.1 and 3.2.2 between the outermost permanently fixed parts of the hull.

The beam of the hull includes all structural or integral parts of the craft, such as extensions of the hull, hull/deck joints and bulwarks.

The beam of the hull excludes removable parts that can be detached in a non-destructive manner and without affecting the integrity of the craft, e.g. rubbing strakes, fenders, guardrails and stanchions extending beyond the craft's side, and other similar equipment.

The beam of the hull does not exclude detachable parts of the hull, which act as hydrostatic or dynamic support when the craft is at rest or underway.

For multihulls, the beam of the hull shall be established accordingly for each individual hull.

See Fig. 3.2.7 for monohull measurements and Fig. 3.2.3-3 for multihull measurements.

3.2.8 Beam at waterline, B_{WL}.

The beam at waterline shall be measured in accordance with 3.2.1 and 3.2.2 as the maximum distance between the intersection of the hull surface and the flotation plane for a specific loading condition.

For multihulls, the beam at waterline shall be established for each hull individually.

3.2.9 Maximum depth, D_{max}.

The maximum depth shall be measured as the vertical distance between the sheerline at half-length of the waterline, L_{WL}, and the lowest point of the keel.

It is well to bear in mind, that with a traditional long-keeled craft or craft with a designed trim, the slope of the keel may result in increased draught aft, which is not at half-length of the waterline or length of the hull.

3.2.10 Midship depth, $D_{LWL/2}$ (D).

The midship depth shall be measured at half-length of the waterline as the distance between the sheerline and the lowest point of the keel at the same position.

3.2.11 Freeboard, F.

The freeboard shall be measured as the distance between the sheerline at the defined lengthwise location and the flotation plane in any specified loading condition.

3.2.12 Freeboard, aft, F_A.

The aft freeboard shall be measured in accordance with 3.2.11 at the aftermost point of the sheerline.

3.2.13 Freeboard, midship, F_M.

The midship freeboard shall be measured in accordance with 3.2.11 at half-length of the hull.

3.2.14 Freeboard, forward, F_F.

The forward freeboard shall be measured in accordance with 3.2.11 at the most forward point of the sheerline/deck at the side.

3.2.15 Draught, T(d).

The draught shall be measured as the vertical distance between the waterline in the fully loaded ready-for-use condition and a specific point of the underwater body (see Fig. 3.2.7).

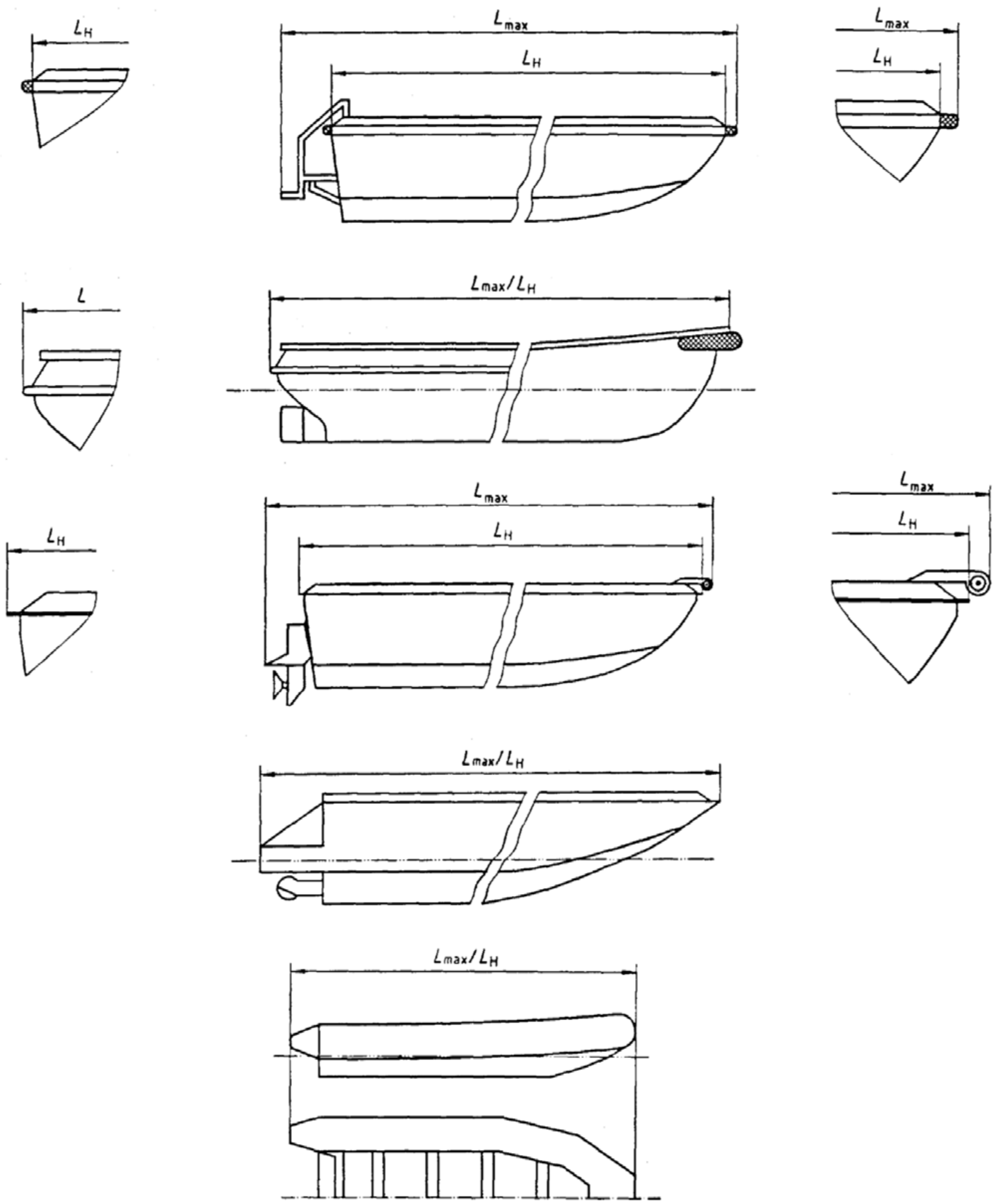


Fig. 3.2.3-1
Determination of L_{max} and L_H for monohull motor craft

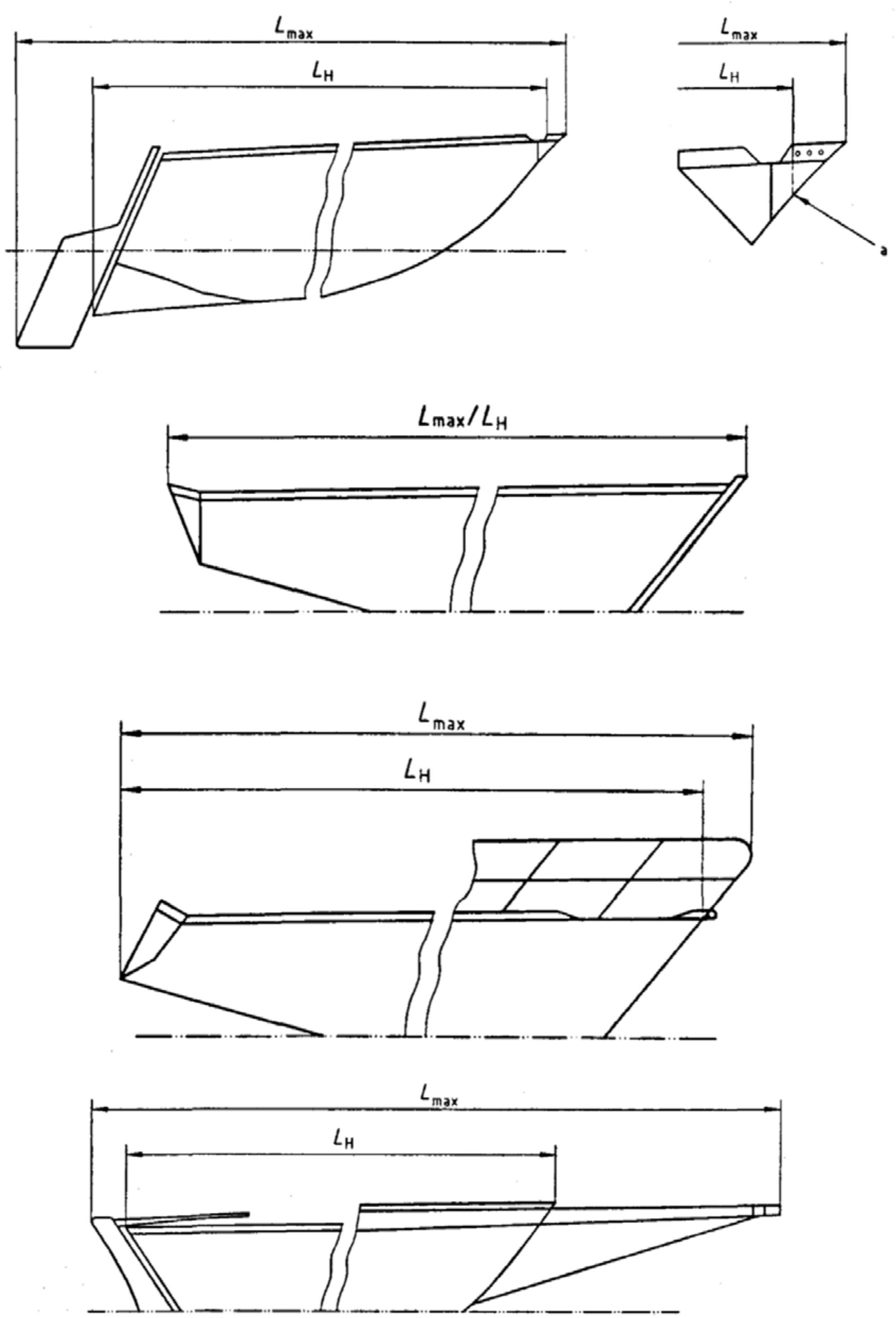


Fig. 3.2.3-2
Determination of L_{max} and L_H for monohull sailing craft

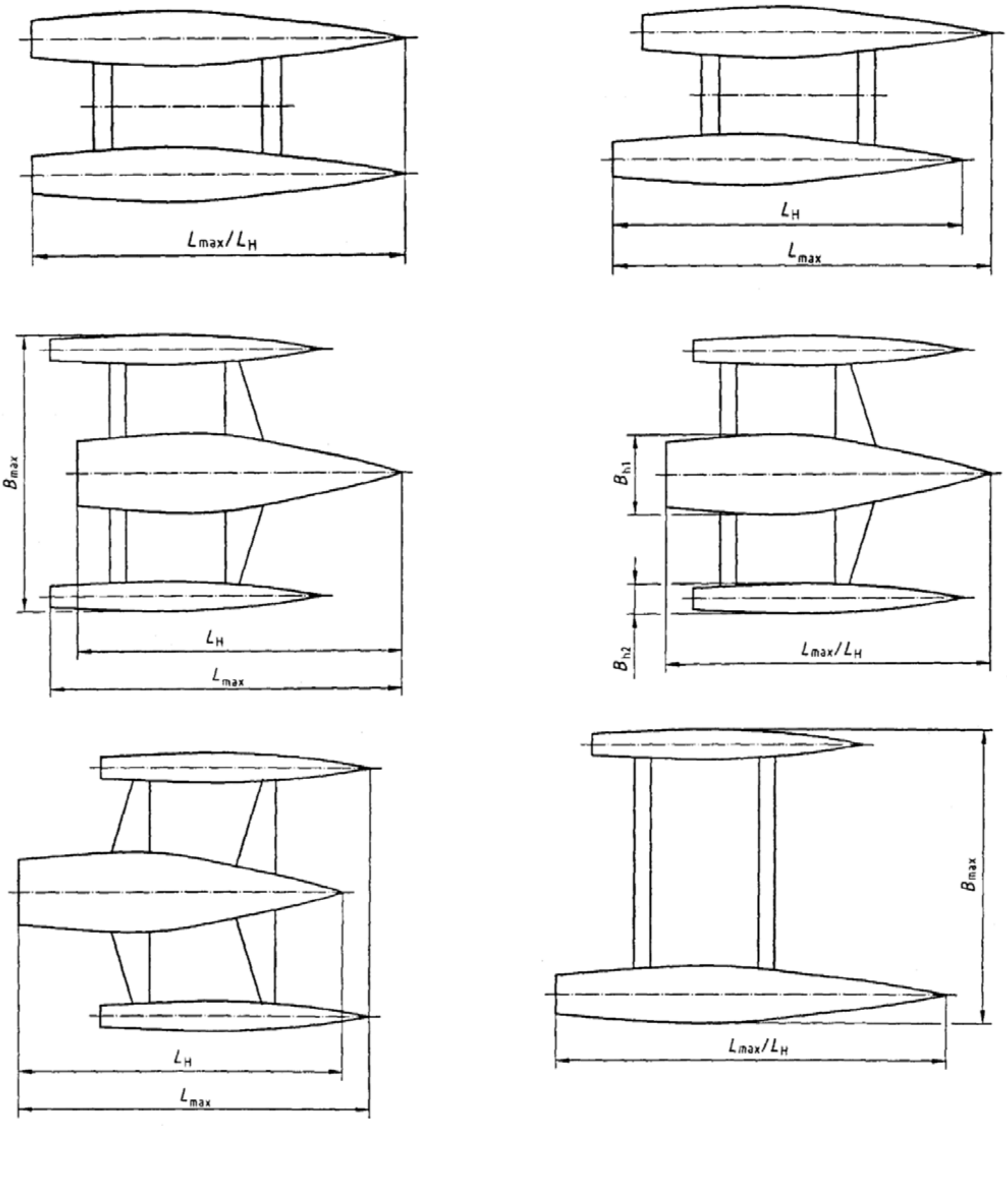


Fig. 3.2.3-3
Determination of L_{max}, L_H, B_{max} and B_H for multihull craft

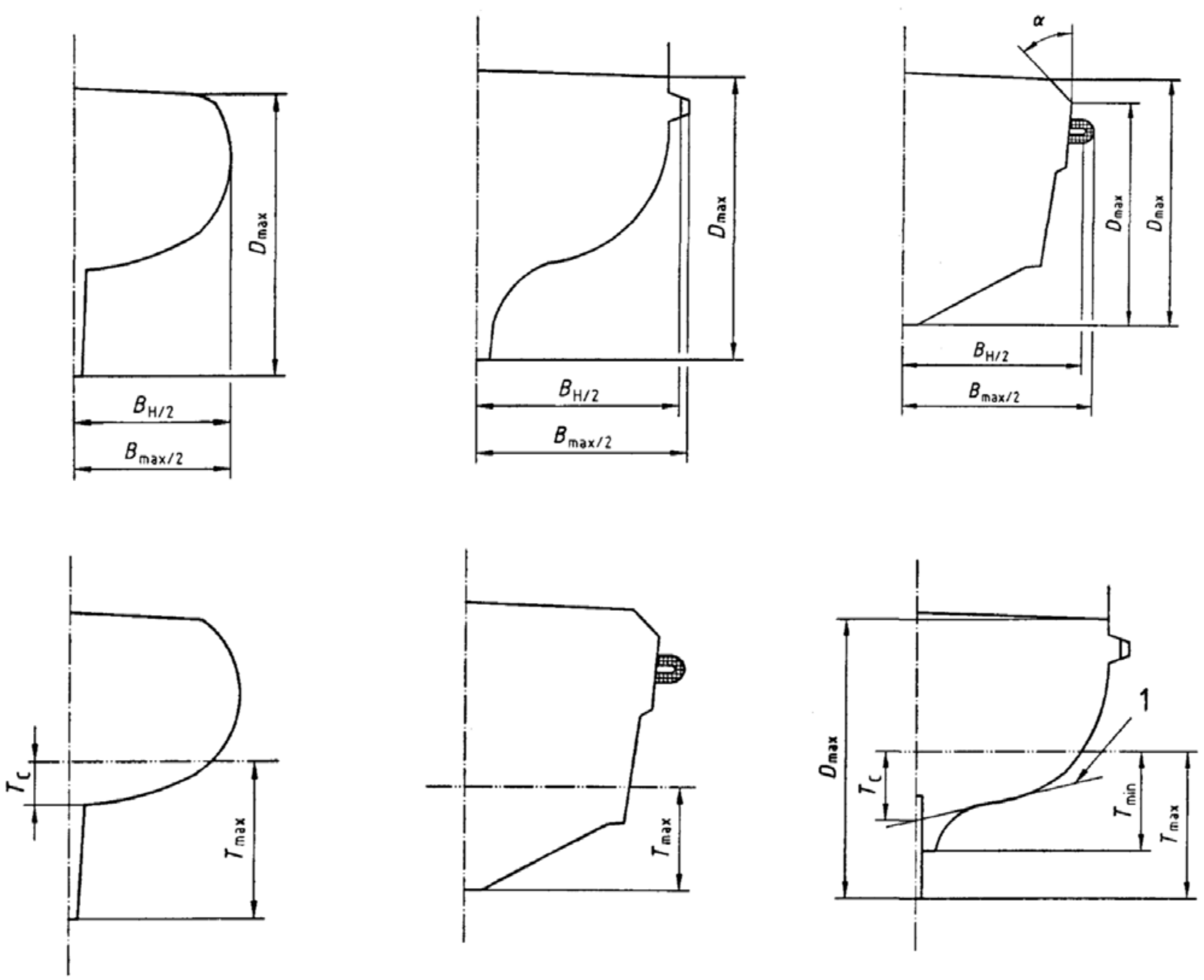


Fig. 3.2.7
Determination of B_{max}, $B_H(B)$, D and $T(d)$

N o t e s : *1* – Tangent to middle frame under hogging condition.
The upper position of D_{max} depends on the inclination between the hull/deck intersection and the actual deck.
Where $a \geq 45°$, the lower position applies, where $a < 45°$, the upper position applies.
$T(d)$ – d shall be used to determine draught in other parts and sections of the present Rules

3.2.16 Maximum draught, T_{max} (d_{max}).

The maximum draught shall be measured to the lowest point of the underwater body or appendage, including centerboards in their lowest position.

3.2.17 Minimum draught, T_{min} (d_{min}).

The minimum draught shall be measured to the lowest point of the craft or non-retractable appendage, whichever is lower. All movable underwater parts shall be in their uppermost possible position

3.2.18 Design draught, T_C (d_c).

Design draught shall be measured between the intersection of the hull with the centerline of the craft at the lowest point of the canoe body. In cases where the keel form cannot be easily separated from that of the hull, the design draught shall be determined by the intersection of the least steep tangent to the hull surface with the centerline plane.

3.2.19 Headroom.

The headroom shall be measured as the vertical distance between the top of the cabin/compartment floor and the underside of the deck beam or deck head (whichever is lower) at the designated position. The manufacturer is free to state the headroom in other locations, e.g. above bunks.

3.2.20 Air draught, H_a.

The air draught shall be measured as the vertical distance between the floatation plane in the light craft condition and the highest point of the craft's structure or mast.

The manufacturer is free to state in the Owner's Manual that the craft owner shall make an allowance for a masthead light and possible fitting of aerial (aerials).

3.2.21 Deadrise angle, β.

The deadrise angle is the angle of the bottom from the horizontal measured athwartship, at a specific position, in degrees. The measurement shall be taken as indicated in Fig.3.2.21.

3.2.22 Projected sail area, A_S.

The projected sail area of a craft, m², is calculated as a sum of the projected profile areas of all sails that may be simultaneously set when sailing to windward which are attached to booms, gaffs, sprits or other spars, plus the foretriangle areas to the outermost forestays permanently attached during operation of the craft to that mast for which suitable sails are carried, without overlaps, luffs and leeches, taken as straight lines.

The foretriangle area for each mast shall be the area given by

$$A_S = I \cdot J / 2 \qquad (3.2.22)$$

where I and J measurements between the forward side of the mast, the aft side of the forestay and the deckline at sidedeck, as shown in Fig. 3.2.22.

Where forestays between masts do not reach the deck, the area of the foretriangle shall be taken as illustrated in Fig. 3.2.22 (P and E), but only if sails are carried that may be set on the stays concerned.

The area of spars is not included in the calculation of the projected sail area except for wing masts.

3.2.23 Volume of the craft, *V*.

The volume, m³, of a craft is given by the following formula:

$$V = V_H + V_S \qquad (3.2.23)$$

where V_H = volume of the hull, in m³;
V_S = volume of the superstructure, in m³.

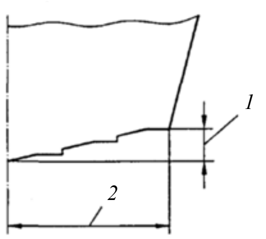
The volume of the craft shall be established for each element either by accepted naval architectural methods or by an approximate assessment according to 3.2.23.1 and 3.2.23.2.

For small boats, the volume may be measured as shown in Fig. 3.2.23.

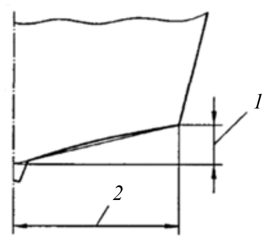
3.2.23.1 Volume of the hull, V_H.

Using the approximate method, the volume of the hull, in m³, may be determined on the basis of measurements taken according to Fig 3.2.23, by the following formula:

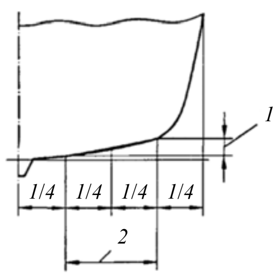
$$V_H = 0{,}15 L_h (B_0 D_0 + B_{20} D_{20} + B_{40} D_{40} + B_{60} D_{60} + B_{80} D_{80} + B_{100} D_{100}). \qquad (3.2.23.1)$$



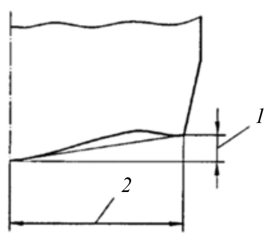
***a)* Straight bottom**
N o t e . Steps and other protrusions are ignored



***b)* Concave bottom plus keel**
N o t e . Deadrise is measured between keel intersection and chine.

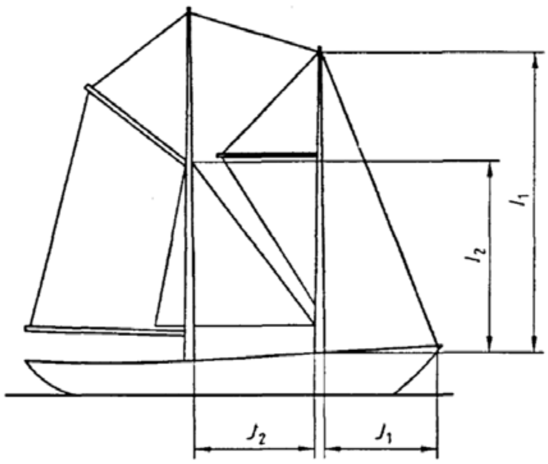


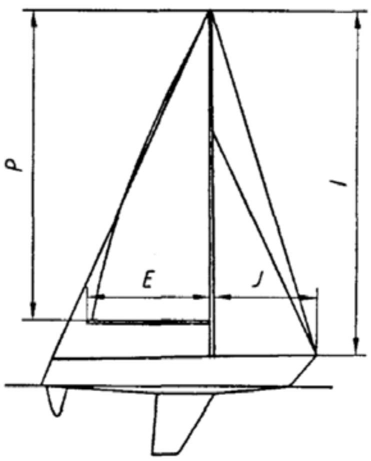
***c)* Convex bottom**
N o t e . Deadrise is measured 1/4 and 3/4 of $B_{H/2}$



***d)* Concave bottom with wing**
N o t e . Deadrise is measured between centerline and outer wing end.

Fig. 3.2.21
Determination of deadrise
Key: *1* – height; *2* – width.
Calculation of deadrise angle: β = arctg (1:2)





N o t e . A wing mast is characterized by its cross-section which shows a smooth transition at the aft end into the sail, thus contributing to its driving force. Cross-sections of masts are usually elliptic; they are less often circular or box-shaped.

Fig. 3.2.22
Measurement of sail area

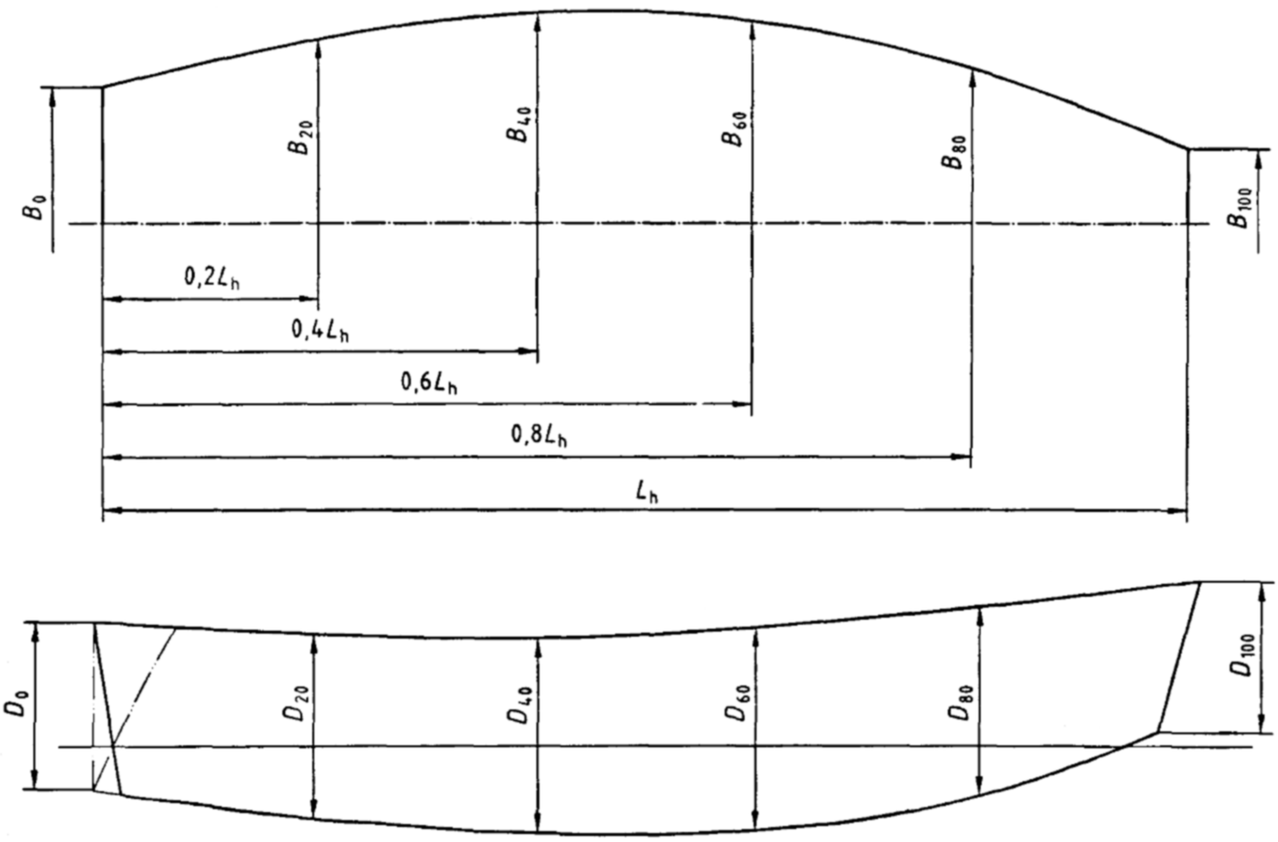


Fig. 3.2.23
Volume measurement

3.2.23.2 Volume of the superstructure, V_S.

The volume of the superstructure, m^3, shall be the sum of the volumes for each part of the superstructure above the sheerline/deck at the side. Any space that is open at no more than one side shall be incorporated in the calculation.

"Open" in this sense means that no more than 10 per cent of the area may be covered.

Volumes of less than 0,05 m^3 shall be omitted.

3.2.24 Net shipping mass, m_N.

The net shipping mass shall include all permanent and loose equipment delivered with the craft by the manufacturer, but no shipping materials.

3.2.25 Gross shipping mass, m_G.

The gross shipping mass is the net shipping mass, as defined in 3.2.24, plus shipping materials such as cradles, support, fastening material and covers.

3.2.26 Light craft mass, m_{LCC} (Δ_{min}).

3.2.26.1 Items of equipment included in m_{LCC}.

The Light craft mass shall include items of equipment as listed below:

.1 all the structural parts, including the ballast keel and/or centerboard/daggerboard(s) and rudder(s);

.2 ballast comprised of removable ballast (whether solid or liquid) when supplied and/or intended by the manufacturer to be carried when the craft is underway;

.3 internal structure and outfitting including bulkheads and partitions, insulation, linings, built-in furniture, flotation material, windows, hatches and doors, upholstery material;

.4 engine and fuel oil/lubricating oil system.

Permanently installed engine and fuel oil/lubricating oil systems.

The permanently installed engine and fuel oil/lubricating oil systems are comprised of inboard engine(s), including all supplies and controls as needed for their operation, and permanently installed fuel oil/lubricating oil systems, including tanks.

Outboard engines.

The mass of craft shall be stated with the mass of the outboard engine(s) as follows:

mass of the heaviest engine(s), as recommended by the craft manufacturer,

irrespective of the fact that the manufacturer may have fitted a lighter engine

related equipment;

mass of any permanently installed fuel oil/lubricating oil system;

mass of engine controls and steering system;

.5 internal equipment, including:

all items of equipment permanently attached to the craft, e.g. tanks (independent

tanks and canisters), sewage and domestic water system/systems, water transfer

and storage equipment, bilge pumping system(s), cooking and heating devices,

cooling equipment, ventilation system(s);

electrical installation and equipment including batteries;

fixed navigational and electronic equipment;

fire fighting equipment;

mattresses, curtains;

.6 external equipment.

For all craft, this includes:

all permanently attached standard or specified deck fittings and equipment,

e.g. guardrails, pulpits and pushpits, bowsprits and their attachments, bathing

platforms, boarding ladders, steering equipment, winches, sprayhood(s),

boat awning(s), cockpit tables, gratings, signal masts;

anchors, anchor warps and chains;

loose external equipment, e.g. fenders, warps, painters.

For craft with sailing rig(s), the mass of the external equipment includes additionally:

mast(s), boom(s), spinnaker poles and other pole(s), standing and running

rigging, working and storm sails where supplied as standard, standard supplies.

3.2.26.2 Items of equipment and other items not included in m_{LCC}:

loose internal equipment, e.g. cutlery, crockery, kitchen utensils, linen;

loose electronic and navigational equipment (e.g. charts);

tools, spare parts;

life-saving and safety equipment, including personal one;

provisions and other stores when intended to be carried;

bilge water;

waste water;

potable water;

fuel oil and lubricating oil;

personal equipment;

life-raft;

dinghy;

crew and passengers;

cargo when intended to be carried.

3.2.27 Performance test mass, m_p.

The performance test mass of a craft shall include all permanently attached standard items of equipment. Further, the craft shall be fitted with all items of loose equipment needed for safe operation of the craft, e.g.:

warps;

anchors/chains/ropes;

working sails;

engine(s);

batteries.

In addition, the masses of the following shall be included:

number of persons needed for the safe operation of the craft;

fuel at least 25 per cent but no more than 50 per cent of the tank capacity of permanently installed fuel tanks, or one portable tank per engine, which shall be at least 50 per cent full at the beginning of each test trial;

personal safety equipment for all people on board.

The performance test mass shall exclude the following masses if not required to perform the test:

fresh water;

waste water;

provisions and other stores;

loose internal equipment, e.g. cutlery, crockery, kitchen utensils, spare parts,

etc.

3.2.28 Mass of the craft when towed on a trailer, m_T.

3.2.28.1 General.

The mass of the craft when towed on a trailer shall only be established for craft advertised as trailerable to allow the owner/user to identify the mass of additional equipment that may be carried without exceeding the trailer capacity.

The mass shall include items of equipment as listed under 3.2.28.2, plus fastenings to secure the craft on the trailer. The mass of the trailer shall be stated separately, even in case where the craft and trailer are constructed/sold by the manufacturer/dealer.

The manufacturer/dealer shall provide a list of parts, components and equipment that are included in the mass, as defined above, and shall state the total sum in kilograms (kg). This may be in the format of the Owner's Manual or itemized descriptions (for items included).

Any items of equipment normally supplied by the manufacturer/dealer not intended to be placed in the craft or on the trailer shall be listed separately.

3.2.28.2 Structure, items of equipment, etc., included in m_T:

.1 structure.

The structure is made up of all structural parts, including ballast keel and/or centerboard/daggerboard(s) and rudder(s).

If loose ballast or parts of the ballast keel are not to be stowed on the trailer, these parts shall be specifically declared and listed under non-included equipment (see 3.2.28.4);

.2 internal structure and accommodation.

The internal structure and accommodation are made of bulkheads and partitions, insulation, lining, built-in furniture, flotation material, windows, hatches and doors, and upholstery material.

.3 internal equipment, including:

all items of equipment permanently attached to the craft, e.g. sewage and

domestic waste water system(s), water transfer and storage equipment, cooking

and heating devices, cooling equipment, ventilation system(s);

electrical installation and equipment, including batteries;

fixed navigational and electronic equipment;

fire-fighting equipment;

mattresses, curtains.

.4 external equipment.

For all craft, this includes:

all permanently attached deck fittings, e.g. guardrails, pulpits and pushpits,

bowsprits and their attachments, bathing platforms, boarding ladders, steering

equipment, winches, sprayhood(s), boat awning(s), cockpit tables, gratings,

signal masts;

anchor(s), anchor warps and chains;

loose external equipment, e.g. fenders, warps, painters.

For craft with sailing rig, this also includes:

mast(s), boom(s), spinnaker and other pole(s), standing and running rigging,

standard working and storm sails, standard stores;

.5 engine and fuel oil/lubricating oil system.

Permanently installed engine and fuel oil/lubricating oil systems.

The permanently installed engine and fuel oil/lubricating oil systems are comprised of inboard engine(s) including all supplies and controls as needed for their operation, and permanently installed fuel oil/lubricating oil systems including tanks.

Outboard engines.

The mass of the craft shall be stated with the mass of the outboard motor(s) and related equipment as follows:

mass of the heaviest engine(s), as recommended by the craft manufacturer,

irrespective of the fact that the manufacturer may have fitted a lighter engine;

mass of any installed fuel oil/lubricating boil system;

mass of engine controls and steering system;

.6 tanks, tank contents:

contents of permanently installed fuel oil/lubricating oil tanks;

portable tanks and their contents;

contents of fresh water tanks.

The mass of the liquids shall be calculated or measured up to the full usable tank volume.

3.2.28.3 Items of equipment not included in m_T:

loose internal equipment, e.g. cutlery, crockery, kitchen utensils, linen;

loose electronic and navigational equipment, e.g. charts, etc;

tools, spare parts;

safety and life-saving equipment, including personal one;

provisions and other stores when intended to be carried;

bilge water;

ballast water;

sewage water;

cargo when intended to be carried.

3.2.28.4 Exclusions, inclusions.

The manufacturer/dealer may exclude items of equipment listed in 3.2.28.2 (inclusions) which shall then be specifically declared in the list of exclusions. These shall not include structural parts of the craft or permanently attached items of equipment needed for the safe operation of the craft.

If intending to include items listed in 3.2.28.3 (exclusions), the manufacturer shall amend the list of items included by adding these items of equipment.

3.2.29 Maximum load (deadweight), m_{MTL} (*DW*).

The term "maximum load", specified in ISO 14946, is to be understood as the "manufacturer's recommended maximum load" determined reasoning from the current standards on disposition and mass of cargoes: people, their effects, stores, etc. making up the maximum load (deadweight) of the craft.

The maximum load shall not exceed the total load that may be added to the light craft mass without exceeding the requirements for stability, freeboard and flotation as defined in the present Rules with consideration for the craft class or in ISO 12217 with due account of the design category of the craft.

3.2.29.1 Definitions.

Seating area – any clear sole space in an open craft or in a cockpit provided that an area measuring 400 mm × 750 mm be available for each person so accommodated

For crafts in design category **C** and **D**, the deck area beside the cockpit may be used for this purpose.

Seat – any surface, horizontal or nearly horizontal, where a person may sit, with minimum dimensions of 400 mm width × 750 mm length. It is recommended that a width of 500 mm be provided.

3.2.29.2 Maximum number of persons.

The maximum number of persons to be carried when the craft is underway shall not exceed:

.1 the number of persons for which the craft has successfully passed the requirements for freeboard, stability and flotation, in accordance with the requirements of the present Rules;

.2 the number of persons for which seating space is assigned by the manufacturer with dimensions as defined in 3.2.29.1.

3.2.29.3 Maximum load (deadweight).

As a minimum, the maximum load (deadweight) shall take into account the mass of the following:

.1 the number of persons at 75 kg each according to 3.2.29.2. Where children are carried as part of the crew, the maximum number of persons may be exceeded provided that each child's mass does not surpass a limit of 37,5 kg and the total persons mass is not exceeded;

.2 basic equipment of $(L_H - 2{,}5)^2$, kg, but not less than 10 kg;

.3 stores and cargo (if any), dry provisions, liquids (consumable liquids not covered by 3.2.29.3.4 or 3.2.29.3.5) and miscellaneous equipment not included in the light craft mass or in 3.2.29.3.2;

.4 consumable liquids (fresh water, fuel, oil) in portable tanks filled to the maximum capacity;

.5 consumable liquids (fresh water, fuel, oil) in permanently installed tanks filled to the maximum capacity;

.6 a life-raft or dinghy when intended to be carried.

3.2.29.4 Owner's Manual.

3.2.29.4.1 The manufacturer shall state in the Owner's Manual the maximum recommended number of persons in accordance with 3.2.29.3.1. Where provision has been made to enable children to replace an adult in accordance with 3.2.29.3.1, where necessary, details of any change to the seating arrangements shall be clearly stated.

3.2.29.4.2 The manufacturer shall state in the Owner's Manual the maximum load recommended by him in accordance with 3.2.29.3. The descriptions of 3.2.29.3.1, 3.2.29.3.5 and 3.2.29.3.6 shall be listed with a note stating that the maximum recommended load (deadweight) includes only these items.

3.3 LOADING CONDITIONS

3.3.1 Test condition.

For the determination of the maneuvering speed and maximum powering, the craft shall be equipped with masses according to 3.2.27.

3.3.2 Ready-for-use condition.

The craft is in ready-for-use condition when it is fully equipped for the intended use with the following:

filled-up fuel oil/lubricating oil tanks;

filled-up fresh water tanks;

water in bait tanks and live wells to their designated limit.

The masses of the liquids shall be measured or calculated up to the full usable tank volume.

The masses of the outboard motors and batteries shall correspond to the highest power rating with which the craft is intended to be equipped and to operate.

3.3.3 Fully loaded ready-for-use condition.

The craft is equipped and loaded according to 3.3.2, but also includes:

the mass of the persons (at 75 kg each) the boat is designed to carry, in their normal seating position in the cockpit;

the mass of personal equipment and basic equipment of the craft of $(L_H - 2{,}5)^2$, kg, but not less than 10 kg;

the mass of a life-raft and/or dinghy when intended to be carried.

The designer/manufacturer shall declare the mass and the related draught of the craft for this loading position.

3.4 DEVIATION OF THE CRAFT DATA

3.4.1 Published data.

Data is considered published if stated in the Owner's Manual or if used as a specification in brochures or other written material used for marketing the craft.

Published data shall be within the following tolerances:

Published data	Tolerance[1], %
Linear dimensions, rigid craft	± 1
Sail areas	± 5
Displacement	± 10
Volumes	± 5
Masses	± 5
Speed[2]	± 5

[1] Certain critical data will effect the permissible tolerances, e.g. maximum beam or maximum mass of the craft when towed on the trailer. In these cases the plus-tolerance does not apply.

[2] This speed relates to the craft in the test condition according to 3.2.27 if no other mass or loading condition is specified.

3.4.2 Preliminary specification.

Preliminary specification of dimensions, displacement and masses shall be identified by an appropriate term such as "preliminary", "approximate", "estimate", "varies", etc. If this applies, the tolerance shall not exceed ± 3% on dimensions and ± 15% on masses, displacement and volumes.

3.5 OWNER'S MANUAL

3.5.1 Each pleasure craft shall be provided with an Owner's Manual which shall contain necessary information for safe operation of the craft, equipment and systems with the consideration for the environment.

The information does not need to include servicing information other than the routine checks intended to be carried out for operating the craft. The Owner's Manual shall contain a check-list of actions to be undertaken before use.

The Owner's Manual shall be produced in hard copy in a language acceptable or required in the country of intended use. It may be multilingual.

The Manual shall contain an index or table of contents referenced with page numbers, if it is more than four pages long. Information may be presented as words, symbols or pictograms.

The Owner's Manual may be also produced in electronic format provided that the following conditions are met:

data protection from editing is ensured;

the Manual shall be installed in a computer intended for this purpose, connected to the main and emergency sources of power supply, which is accessible for use at all times during operation of the craft;

brightness of the data display on the computer monitor shall not interfere with

watch keeping at night;

the Manual shall also be stored in a data backup software.

The following data, where relevant, shall be indicated in the Owner's Manual, which is specified in ISO 10240:2004:

dimensions, maximum;

dimensions of the hull;

draught(s);

air draught;

tank capacities, including usable tank volume and dead stock;

projected sail area;

performance test mass (motor craft only);

mass for trailering (if applicable);

mass in the light craft condition;

mass in the fully loaded ready-for-use condition;

maximum load (deadweight).

Other necessary information is provided also in other Parts of the present Rules.

3.6 BUILDER'S PLATE

3.6.1 General.

These requirements apply to small pleasure craft built inside the EC countries as well as to craft built in other countries but intended for operation in the EC countries. As the small pleasure craft market is operating all worldwide, an ISO 14945 standard has been created, thus making the requirements of the Builder's Plate known to manufactures in the countries inside and outside the EC to facilitate marketing the small pleasure craft to the market in EC countries without any additional requirements as to labeling.

3.6.2 Definitions and explanations.

For the purpose of this Chapter, the following definitions and explanations apply:

Design categories are description of the sea and wind conditions for which the craft is assessed to be suitable.

Depending on the sailing conditions, the following design categories apply:

A: Ocean – The craft is designed for extended voyages where conditions may exceed wind force 8 (Beaufort scale) and significant wave heights of 4 m and above but excluding abnormal conditions, and craft largely self-sufficient.

B: Offshore with maximum proceeding from the shore – The craft is designed for offshore voyages where conditions up to, and including, wind force 8 and significant wave heights up to, and including, 4 m may be experienced.

C: Inshore – The craft is designed for voyages in coastal waters, large bays, estuaries, lakes and rivers where conditions up to, and including, wind force 6 and significant wave heights up to, and including, 2 m may be experienced.

D: Sheltered waters – The craft is designed for voyages on sheltered coastal waters, small bays, small lakes, rivers and canals when conditions up to, and including, wind force 4 and significant wave heights up to, and including, 0,3 m may be experienced, with occasional waves of 0,5 maximum height, for example from passing craft.

Builder's Plate is a label or plate do display basic user information related to the small pleasure craft to which it is affixed.

Person's symbol is figure of a person with a mass of 75 kg.

S u i t c a s e s y m b o l is figure of a suitcase representing a mass of load that may be carried when the craft is underway, such as personal equipment, personal safety equipment, spare parts, tools, dry provisions, fishing tackle, portable tanks, etc.

O u t b o a r d e n g i n e s y m b o l is figure of an outboard engine representing the total maximum recommended outboard engine(s) mass.

N o t e . Mass shall be expressed in kilograms (kg).

3.6.3 General requirements.

3.6.3.1 Each pleasure craft shall carry a Builder's Plate displaying the Manufacturer's information.

3.6.3.2 Material and fitting.

The Builder's Plate shall be a rigid plate or flexible label affixed to the craft in such a way that it can only be removed with the use of tools. Alternatively, the craft shell may be used for the marking.

3.6.3.3 Marking.

Characters and other markings on the Builder's Plate shall be carved, stamped-burned, embossed, moulded, etched, printed, affixed by permanently setting adhesive, or be applied by other suitable means. Alternatively, the information may be printed or etched on the craft itself. The characters shall be contrast or be on a different level to the background so that the alterations will be obvious.

The colours applied to the label shall be fade resistant.

3.6.3.4 Size of characters.

The required information characters shall be at least 5 mm in height.

Other characters shall be at least 3 mm in height.

3.6.3.5 Size of pictograms and symbols.

Pictograms and symbols shall be at least 8 mm in height.

3.6.3.6 Location.

The Builder's Plate shall be readily visible, preferably in the cockpit or near the main steering position. In any case, the Builder's Plate shall be separate from the hull identification number.

3.6.4 Displayed information.

3.6.4.1 The following information shall be displayed on each Builder's Plate:

.1 manufacturer's name;

.2 craft design category;

.3 manufacturer's recommended maximum load, excluding the mass of the contents of fuel and water tanks when full, with the person symbol and the suitcase symbol;

.4 for craft which are powered by outboard engine(s), the mass of the engine(s), with the outboard engine symbol;

.5 maximum number of persons that the craft is designed to carry while underway, with the person symbol.

3.6.4.2 Where the manufacturer wishes to assign more than one design category to a boat, the display shall be such that the maximum number of persons and the maximum load are clearly identified to belong to a specific design category.

3.6.4.3 The manufacturer is free to provide additional information in the label. The inclusion of this additional information shall not impair the legibility of the minimum required information and shall be separated from it preferably by a line or similar delimeter.

4 CRAFT DESIGN CATEGORY AND HYDROMETEOROLOGY

4.1 GENERAL

4.1.1 Depending on the craft design category and the owner's needs, the pleasure craft supposedly may navigate both in the sea areas and on the inland waterways.

4.1.2 The design category of a pleasure craft, as defined in 4.2, is associated with the current classification of various water areas established by the following regulatory documents:

.1 Directive 94/25/EC;

.2 Rules for the Classification and Construction of Sea-Going Ships;

.3 United Nations. Economic Commission for Europe. Resolution No. 61 "Recommendations on Harmonized Europe-Wide Technical Requirements for Inland Navigation Vessels", 2006[1].

4.1.3 To operate pleasure craft on water areas of oceans, seas, classified inland waterways, as well as on water areas and basins which are not classified inland waterways (refer to Section 5), the following craft design categories are established: **A**, **B**, **C** and **D**, having regard to the following provisions:

.1 the design category of a pleasure craft is defined by sea and wind conditions encountered by the craft while underway, including waves from passing vessels for craft in design category **D**, with restriction on maximum distance from shore or place of refuge;

.2 interrelation between the wind and seas with an account taken of the distance from the shoreline, is assumed as follows:

for ocean and sea areas, relaying on the basic characteristics of a fully developed sea from the Pierson-Moskowits spectrum given in Table 4.1.3.2;

[1] Hereinafter referred to as "UN ECE Resolution No. 61".

Table 4.1.3.2

Basic characteristics of the fully-arisen ocean and sea waves (by Pearson-Moskowits)

Wind force according to Beaufort Scale at a height of 6,0 m			Sea state number	Wave height, m		Wave period, s	Wave length, m	Fetch length, miles	Fetch time, h
Beaufort number and description	Wind speed, m/h: limits	Wind speed, m/h: measurements		$h_{1/3}$	$h_{3\%}$				
1 light air	0,6 – 1,7	1,0	0	< 0,05	< 0,10	0, 3-1,9	0,3	5	0,3
2 light breeze	1,8 – 3,3	2,6	1	0,15	0,20	0,4-2,8	2,0	8	0,6
3 gentle breeze	3,4 – 5,2	4,4 5,1	2	0,40 0,55	0,52 0,72	0,8-5,0 1,0-6,0	6,1 8,2	9,8 10	1,7 2,4
4 moderate breeze	5,3 – 7,4	6,2 7,0	3 3	0,79 1,0	1,0 1,3	1,0-7,0 1,4-7,6	12 16	18 24	3,8 4,8
5 fresh breeze	7,5 – 9,8	8,2 9,3 9,8	4 4-5 4-5	1,4 1,8 2,0	1,9 2,4 2,6	2,0-8,8 2,5-10,0 2,8-10,6	22 27 30	40 55 65	6,6 8,3 9,2
6 strong breeze	9,9 – 12,4	10,3 11,3	5 5	2,2 2,7	2,9 3,5	3,0-11,1 3,4-12,2	35 40	75 100	10 12
7 moderate gale	12,5 – 15,2	12,6 13,4 14,4	5-6 6 6	3,3 3,7 4,4	4,4 4,9 5,7	3,8-13,6 4,0-14,5 4,5-15,5	50 55 65	140 180 230	15 17 20
8 fresh gale	15,3 – 18,2	15,7 16,4 17,5	6-7 6-7 7	5,1 5,7 6,4	6,8 7,5 8,5	4,8-17,0 5,0-17,5 5,5-18,5	80 85 100	290 340 420	24 27 30
9 strong gale	18,3 – 21,5	19,0 20,6	7-8 8	7,6 8,9	10,0 11,7	6,0-20,5 6,5-21,7	115 135	530 710	37 42

for inland waterways, relaying on their classification by the navigation **zones 1**, **2** and **3** in accordance with the UN EEC Resolution No.61, as well as the interrelation between characteristics represented in Fig. 4.1.3.2.

4.1.4 For all design categories **A** and **B**, specified in 4.2.1, the wind and wave characteristics are assumed in accordance with the Register Rules for the Classification and Construction of Sea-Going Ships with due regard to the norms of Directive 94/25/EC.

4.1.5 For all design categories C, specified in 4.2.2, the wave characteristics are assumed in accordance with UN EEC Resolution No.61 with due regard to the wind force according to Directive 94/25/EC.

For all design categories **C** the wave characteristics are assumed for an open water area exposed to the shore wind force or for an area sheltered by the nearby shores.

In this case, it is dealt with the deep water areas with respect to the wave heights not associated with the breaking and head (broken water) waves.

4.1.6 For design category **D**, specified in 4.2.3, the sea state characteristic is assessed as specified by Directive 2003/44/EC of the European Parliament and of the Council of 16 June 2003.

4.2 DESIGN CATEGORIES

4.2.1 Ocean and offshore.

Design category A – ocean navigation without any restrictions (typical are wave heights of 10,0 m with 3 per cent probability of over-topping and wind force 10).

Design category A1 – navigation in **offshore areas** in the seas with a wave height of 8,5 m with 3 per cent probability of over-topping and wind force more than 8, with the craft proceeding not more than 200 miles from the place of refuge and with an allowable distance between the places of refuge not more than 400 miles.

Design category A2 – navigation in **offshore areas** in the seas with a wave height of 7,0 m with 3 per cent probability of over-topping and wind force more than 8, with the craft proceeding not more than 100 miles from the place of refuge and with an allowable distance between the places of refuge not more than 200 miles.

Design category B – navigation in **offshore areas** in the seas with a wave height of 5,5 m with 3 per cent probability of over-topping and wind force not more than 8, with the craft proceeding not more than 50 miles from the place of refuge and with an allowable distance between the places of refuge not more than 100 miles.

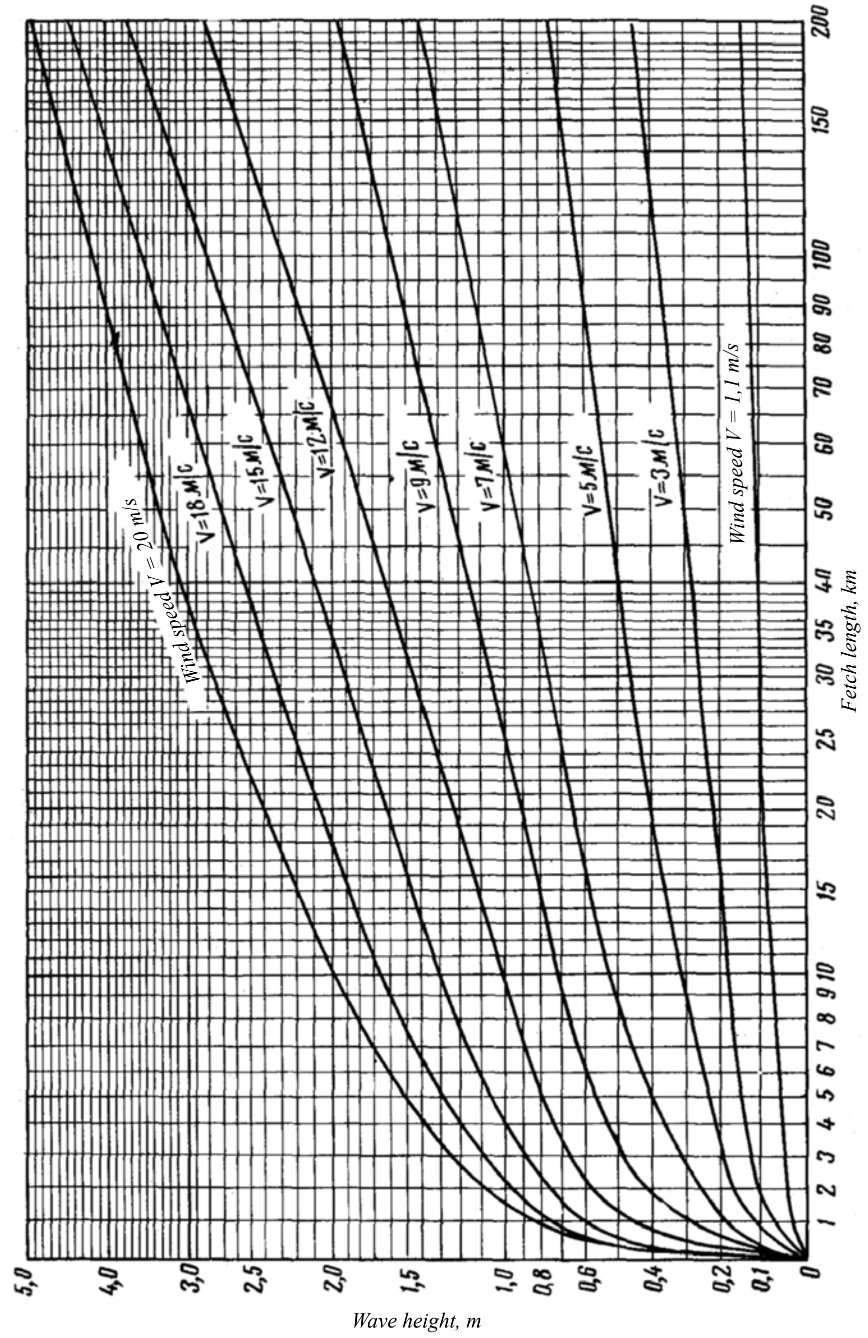


Fig. 4.1.3.2
Basic characteristics of development of the wind waves with 1 per cent probability of over-topping on shallow water areas of inland waterways

4.2.2 Inshore.

Design category **C** – inshore navigation under favourable weather conditions in the seas with a wave height of 3,0 m with 3 per cent probability of over-topping and wind force not more than 6, with the craft proceeding not more than 20 miles from the place of refuge, within the sea coast, where an emergency assistance may be rendered to the craft, or without any restrictions on the inland waterways within **zones 1**, **2** and **3**.

Design category **C1 –** inshore navigation under favourable weather conditions in the seas with a wave height of 2,0 m with 3 per cent probability of over-topping and wind force not more than 6, with the craft proceeding 5 miles from the shoreline and 15 miles from the place of refuge, within the sea coast**,** where an emergency assistance may be rendered to the craft, or without any restrictions on the inland waterways within **zones 1**, **2** and **3**.

Design category **C2** – inshore navigation under favourable weather conditions in the seas with a wave height of 1,2 m with 5 per cent probability of over-topping and wind force not more than 6, with the craft proceeding 3 miles from the shoreline and 6 miles from the place of refuge, within the inland waterways of **zone 1** or the sea coast**,** where an emergency assistance may be rendered to the craft, or without any restrictions on the inland waterways within **zones 2** and **3**.

Design category **C3** – inshore navigation under favourable weather conditions in the seas with a wave height of 0,6 m with 5 per cent probability of over-topping and wind force not more than 6, with the craft proceeding up to 1 km from the shoreline for motor, sailing and towed craft, within the inland waterways of **zone 1** and **2** or the sea coast**,** where an emergency assistance may be rendered to the craft, or without any restrictions on the inland waterways within **zone 3**.

4.2.3 Sheltered.

Design category **D** – sheltered navigation under favourable weather conditions in the seas with a wave height of 0,3 m with 5 per cent probability of over-topping and wind force not more than 4, with the craft proceeding up to 200 miles from the shoreline within the inland waterways of **zones 1**, **2** and **3** or the sea coast, where an emergency assistance may be rendered to the craft, or without any restrictions on the non-classified inland waterways.

4.3 HYDROMETEOROLOGY

4.3.1 General.

The principles of the hydrometeorology for the small pleasure craft are based on the following provisions:

.1 wind pressure for the pleasure craft will be determined with due account of the position of the windage area center above waterline of the craft when on wave top with reference to the design category of the craft;

.2 craft will operate in the seas with an wave height *h* to length λ ratio less than 1/8 and will not operate in water areas which feature chopping sea, estuary waves or wave breaking in shallow waters;

.3 restrictions assigned to the design categories **B**, **C**, **C1**, **C2** and **D**, specified in 4.2 and based on the applicable standards of the current rules of various classification societies and on the data given in Table 4.1.3.2 or Fig. 4.1.3.2 provide for timely and safe proceeding of the craft to the place of refuge or to shore.

4.3.2 Definitions and explanations.

Wind velocity is expressed by the number of meters covered by the air mass in one second.

Squall is a sudden and strong wind gust or drastic temporal change of the wind direction or drastic increase of its velocity.

Waves on the water surface as for their origination (forces producing waves) are subdivided into the following types:

wind waves are wind-produced waves. The wind waves are asymmetrical, their windward slope is smooth, leeward slope is steep;

broken water is a confused swell generated when the direct waves encounter the reflected waves;

river mouth waves are waves generated in the estuaries of rivers where they flow into the seas, lakes and rivers in way of bars;

and are determined by the following parameters:

wave length (λ) is the horizontal distance between the adjacent crests or troughs of waves, m;

wave height (*h*) is the vertical distance from the wave through to top, m;

wave speed (s_w) is the distance traversed by the wave crest or trough in a unit time in the direction of the wave motion;

wave period (τ) is the time lapse during which two adjacent wave crests pass successively through the same point, *seconds*;

wave steepness (α) is the angle of the wave slope. The wave steepness is characterized also by the wave height *h* to length λ ratio which depend on the depth of the water area and is generally less than 1/15 in seas and oceans and less than 1/10 in water storage basins and lakes with the maximum value being of 1/8;

wave front is the line being perpendicular to the direction of wave motion.

4.3.3 Measurement of sea state.

Degree of sea state is measured on a 9-point scale, a unified sea scale, which has been established since 1 August 1975 by the Directive of the Hydrometeorological services Head Office (HMSHO) under the Council of Ministers of the USSR see Table 4.3.3.

The characteristic relationship between the wind and sea state is given in Table 4.1.3.2 and in Fig. 4.1.3.2.

Table 4.3.3

Sea scale

Wave height (limits), m	Sea state	Characteristic of the sea	Indications to determine water surface condition
0	0	Calm	Like a mirror
Up to 0,25	I	Light airs	Ripples without crests
0,25-0,75	II	Slight	Small wave crests begin to break., the foam is not white, but of glassy appearance
0,75-1,25	III	Moderate	Small wavelets. Crests of some waves break. Scattered white horses
1,25-3,5	IV		Waves take a well-marked shape. Fairly frequent white horses.
2,0-3,5	V	Very rough	High crests. White foam crests are very frequent. Wind begins to blow foam away from wave crests
3,5-6,0	VI		Crests outline long rollers of wind waves; foam blown by wind away from crests begins to cover the wave slopes in streaks.
6,0-8,5	VII	Very high	Long streaks of foam blown away by wind cover the wave slopes and, merging in some areas, reach wave hollows
8,5-11,0	VIII		Foam covers wave slops in dense wide merging streaks with the resulting formation of white foam with some areas in the wave hollows free of foam
11,0 and over	IX	Phenomenal	Sea surface is covered by dense foam. Large amounts of airborne spray and spindrifts reduce considerably visibility.

4.3.4 Wind-load force measurement.

Wind speed is measured on 12-point scale at 10,0 m above the water surface , in accordance with Beaufort wind force scale, see Table 4.3.4.

The design wind pressure is determined as a sum of the statistic (average) and dynamic (pulsating) components.

The design wind pressure is determined with reference to the vertical position of the windage area cen-

Table 4.3.4

Wind speed according to Beaufort wind force scale

Wind		Wind speed (average) m/s	Sea condition
scale number	description		
0	Calm	0-0,2 (0)	Flat
1	Light air	0,3-1,5 (1,0)	Ripples without crests
2	Light breeze	1,6-3,3 (3,0)	Small wavelets. Crests of glassy appearance, not breaking.
3	Gentle breeze	3,4-5,4 (5,0)	Large wavelets. Crests begin to break; scattered whitecaps
4	Moderate breeze	5,5-7,9 (7,0)	Small waves with some breaking crests. Fairly frequent white horses.
5	Fresh breeze	8,0-10,0 (9,0)	Moderate waves of some length. Many white horses. Small amount of spray
6	Strong breeze	10,1-13,8 (12,0)	Large waves begin to form. White foam crests are very frequent. Some airborne spray is present. Wind begins to blow foam away from wave crests.
7	High wind	13,9-17,1 (15,0)	Sea heaps up. Some foam from breaking waves is blown into streaks along wind direction. Moderate amounts of airborne spray.
8	Fresh gale	17,2-20,7 (19,0)	Moderately high waves with breaking crests forming spindrift. Well-marked streaks of foam are blown along wind direction. Considerable airborne spray..
9	Strong gale	20,8-24,4 (23,0)	High waves whose crests sometimes roll over/ Dense foam is blown along wind direction. Large amounts of airborne spray may begin to reduce visibility.
10	Storm, Whole gale	24,5-28,5 (27,0)	Very high waves with overhanging crests. Large patches of foam from wave crests give the sea a white appearance. Considerable tumbling of waves with heavy impact. Large amounts of airborne reduce cisibility.
11	Violent storm	28,6-32,0 (31,0)	Exceptionally high waves. Very larges patches of foam cover water surface. Sea is completely whitewith foam and spray. Horizontal visibility is minimum.
12	Hurricane	Above 32,0	

ter with consideration for the wind wave heights which have been defined by the present Rules for the navigation area corresponding to the assigned Register class as required in Part IV "Stability, Reserve of Buoyancy and Freeboard".

4.3.4.1 Determination of the wind pressure static component.

The static component of the wind load W_{st}, in Pa, is determined by the formula

$$W_{st} = 0{,}732\,k\,v_0^2 \quad (4.3.4.1)$$

where v_0 – wind speed at 10 m above the water surface to be assumed as an average of the wind speed range specified in Table 4.3.4;
k – factor accounting for the change in the wind pressure throughout the height and assumed to be equal to:
0,75 for heights of 5,0 m and less;
1,0 for heights of 10,0 m and more.

The intermediate values are determined by linear interpolation.

4.3.4.2 Determination of the wind pressure dynamic component.

The dynamic component of the wind load W_{dm}, in Pa, is determined by the formula:

$$W_{dm} = W_{st}\zeta\eta \quad (4.3.4.2)$$

where ζ = pulsation coefficient of wind pressure assumed to be equal to:
0,85 for heights of 5,0 m and less;
0,76 for heights of 10,0 m;
0,69 for heights of 20,0 m.
The intermediate values are determined by linear interpolation.
η = correlation factor of the wind pressure pulsations assumed in accordance with the data of Table 4.3.4.2.

Table 4.3.4.2

Correlation factor of the wind pressure pulsations

Size of an object perpendicularly to wind direction	Height of windage area center above waterline, m		
	2,5	5,0	10
0,1	0,95	0,92	0,88
5,0	0,89	0,87	0,84
10	0,85	0,84	0,81
20	0,80	0,78	0,76
40	0,72	0,72	0,70

Note. The intermediate values are determined by linear interpolation.

5 CATEGORIES OF INLAND WATERWAYS

5.1 Classification of the European inland waterways by navigation zones corresponds to the adopted UN EEC Resolution No. 61 which includes the following provisions:

.1 navigation zone is defined by the maximum significant wave height corresponding to the wave with 5 per cent probability of over-topping:

zone 1 (wave height of up to 2,0 m);
zone 2 (wave height of up to 1,2 m);
zone 3 (wave height of up to 0,6 m);

.2 significant wave height means the average of heights of 10 per cent of the total number of waves having the greatest heights measured between wave trough and wave crest, observed over a short period.

5.2 The list of the European inland waterways divided geographically into **zones 1**, **2** and **3**, is given in Appendix 1.

Rivers, lakes and water basins located in European territory and not listed in Appendix 1, belong to unclassified waterways with characteristics of sheltered water area.

APPENDIX

LIST OF EUROPEAN INLAND WATERWAYS DIVIDED GEOGRAPHICALLY INTO ZONES 1, 2 AND 3

Zone 1

Germany

Ems: from a line linking Delfzijl church tower and Knock lighthouse towards the open sea to the parallel of latitude 53°30'N and longitude 6°45'E, i.e. slightly seawards from the lightening place for dry-cargo carriers in the Alte Ems[1].

Poland

Pomorska Bay: to the south of the line linking the headland of Nord Perd on the Rűgen Island and the Niechorze lighthouse.

Gdansk Bay: to the south of the line running from the Hel lighthouse to the Krynica lighthouse.

Russian Federation

Vygozero.

Volgogradskoe Reservoir: from the Uvek bridge to the dam at the Volgograd hydroelectric power station.

Volgokaspiysky Canal: from buoy 217 (146,0 km) to the Astrakhan lighthouse.

Votkiskoe Reservoir, from the Chastye wharf to the dam at the Votkinsk hydroelectric power station.

Don: from Azov to the port of Taganrog.

Kamskoe Reservoir: from Berezniki to the dam at the Kama hydroelectric power station.

Kuibyshevskoe Reservoir: along the Volga river from the village of Kamskoe Ustye to the dam at the Kuibyshev hydroelectric power station; along the Kama river from Chistopol to the village of Kamskoe Ustye;

Mezen: from the mouth of the Bolshaya Chetsa river to the Mezen entrance buoy.

Nizhne-Kamskoe Reservoir: from the town of Ust-Belsk (1766 km) to the dam at the Lower Kama hydroelectric power station.

Pechora: from the Alekseevsky Island to the line between the Cape of Bolvansky. Nos- northern extremity of the Lovetsky Island.

Rybinskoe Reservoir: with the exception of the northern section, from Cherepovets to the village of Vichelovo.

Northern Dvina: along the Maymaksan from the village of Lapominka to the southern extremity of the Mudiug Island, along the Murmansk branch to the Kumbysh Island.

Tsimlyanskoe Reservoir: from Pyatiizbyan roadsteads to the dam at the Tsimlyanskaya hydroelectric power station.

Ukraine

Dnipro-Bugsky Lyman: up to the port of Ochakiv.

Pivdenny Buh: downstream of Nykolaiv sea port.

Kakhovske Reservoir: from the dam of the Kakhovska hydroelectric hydro-electric power station to Bilenka wharf (180 km).

Kremenchuzke Reservoir: from the dam at the Kremenchuzka hydroelectric power station to the Topylivka village (70 km).

Zone 2

Germany

Ems: from a line across the river Ems near the entrance to Papenburg harbour between Diemer Schöpfwerk and the opening of the dyke at Halte as far as a line linking Delfzijl church tower and Knock lighthouse[1].

Jade: inside a line linking the Schillinghörn upper range light and the Langwarden church tower.

Weser: from the Bremen railway bridge to a line linking Langwarden and the Cappel church towers with the side branches: Westergate, Rekumer Loch, Rechter Nebenarm and Schweiburg.

Elbe: from the lower limit of the port of Hamburg to a line linking the Döse beacon and the north-western point of the Hohes Ufer (Dieksand) with the Nebenelben as well as the tributaries: Este, Lühe, Schwinge, Oste, Pinnau, Krückau and Stör (in each case from the barrage to the mouth).

Meldorfer-Hafen Bucht: inside a line linking the north-western point of the Hohes Ufer (Dieskland)and the Büsum west pier head.

Eider: from the Gieselau to the Eider barrage.

Flensburger Förde: inside a line linking the Kekenis lighthouse and the Birknack.

Schlei: inside a line linking the Schleimünde pier heads.

Eckernförder Bucht: inside a line linking Bocknis-Eck to the north-eastern point of the mainland near Dänisch Nienhof.

Kieler Förde : inside a line linking the Bülk lighthouse and the Laboe naval memorial.

Nord-Ostsee-Kanal (Kiel Canal): from the line linking the Brunsbüttel pier heads to a line linking the entrance lights of Kiel-Holtenau including Obereidesee with Enge, Audorfer See, Bergstedter See, Schirmauer See, Flemhuder See and Achterwehrer Schiffahrtskanal.

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[1] To be applied to ships registered in another country as provided in the Ems-Dollard Treaty, Article 32 of 8 April 1960 (Federal Law Gazette 1963, II, page 602).

Trave: from the railway bridge and the Holsten Bridge (Stadttrave) in Lübeck to a line linking the two outer pier heads at Travemünde including Pötenitzer Wiek and the Dassower See.

Leda: from the entrance to the outer harbour of the Leer sea lock to the mouth.

Hunte: from the Oldenburg harbour and from 140 km downstream of the Amalienbrücke in Oldenburg to the mouth.

Lesum: from the Bremen-Burg railway bridge to the mouth.

Este: from the Buxtehude lock downstream to the Este barrage.

Lühe: from the mill 250 m upstream from the Marschdamm-Horneburg road bridge to the Lühe barrage.

Schwinge: from the foot-bridge downstream of the Güldenstern bastion at Stade to the Schwinge barrage.

Freiburger-Hafenpriel: from the Freiburg/Elbe lock to the mouth.

Oste: from the Bremervörde mill dam to the Oste barrage.

Pinnau: from the Pinnederg railway bridge to the Pinnau barrage.

Krückau: from the Elmshorn water mill to the Krückau barrage.

Stör: from the Rensing tide gauge to the Stör barrage.

Wismarbucht, Kirchsee, Breitling, Saltzhaff and Wismar: area limited from the seaward by a line linking Hohen Wieschendorf Huk and the Timmerdorf light as well as the Gollwitz light on the Poel Island and the southern point of Wustrow Peninsula.

Unterwarnow and Breitling: area limited from the seaward by a line linking the northernmost points of the western, central and eastern piers of Warnemonde.

Waters between the mainland and the Darss and Zingst peninsulas as well as the Hiddensee and Rügen islands (including Stralsund port area): water area limited from the seaward between:

the Zingst peninsula and the island of Bock by the parallel of latitude 54°27'N;

the islands of Bock and Hiddensee by a line linking the northern point of the island of Bock and the southern point of the Hiddensee island;

the island of Hiddensee and the island of Rügen (Bug) island by a line linking the south-eastern point of Neubessin with Buger Haken.

Greifswalder Bodden and Greifswald port area including the river Ryck: water area limited from the seaward by a line linking the eastern point of Thiessower Haken (Südperd) with the eastern point of the Ruden island and further with the northern point of the island of Usedom (54°10'37''N, 13°47'51''E).

Waters between the mainland and the island of Usedom (Peenestrom including Wolgast port area, Achterwasser, Stettiner Haff): water area limited in the east by the border between the Federal Republic of Germany and the Republic of Poland in the Stettiner Haff.

Netherlands

Dollard.

Eems.

Waddenzee: including the links with the North Sea.

IJselmeer: including the Markermeer and the IJlmeer, but excluding the Gouwzee.

Rotterdam Waterweg and the Scheur.

Hollands Diep.

Harringvliet and Vuile Gat, including the waterways between Goeree-Overflakkee on the one hand, and Voorne-Putten and Hoekse Waard on the other.

Hellegat.

Volkerak.

Krammer.

Grevelingenmeer and Brouwershavense Gat, including all waterways between Schouwen-Duiveland and Goeree-Overflakkee

Keten, Mastgat, Zijpe, Eastern Scheldt and Roompot, including the waterways berween Walheren, Noord-Beveland and Zuid-Beveland on the one hand and Schouwen-Duiveland and Tholen on the other hand, excluding the Scheldt-Rhine Canal.

Scheldt and Western Scheldt and its mouth on the sea: including the waterways between Zeeland-Flanders on the one hand and between Walheren-Zuid Beveland on the other, excluding the Scheldt-Rhine Canal.

Breediep.

Beer Canal and adjacent ports.

Caland Canal, west of Benelux port.

Krabbencreek.

Poland

Oder: from Szczecin to Swinoujscie, including the Szczecin Inlet (from the border with Germany) and the Kemienski Inlet.

Zaliv Wislany: up to the Polish/Russian border.

Mazuri Lake Area: covering the Sniardwy, Niegocin and Mamry Lakes.

Republic of Moldova

Dubossarskoe Reservoir .

Koshteshtskoe Reservoir.

Russian Federation

Belaya: from Yamalinsky Yar (1786 km) to the mouth.

White Sea access canal to the entrance buoy.

Veselovskoe Reservoir.

Gulfs of Visla and Kalinigrad including the sea port of Kaliningrad and the canal to the line between the ends of the southern and northern moles of the port of Baltiysk.

Volga: from the city of Tver to the town of Koprino (including Ivankovskoe and Uglichkoe reservoirs), from the dam at the Rybinsk hydroelectric power station to the Elnat mouth, from the dam at the Gorkovskaya hydro-electric power station to the Sura river mouth, from the dam at the Cheboksary hydro-electric power station to the village of Kamskoe Ustye, from the dam at the Kuibyshevskaya hydro-electric power station to the Syzran bridge, from the dam of the Saratov hydro-electric power station to the Uvek bridge, from the dam at the Volgograd hydro-electric power station to the town of Krasnye Barricady.

Volga-Baltic Canal: from the Onega Lake to the dam at the Sheksna hydro-electric power station, including the Sizmin flooding.

Volgo-Donskoy Canal: from the city of Volgograd to Pyatizbyanskiye roadsteads.

Volgo-Kaspiysky canal: from the town of Krasnye Barricady (0 km) to the buoy 217 (146 km).

Gorkovskoe Reservoir.

Don: from Rostov-na-Donu to Azov.

Ivankovskoe Reservoir.

Kama: from the dam at the Kama hydroelectric power station to the Chastye wharf, from the dam at the Votkinsk hydroelectric power station to the town of Ust-Belsk (1766 km), from the dam at the Lower-Kama hydroelectric power station to the city of Chistopol.

Canal im. Moskvi; from the Bolshaya Volga wharf to lock No.7.

Krasnodarskoe Reservoir.

Kubenskoe Lake.

Gulf of Kurshsky: to the line between the ends of the south and north moles of the entrance gate to the port of Klaipeda.

Mezen: from the city of Mezen to the Bolshaya Chetsa river mouth.

Neva: from the source to the bounder of the inland waterways, namely: along the Bolshaya Neva river to the Blagoveshchensky bridge; along the Malaya Neva river to the alignment of the 1st line of the Vasilevsky island ; along the Bolshaya Nevka river to the alignment of the spit of the Elagin island; along the Srednyaya Nevka river to the upper cape of the Chukhonka river mouth (the entrance to the rowing canal); along the Malaya Nevka river to the Petrovsky bridge.

Nevskaya Guba: from the bounder of the inland waterways to the dam along the line between Gorskaya – Kronshtadt – Oranienbaum.

Beloe Lake.

Ilmen Lake.

Pechora: from the village of Ust-Tsilma to the city of Naryan-Mar.

Pskovskoye Lake.

Rybinskoe Reservoir: from the city of Cherepovets to the village of Vichelovo.

Sarartovskoe Reservoir: from the Syzran bridge to the dam at the Saratov hydro-electric power station.

Northern Dvina: from the Pinega river mouth to the Uyma river mouth; along the Maymaksan branch from the Uyma river mouth to the village of Lapominka; along the Nikolsky branch and channels between the isles of Yagra, Uglomin and Nikolsky to the south-western extremity of the isle of Yagra.

Svir.

Uglichskoe Reservoir.

Cheboksarskoe Reservoir.

Chudskoye Lake.

Shekaninskoe Reservoir.

Ukraine

Dnipro: downstream of the port of Kyiv (with the exception of areas belonging to **zone 1**) and the section from the Teremtsy wharf to the dam of the Kyiv hydro-electric power station.

Pivdenny Buh: from the Ternovate village to the Mikolaiv sea port.

Dnistrovsky Liman.

Dnistrovske Reservoir: from the dam to the Dnistrovka village (60 km).

Kakhovske Reservoir: upstream of the Bilenka wharf (180 km).

Dniprovske Reservoir.

Kremenchuzke Reservoir: upstream of the Topylivka village (70 km).

Dniprodzerzhinske Reservoir.

Kanivske Reservoir: from the dam at the Kaniv hydro-electric power station to the Novo-Ukrainka wharf.

Kyivske Reservoir: from the dam at the Kyiv hydro-electric power station to the Teremtsy wharf on the Dnipro and to the Vydumka wharf on the Prypat.

Pechenezke Reservoir.

Krasnooskolske Reservoir.

Burshtynske Reservoir.

Svitiaz Lake.

France

Dordogne: downstream from the stone bridge at Libourne.

Garonne: downstream from the stone bridge at Bordeaux.

Gironde.

Loire: downstream from the Haudaudine bridge on the Madeleine branch and downstream from the Permil bridge on the Permil branch.

Rhône: downstream from the Trinquetaille bridge at Arles.

Seine: downstream from the Jeanne d'Arc bridge at Rouen.

Czech Republic

Lipno Reservoir.

Zone 3

Austria

Danube.

Belarus

Dnepr: from the mouth of the Leshch river to the Lyubech wharf.

Neman: from the town of Mosty to the frontier with Lithuania.

Pripyat: from the Stakhovo lock to the frontier with Ukraine.

Zapadnaya Dvina: from the mouth of the Usvyacha river to the city of V. Dvinsk.

Sozh: from the Gronovo village to the mouth.

Berezina: from the city of Borisov to the mouth.

Dneprovsko-Bugsky Canal: from the city of Brest to the Stakhovo lock.

Mikashevichsky Canal: from the town of Mikashevichi to the Pripyat river.

Belgium

Maritime Scheldt: (downstream of the Antwerp open anchorage).

Bulgaria

Danube.

Hungary

Danube.

Germany

Danube: from Kelheim (2414,72 km) to the German/Austrian border.

Rhine: from the German/Swiss border to the German/Netherlands border.

Elbe: from the mouth of the Elbe-Seitenkanal to the lower limit of the port of Hamburg.

Müritz.

Netherlands

Rhine.

Sneekermeer.

Koevordermeer.

Heegermeer.

Fluessen.

Slotermeer.

Tjeukemeer.

Beulakkerwijde

Beterwijde.

Ramsdiep.

Ketelmeer.

Zwartemeer.

Veluwermeer.

Eemeer.

Alkmaardemeer.

Gouwzee.

Buiten IJ.

Afgesloten IJ.

Noordzeekanaal.

Port of Ijmuiden.

Rotterdam port area.

Nieuwe Maas.

Noord.

Oude Maas.

Beneden Merwede.

Nieuwe Merwede.

Dordtsche Kil.

Boven Merwede.

Waal.

Bijlandsch Canal.

Boven Rijn.

Pannersdensch Canal.

Geldersche IJssel

Neder Rijn.

Lek.

Amsterdam – Rhine Canal.

Veerse Meer.

Scheldt-Rhine Canal: till the mouth in Volkerak.

Amer.

Bergsche Maas.

Meuse: downstream from Venlo.

Gooimeer.

Europort.

Caland Canal: east of Benelux Port.

Hartel Canal.

Poland

Oder: upstream of Szczecin, except for the section from 704, 1 km to 542,4 km, which forms the state border between Germany and Poland.

Western Oder: upstream of Szczecin to the state border between Germany and Poland.

East-West waterway: (rivers Warta, Notec, Brda and Bydgoski Canal).

Vistula.

Republic of Moldova

Dnestr.

Prut: from the Koshteshtskaya hydro-electric power station to the mouth.

Russian Federation

Belaya: from the upper reaches to Yamalisky Yar (1786 km).

Belomorsko-Baltiysky Canal.

Volga: from its uppermost navigatable point to the city of Tver.

Voronezhskoe Reservoir.

Don: from the upper reaches to the Pyatiizbian roadsteads and from the dam at the Tsymliansk hydro-electric power station to the city of Rostov-on-Don.

Kama: from the upper reaches to the city of Berezniki.

Manych: from the dam at the Veselovsk reservoir to the mouth.

Mezen: from the upper reaches to the city of Mezen.

Oka (tributary of Volga): from the upper reaches to the mouth.

Pechora: from its uppermost navigatable point to the village of Oust-Tsylma.

Severnaja Dvina: from its uppermost navigatable point to the mouth of Pinega River.

Lakes, canals and rivers other than those belonging to **zones 1** and **2**.

Romania

Danube.

Serbia

Danube.

Slovakia

Danube.

Ukraine

Dnipro: upstream of the Teremtsy wharf and the section from the port of Kyiv to the dam at the Kyiv hydroelectric power station and the Stariy Dnipro branch (beyond the Khortytsa Lake).

Pripat: upstream of the Vydumka wharf.

Desna and other tributaries of Dnipro.

Pivdenny Buh: upstream of the Ternovate village.

Dnister: upstream of the Dnistrovka village.

Danube.

Ladyzhynske Reservoir.

Dnistrovske Reservoir: from the Dnistrovka village (60 km from the dam) to the Vylkhovtsy village (190 km from the dam).

Other inland waterways not mentioned as belonging to **zones 1** and **2**.

France

Rhine.

Croatia

Danube.

Czech Republic

Elbe: from the Lovosice lock to the Usti-nad-Labem lock.

Switzerland

Rhine: from Basel to Niffer (Kembs).

PART I. CLASSIFICATION

1 DEFINITIONS AND EXPLANATIONS

1.1 Definitions and explanations pertinent to the general terminology used in the present Rules are given in the General Regulations.

1.2 For the purpose of this Part of the Rules the following definitions and explanations have been adopted.

1.2.1 Classification is development, publication and application of the Rules the continuous compliance with which will, along with the proper maintenance of the craft provided by the Shipowner or by the Operator, ensure:

.1 structural strength and integrity of the hull and its elements including structural fire protection;

.2 sufficient reserve of buoyancy and stability under all specified loading conditions and specific sailing conditions;

.3 safe and reliable operation of its propulsion plant, systems and devices for craft control, other systems, auxiliary machinery, arrangements, equipment and outfit including fire-fighting outfit;

and thereby permit safe operation of the coat to suit its intended purpose.

1.2.2 The small pleasure craft, depending on the specified propelling force are subdivided into following types:

Motor craft is a boat propelled by mechanical propulsion plant (propeller, paddle wheels, water-jet, aerial propeller, etc.) with a prime internal combustion engine.

Sailing craft is a sail propelled boat.

Self-propelled craft is a motor or sailing craft.

Non-self-propelled craft is a craft the purposeful movement of which is ensured by a facility or arrangement located outside the craft.

Berth-connected craft is a non-self-propelled craft intended for operation for its designated purpose when anchored or moored at shore.

1.2.3 Where the propelling forces produced by «engine and sail» or «sail and engine» are combined, the small pleasure craft shall be considered as a motor- sailing craft or a sailing- motor craft, respectively, depending on the following:

.1 a craft designed to use wind for translational movement is considered as a sailing craft, if the sail area, in m^2, is:

$$A_S \geq 1{,}5\,(g\,V)^{2/3} \qquad (1.2.3.1)$$

where V = the full-load volume displacement, in m^3;
g = the gravitational constant (9,8 m · s^{-2}).

With lesser sailing rig area of the craft the requirements of these Rules regarding stability and freeboard of sailing craft do not apply to.

Sailing rig area A_S, in m^2, is determined in accordance with 3.2.22 of the General Regulations;

.2 a craft with the rig area not less than that specified in Formula (1.2.3.1) and with a propulsion plant, respectively, shall be considered as a motor-sailing boat if the rated power output of the propulsion engines, in kW, is:

$$N_e \geq 5\,(g\,V)^{1/3} \qquad (1.2.3.2)$$

for g and V, refer to 1.2.3.1.

With lesser power output of the propulsion plant the craft shall be considered as a sailing-motor craft.

The motor-sailing and sailing-motor craft shall fully meet the requirements imposed upon sailing craft as well as the requirements imposed upon the craft with internal combustion engines on board.

1.2.4 A craft shall be considered as a high-speed craft if it is capable to develop speed in excess of 40,0 km/h.

2 CLASS OF A CRAFT

2.1 GENERAL

2.1.1 Assignment of the Register class to a craft means confirmation by the Register that the craft construction complies with the applicable requirements of the Register Rules and its technical condition complies with the conditions of the craft operation; the craft is registered with the Register for a specified period with performing all types of surveys.

2.1.2 The Register may assign a class to a a craft proceeding from the results of survey during its construction as well as assign or renew a class to a craft in service.

2.1.3 Class renewal means confirmation by the Register that the construction and technical condition of the craft comply with the provisions based on which a class has been assigned as well as extension of validity of the Register documents for a definite period as required by the Rules.

2.1.4 Class of a small pleasure craft is assigned or renewed by the Register for different periods depending on the design category of the craft:

to craft of design categories **A**, **A1**, **A2** and **B** – for 5 years subject to the condition that intermediate surveys to confirm the class are performed during this period every 12 months;

to craft of design categories **C, C1, C2, C3** and **D** – for 6 years for self-propelled craft and for 8 years for non-self-propelled and berth-connected craft subject to the condition that intermediate surveys to confirm the class are performed during this period every 24 months.

In sound cases, the Register may assign or renew a class for a lesser period.

Intermediate surveys to confirm the class are performed within three months prior to or after each of the above periods but without any impact upon the dates of the subsequent special surveys to renew the class.

2.1.5 If a craft has the valid Register class, this means that the craft technical condition in full measure or to a degree considered adequate by the Register complies with the requirements of the Rules which apply to it according to its application, service conditions and class notation

If a class of a craft is valid, it shall be certified by the valid Classification Certificate drawn up in accordance with a set form, available on board.

2.1.6 Classification Certificate becomes invalid and classification is automatically suspended in the following cases:

.1 if the craft as a whole or its separate elements have not been submitted to scheduled periodical or occasional surveys in specified terms (if the special survey has not been completed or it is not intended to be completed before its operation renewal in due date; if the intermediate survey has not been completed within three (3) months of the due date in each periodic survey cycle);

.2 unless the craft is not submitted for completion of the relevant survey or unless in the RS Rules provided otherwise;

.3 after an accident (the craft shall be submitted for occasional survey at port where the accident took place or at the first port of call, if the accident took place at sea);

.4 when unapproved by the Register structural modifications or the craft outfit changes which may result in reducing the standards required by the Rules have been implemented ;

.5 when repair of craft items has been performed without the Register agreement and/or survey;

.6 when a craft navigates with a draught exceeding that specified by the Register for specific conditions, as well as in case of operation of a craft in conditions which do not comply with the requirements for assigned class of a craft or the restrictions specified by the Register;

.7 if the prescribed specific requirements which during previous surveys of the craft were the conditions for assignment or retainment of the Register class have not been fulfilled within the specified period;

.8 if the process of surveying the craft by the Register has been suspended on the Shipowner's initiative or through his fault;

.9 when the craft has been taken out of service for a long period (more than 3 months) for fulfillment of the Register requirements (except the case when a craft is under repair for these purposes).

The Register shall specially notify the Shipowner of suspension of a craft's class and Classification Certificate.

2.1.7 Suspended class of a craft shall be reinstated on the basis of satisfactory results of the appropriate periodical or occasional survey carried out by the Register in case of craft to be submitted for survey. During the period from suspension of a class to its reinstatement the craft shall be considered to have lost the Register class.

The class may be suspended for a period of no more than six months.

2.1.8 The class of a boat shall be withdrawn by the Register in the following cases:

.1 upon expiration of the maximum term of class suspension;

.2 when the Register and/or Shipowner consider reinstatement of the suspended class to be impossible;

.3 upon transfer of the craft to the class of another classification body

.4 at the request of the Shipowner.

Withdrawal of the craft class means termination of the technical supervision of the craft and cancellation of the Classification Certificate validity.

2.1.9 The class of a craft shall be cancelled due to its loss or scrapping.

2.2 CLASS NOTATION OF CRAFT

The class notation assigned by the Register to a craft consists of the character of classification and additional distinguishing marks and descriptive notations defining structure and purpose of the craft.

The sequence of distinguishing marks and descriptive notations being added to the character of classification of a craft is set down by the provisions of this Chapter.

2.2.1 Character of classification.

2.2.1.1 The character of classification assigned by the Register to a craft consists of distinguishing marks:

KM⍟, **KM★**, **(KM)★** – for motor and motor-sailing craft;

K⍟, **K★**, **(K)★** – for non-self-propelled sailing and berth-connected craft;

KE⍟, **KE★**, **(KE)★** – for non-self-propelled, sailing, sailing-motor and berth-connected craft having a power plant on board with power output of prime mover 100 kW and upwards.

2.2.1.2 Depending on the Rules under which the craft has been surveyed, and the classification body which has carried out the survey, the character of classification is established as follows:

.1 craft built according to the Register Rules and surveyed by the Register are assigned a class with the character of classification: **KM⍟,** or **KE⍟** or **K⍟** (see 2.2.1.1);

.2 craft which have been as a whole (or their hull or machinery installation, machinery or equipment) built and/or manufactured under the Rules of another classification society recognized by the Register and surveyed by that body during their construction and manufacture, when classed with the Register are assigned a class with the character of classification: **KM★,** or **KE★,** or **K★** (see 2.2.1.1);

.3 craft which have been as a whole (or their hull or machinery installation, machinery or equipment) built and/or manufactured without being surveyed by a classification body recognized by the Register or without any survey at all, when classed with the Register are assigned a class with the character of classification: **(KM)★** or **(KE)★** or **(K)★** (see 2.2.1.1).

2.2.2 Craft's design category marks.

The craft design category mark (**A** or **A1,** or **A2,** or **B,** or **C,** or **C1,** or **C2,** or **C3,** or **D**) is assigned in accordance with 4.2 of the General Regulations and specified in the class notation of the craft after the character of classification.

For pleasure boats to which the requirements of these Rules apply, the decision on assignment of design category marks **A, A1** and **A2** is taken in each particular case by the RS Head Office only.

In any case, for craft of design category **A** the craft length shall be more than 24 m.

2.2.3 Ice category mark.

If a craft is specially strengthened for navigation in ice, mark **Ice** shall be added to its character of classification, followed by the thickness of ice cake, in cm, at which craft operation is allowed, to be stated (in parentheses) in the class notation, e.g.: **Ice (5)** or **Ice (10).**

The ice category mark shall be introduced in the class notation after the mark specified in 2.2.2.

2.2.4 Subdivision distinguishing mark.

The possibility of introducing the subdivision distinguishing mark to the class notation of a craft shall be subject to special consideration by the Register.

2.2.5 Distinguishing mark for seasonal navigation restriction.

Depending on whether the craft has or has no appropriate hull strength, stability and reserve of buoyancy, specially designed equipment, insulation and heating of spaces as well as suitable emergency and salvage outfit, the distinguishing mark for seasonal navigation restriction shall be introduced in the class notation.

Seasonal periods for appropriate zones and areas are defined in the Load Line Rules for Sea-Going Ships of the Register.

The distinguishing mark for seasonal restrictions is denoted by letter **T** accompanied by an appropriate figure **0**, **1**, **2** or **3**, namely:

TO – for craft built, equipped and outfitted for navigation in summer in the winter seasonal zone or area; navigation in zones denoted **T1** and **T2** is also possible;

T1 – for craft built, equipped and outfitted to be capable of year-round navigating in summer zone; navigation in zone denoted **T2** is also possible;

T2 – for craft built, equipped and outfitted for navigation in summer period in the summer zone;

T3 – for craft built, equipped and outfitted for year-round navigation in tropical zone and tropical seasonal area; navigation in zone denoted **T2** is also possible.

The possibility of assigning a particular distinguishing mark for seasonal navigation restriction shall be subject to special consideration by the Register in each case.

The distinguishing mark for seasonal navigation restriction is introduced in the class notation after the marks specified in 2.2.2 or after the marks specified in 2.2.3 and 2.2.4, as appropriate.

2.2.6 Distinguishing mark for day time navigation restriction.

For of design categories **C2, C3** and **D,** restrictions on navigation only in the daylight may be allowed. In such case, mark **O** is added to the class notation.

The possibility of assigning such a mark shall be subject to special consideration by the Register in each case.

The distinguishing mark for day time navigation restriction is introduced in the class notation after the marks specified in 2.2.5.

2.2.7 Distinguishing automation mark.

The mark **AUT** (abbreviation of the word «automation») may be added to the character of classification of a craft which meets the requirements of Part VI «Automation» of these Rules.

The distinguishing automation mark is introduced in the class notation after the marks specified in 2.2.5 or after the mark specified in 2.2.6, as appropriate.

2.2.8 Descriptive notation in the class notation.

2.2.8.1 For all pleasure craft, the **main** descriptive notation is added to the character of classification, as follows:

Pleasure craft – in the general case;

Pleasure yacht – only for yachts.

The main descriptive notation is introduced after the marks specified in 2.2.4 to 2.2.7.

2.2.8.2 Craft complying with a definite scope of requirements of these Rules taking account of their structural features or purpose are assigned, whenever necessary, one or several **additional** descriptive notations, as stated below.

The additional descriptive notations are stated (in parentheses) after the main descriptive notation.

The **additional** descriptive notation may represent:

.1 determination of propelling forces:

(Sailing) – for sailing craft;

(Sailing-motor) – for sailing-motor craft;

(Motor- sailing) – for motor-sailing craft;

(Tow) –towed craft;

(Berth-connected) – berth-connected craft;

.2 structural particulars of a craft:

(Catamaran) or **(Trimaran)** or **(Proa)** – for multi-hull craft;

(Hydroplane) – for planing craft;

.3 details of the craft purpose:

(Tourist) – tourist craft;

(Water-bower) – a craft designed and equipped for use a dwelling;

(Water-house) – house for living afloat, etc.

2.2.8.3 Change of structural features or purpose of a boat is subject to special consideration by the Register.

2.2.9 Additional characteristics.

When complying with definite requirements of these Rules stipulated by the structural features or operational characteristics of the craft the fulfillment of which is not reflected by distinguishing marks and descriptive notation in the class notation, the confirmation of compliance of the craft with such requirements shall be certified by an entry in column «Other characteristics» of the Classification Certificate (e.g. that additional restrictions on navigation have been imposed on the craft).

2.2.10 Example of statement of the class notation:

.1 for motor-sailing catamaran yacht:

KM⍟ C2 Ice (5) T2 O AUT Pleasure yacht (Motor-sailing Catamaran)

where **KM** – the character of classification of a motor craft built in compliance with the Register Rules and under its technical supervision;

C2 – the design category of the craft;

Ice (5) – the hull of the craft is strengthened for navigation in ice cake of 5 cm thick;

T2 – the seasonal navigation restriction;

O – navigation is permitted in daylight only;

AUT – automated craft control;

Pleasure – recreational craft;

Yacht – yacht;

Motor-sailing – motor-sailing craft;

Catamaran – twin-hull craft.

.2 berth-connected craft for living:

KE⍟ C3 T1 Pleasure craft (Berth-connected Water-house)

where **KE⍟** – the character of classification of a non-self-propelled boat having a power plant on board with power output of prime mover more than 100 kW, built in compliance with the Register Rules and under its technical supervision;

C3 – the design category of the boat;

T1 – the seasonal navigation restriction;

Pleasure craft – a recreational craft;

Berth-connected – a berth-connected craft;

Water-house – a house for living afloat.

2.3 ALTERATION OF MARKS IN CLASS NOTATION

2.3.1 The Register may delete or change any mark in case of any alteration of or non-compliance with the requirements defining the insertion of this mark in the class notation.

2.4 CRAFT DOCUMENTS

2.4.1 The Register class is confirmed by issue to the ship of the Classification Certificate according to the set form.

2.4.2 Any other craft's documents issued by the Register on behalf of the craft Flag Administration shall be drawn up on conditions and in accordance with the form specified in the authorization.

2.4.3 Along with the Classification Certificate referred to in 2.4.1, the following documents developed by the designer or Shipowner and approved by the Register shall be submitted to the ship: the Stability Information and the Owner's Manual. The requirements for the contents of these documents shall be set out in relevant Parts of these Rules (see 3.5 of the General Regulations and in 1.3.16, Part IV "Stability, Reserve of Buoyancy and Freeboard") of the present Rules.

3 TECHNICAL DOCUMENTATION

3.1 DESIGN DOCUMENTATION ON CRAFT UNDER CONSTRUCTION

3.1.1 General provisions.

Prior to the beginning of the construction of a craft, technical design documentation proving that the requirements of the Rules applicable to the craft concerned are complied with shall be submitted to the Register for review.

The documentation shall be submitted, as a rule, in triplicate, completed in accordance with the lists given in 3.1.2 to 3.1.12 taking into account the details of the architectonic-constructive type and purpose of the craft.

The documents cited in 3.1.3 to 3.1.12 may be appropriately combined subject to condition that they reflect all design approaches needed to provide a possibility of verifying the fulfillment of all requirements of the Rules.

The requirements for the contents of the documents listed in this Section are given in relevant Parts of the Rules.

The scope of the documentation to be submitted for review for boats and equipment of special design shall be determined specifically in each particular case.

If the safety of the craft operation or sufficiency of the documents submitted is questioned, the Register has the right to request additional documentation on the issues under review to take a final decision.

All the documents submitted for review shall be in Russian or English. The Register Certificate of Compliance or the Certificate of one of the recognized classification societies shall be submitted for the equipment, devices and products subject to technical supervision by the Register during manufacture.

The technical documentation may include the Manufacturer's declaration or other information stating specific technical parameters and characteristics confirming suitability of these products for operation on board.

Simultaneously with the technical design documentation of a craft or its separate parts a list of regulated documents used during the development of the design shall be submitted. If finished computer programs with uncertain algorithm were used, the name of the program, legal address of its author and year when the program was developed shall be stated.

Upon satisfactory results of review, the technical documentation shall be approved or noted as useful information, and stamped by Register (see Section 8, Part II "Technical Documentation" of the Rules for Technical Supervision During Construction of Ships and Manufacture of Materials and Products for Ships).

The period of validity of the Register approval of the craft's technical documentation shall be limited by the duration of the contract for construction of the craft or series of sister crafts. During construction of the craft according to the technical documentation approved by the Register, it is mandatory to meet the requirements of the Register's circulars with due regard for the dates set for their implementation.

3.1.2 Documents of general nature are to be submitted within the following scope:

.1 general craft's specification;

.2 general arrangement plans;

.3 list of associated equipments, outfit and materials subject to the technical supervision by the Register with indication of their technical data, manufacturer and availability of the approval by the Register or other body recognized by the Register;

.4 program of mooring trials and sea trials of the constructed craft.

3.1.3 Hull documentation:

.1 hull members scantlings determination, as well as analysis of the overall and local strength, if required;

.2 midship section plan with the most typical transverse sections and main framing assemblies with indication of scantlings of all main hull structural members including superstructures and deckhouses, their material with indication of categories and grades, spacing between main structural members, main particulars of the craft and their ratios;

.3 structural plan with indication of main particulars of the craft and their ratios, bulkheads, integral tanks, buoyancy tanks, superstructures and deckhouses, cockpits, with spacing between main structural members;

.4 deck and platform plans;

.5 single and double bottom plan;

.6 shell expansion;

.7 drawings of longitudinal, transverse and transom bulkheads;

.8 drawings of stem, stern frame and ballast keel including attachment thereof to hull;

.9 drawings of hull framework connections, interconnection of flexible and elastic members and their securing to hull;

.10 drawings of multi-hull craft's bridge structures

.11 drawings of seatings of main engines and machinery, drawings of outboard engine and aerial propeller attachment;

.12 hull welding table containing the following information:

name and thickness of structural components to be joined;

shape and symbol of edge preparation;

marks and grades of base metal;

method of welding and position of joint in space.

If the information indicated in 3.1.2.12 is stated to the full in the drawings of the craft hull, then submission of the welding table is not required.

.13 scheme of tightness test of hull structures with table of pressure heads;

.14 description of the technological hull constructing process with indication of production process details including quality control during construction.

3.1.4 Documentation on arrangements, equipment, outfit and signal means:

.1 arrangement plan of openings in hull, superstructures, deckhouses, with indication of coaming heights and type of closing appliances (doors, hatches, portholes, sea openings and bottom and side fittings, etc.);

.2 strength calculation of closing appliance where no technical characteristics of the appliances are available;

.3 general arrangement plans of rudder and steering gear (with drawings of rudder and rudder stock), anchor, mooring and centerboard arrangements, spar and rigging with basic data on the equipment in use;

.4 calculations of rudder and steering gear, anchor, mooring and centerboard arrangements, spar and rigging, attachment of external and internal ballast;

.5 general arrangement plan of life-saving appliances with indication of basic data on the appliances in use;

.6 general arrangement plan of signal means with indication of their characteristics;

.7 drawing of guarding.

.8 list of life-saving means and signal means with indication of their technical data (may be submitted together with 3.1.2.3).

3.1.5 Documentation on stability, reserve of buoyancy and freeboard:

.1 lines drawing;

.2 hydrostatic curves;

.3 calculations and curves of arms of form stability (cross-curves) with schemes of hull volumes taken into account;

.4 calculation materials relating to initial stability and verification of craft's stability according to the Rules; weight tables for various loading conditions with indication of distribution of cargoes, fuel oil, fresh water and liquid ballast in tanks, calculation of buoyancy and initial stability characteristics, windage area, heel caused by crowding of passengers, corrections for free surface effect of liquid cargoes, angles of flooding, etc.; deck cargo stowage plan; arrangement plan of compartments and openings as well as corner points coordinate table for compartments and tanks. The deck plans of craft shall display the areas specified for people accommodation and movement, and also the maximum potential crowding of people at one side for the worst case;

.5 static and dynamic stability curves, stability calculations in accordance with the requirements of the Rules, summary table of the results of stability verification for various loading conditions;

.6 freeboard calculation;

.7 calculation of damage trim and stability (for boats held afloat in damaged condition);

.8 drawing of load line (if applied);

.9 preliminary Information on Stability.

3.1.6 Documentation on fire protection:

.1 fire protection plan with indication of fire-resisting, fire- retarding and non-combustible divisions, doors, closures, passages, ducts, etc. in these divisions, dangerous zones, means of escape and emergency exits, positioning of fire extinguishing equipment;

.2 detailed description of the craft's fire protection with indication of used heat insulating, finishing, construction materials, places where they are installed and degree of their combustibleness, calculation of the quantity of combustible materials per 1 m^3 volume of typical spaces;

.3 basic diagrams and arrangement of domestic-service liquefied gas installations;

.4 basic diagrams of fire extinguishing systems;

.5 list of fire-fighting outfit with indication of its technical data (may be submitted together with 3.1.2.3).

3.1.7 Documentation on machinery installations:

.1 general arrangement plans of machinery, boilers and equipment in machinery spaces with indication of passageways and escape routes;

.2 diagrams and description of remote control for main machinery with information on equipping the remote control stations with control devices, indication and alarm devices, means of communication and other arrangements;

.3 general view of shafting representing construction and dimensions of propeller, intermediate and thrust shafts, their bearings and shaft connections and couplings, sterntube and parts of sterntube arrangement including seals; information on shafting alignment parameters;

.4 strength calculations of shafting and propeller gearings, data on life cycle of gearings;

.5 torsional vibration calculations of shafting and propeller gearings in the "engine – propeller" system for propulsion installations with internal combustion engine of more than 75 kW. For propulsion installations with turbine and electric drive, as well as diesel-generators and auxiliary machinery the need for torsional vibration calculations shall be subject to special consideration by the Register in each case;

.6 drawing of propeller (and its strength calculation), aerial propeller or other thruster (no separate submission is required if submitted complete with main engine or shaftline), air cushion fan, drawings of CP – propellers with pitch adjusting mechanisms, their components, strength calculations of propeller blades, data on their life cycle;

.7 diagrams of remote control of stern drives (outboard engines);

.8 diagrams of main engine systems: fuel oil, lubricating, cooling, exhaust gas with calculations and characteristics of equipment, piping, materials and fittings;

.9 drawings of attachment and earthing of main engines, diesel-generators and boilers, drawings of installation of machinery;

.10 calculations of power output of main engines, power system of hovercraft and outboard engines:

minimum necessary, ensuring compliance with the requirements of 2.3.1, Part V "Machinery Installations. Machinery. Systems and Piping";

maximum allowable, ensuring compliance with the requirements of 2.3.2 to 2.3.4, Part V "Machinery Installations. Machinery. Systems and Piping".

3.1.8 Documentation on hull systems:

.1 diagrams of systems: bilge, ventilation, domestic-service liquefied gas, heating with characteristics of equipment, piping, materials and fittings with indication of details of attachment of bottom and side fittings with positioning of watertight and fireproof bulkheads;

.2 calculations of systems;

.3 calculations of fuel and drinking water stores.

3.1.9 Documentation on electrical equipment:

.1 schematic diagrams of generation and distribution of electrical power from the main and emergency sources with indication of consumers;

.2 schematic diagram of navigation lights;

.3 schematic diagrams of switchboards, control desks and other switchboards of non-standard design;

.4 schematic diagrams of electric drives of boat's arrangements and machinery;

.5 calculation results of necessary output of boat's electric power plant and/or capacity of accumulator batteries;

.6 calculation results of cross-sections of cables with indication of their types, currents and protection;

.7 diagram of protective earthing.

3.1.10 Documentation on automation equipment:

.1 circuit and block diagrams of remote automated control and alarm systems.

3.1.11 Documentation on radio and navigation equipment:

.1 list of radio and navigation equipment installed on board craft with specification of Manufacturer, type, reference of approval of this equipment by the Register);

.2 connection circuit block-diagram of radio and navigation equipment (all units, power supply, aerials);

.3 arrangement plans (at least in two projections) of all units of radio and navigation equipment and aerials;

.4 calculation of the capacity of reserve of electrical power (accumulators) for supplying the radio installations.

3.1.12 Documentation on equipment for the prevention of pollution from craft:

.1 arrangement plan of equipment and arrangements for prevention of pollution from craft;

.2 calculations of the required capacity of holding tanks for oil-containing bilge water and sewage water, oil residues, as well as the required capacity of garbage receptacles and their general arrangement plan;

.3 diagrams of systems with calculations and characteristics of equipment, pipelines, materials and fittings;

.4 operating instructions for the equipment for prevention of pollution (may be included in the Owner's Manual).

3.2 DESIGN DOCUMENTATION ON CRAFT SUBJECT TO RECONSTRUCTION OR CONVERSION

3.2.1 Prior to reconstruction or conversion of a craft to be classed (or which has been classed) with the Register the documentation relating to those parts of hull, arrangements, machinery, equipment or systems which are subject to conversion or reconstruction, and, where necessary, updated general documents and documents on stability, freeboard and subdivision (damaged stability) shall be submitted to the Register for review and approval.

3.2.2 When new machinery or arrangements shall be installed on the craft in service which differ substantially from those fitted initially and shall meet the requirements of these Rules, additional design documentation on new installations shall be submitted to the Register for review and approval in connection with that machinery and arrangements within a scope required for the craft under construction (see 3.1), as well as documents specified by the Nomenclature of items of the Register Technical Supervision and confirming manufacture of materials and products according to the approved technical documentation.

PART II. HULL

1 GENERAL

1.1 APPLICATION

1.1.1 The requirements of this Part of the Rules apply to the craft having a length of 2,5 m to 24 m with the welded hull in steel or aluminium alloys, as well as in glass-reinforced plastic.

1.2 GENERAL REQUIREMENTS

1.2.1 All the hull structures regulated by the present Part of the Rules are subject to the Register survey. For this purpose am access shall be provided for their survety.

The structures regulated by the present Part of the Rules shall comply with the approved technical documentation specified in Part I "Classification".

1.3 DEFINITIONS, DESIGNATIONS AND EXPLANATIONS

1.3.1 The definitions and explanations relating to the general terminology of the Rules are given in the General Regulations and in Part I "Classification". For the purpose of this Part of the Rules the following definitions, designations and explanations have been adopted:

Upper deck is the uppermost continuous deck extending the full length of the craft.

Moulded depth D is the vertical distance, in m, measured amidships from the top of the plate keel or from the point where the inner surface of shell plating abuts on the bar keel, to the top of the upper deck beam at side.

Length L is the distance, in m, measured at the level of the summer load waterline from the forward side of the stem to the after side of the rudder post or to the centre of the rudder stock (in the absence of the rudder post), or the distance equal to 96 per cent of the craft's length measured at the level of that waterline from the forward side of the stem to the after side of the after end of the craft, whichever is greater.

However, L need not be greater than 97 per cent of the craft's length measured at the level of the maximum summer waterline.

Where the craft's fore or aft end has an unusual form, the length L is subject to special consideration by the Register.

After perpendicular is a vertical line in the craft centre plane which limits the craft length L at the aft end.

Block coefficient C_b is the block at length L, breadth B and draught d determined by the formula

$$C_b = \frac{\text{Moulded displacement (m}^3\text{)}}{LBd}.$$

Maximum summer waterline is the waterline on the level of the centre of the load line ring for the upright craft without heel and trim.

Midship section is the hull section at the middle of the craft's length L.

Superstructure is a decked structure on the upper deck extended from side to side of the craft or with the side plating not being inboard of the shell plating more than 4 per cent of the craft's breadth from any craft's side.

Tight structure means a structure which is impervious to water or other liquids.

Lower decks are the decks located below the upper deck. Where the craft has more than one lower deck, they are called: second deck, third deck, etc. counting from the upper deck.

Forward perpendicular is a vertical running through the craft centre plane at a point of intersection where the maximum summer waterline and the fore side of the stem intersect.

Craft's ends are the portions of the craft's length beyond the midship region.

Draught d is the vertical distance, in m, measured amidships from the top of the plate keel or from the point where the inner surface of shell plating abuts upon the bar keel, to the maximum summer waterline.

Frames are vertical beams (members) of side framing fitted in the plane of floors or bilge brackets.

Freeboard deck is the deck from which the freeboard is calculated.

Superstructure deck is a deck forming the top of a tier of superstructure. Where the superstructure has several tiers, its decks are called: first tier superstructure deck, second tier superstructure deck, etc. counting from the upper deck.

Bulkhead deck is the deck to which the main transverse watertight bulkheads are carried where subdivision is provided.

Deckhouse top is a deck forming the top of a tier of a deckhouse. Where the deckhouse has several tiers, its decks are called: first tier deckhouse top, second tier deckhouse top, etc. counting from the upper deck. If a deckhouse is fitted on a superstructure deck of the first tier, second tier, etc., the deckhouse top is called accordingly: the top of second tier deckhouse, third tier deckhouse, etc.

Platform is a lower deck extended over portions of the craft's length or breadth.

Strength deck is the deck forming the upper flange of the hull girder. The quarter deck outside the transition area may be considered as the strength deck (refer to 2.12.1.2).

D e c k h o u s e is a decked structure on the upper deck or superstructure deck with its side plating, if one side at least, being inboard of the shell plating by more than 4 per cent of the craft's breadth.

S p e c i f i e d s p e e d v_0 is the maximum speed of the craft, in knots, at the maximum summer waterline in still water at the rated power of the propulsion plant.

g = 9,81 m/s^2 – acceleration of gravity;

ρ = 1,025 t/ m^3 – density of sea water.

M i d s h i p r e g i o n is the part of the craft's length equal to 0,4 L (0,2 L forward and aft of amidships), unless expressly provided otherwise

Moulded breadth B is the greatest moulded breadth of the craft, in m, measured amidships to the moulded line of the frame.

Spacing is the distance between primary members assumed on the basis of the value of standard spacing a_0, in m.

2 STEEL HULL

2.1 GENERAL

2.1.1 Basic provisions for determining hull structural members.

2.1.1.1 The scantlings of hull members are regulated for the craft's steel welded hulls with the ratios of main dimensions within the values given in Table 2.1.1.1 and the standard spacing a_0, in m, being determined by Formula (2.1.1.1), within the following limits:

for the craft of design categories **A** and **A1**: 0,75 a_0 to 1,25 a_0;

for the craft of design categories **A2** and **B**: 0,7 a_0 to 1,25 a_0;

for the craft of design categories **C, C1, C2, C3** and **D**: 0,65 a_0 to 1,25 a_0.

Table 2.1.1.1

Ratio of craft's main dimensions	Design category					
	A	**A1**	**A2**	**B**	**C** and **C1**	**C2**, **C3** and **D**
L/D	18	19	20	21	22	23
B/D	2,5	2,5	3,0	3,0	3,0	4,0

$$a_0 = 0{,}002L + 0{,}48. \quad (2.1.1.1)$$

The scantlings of the members ensuring the strength of the craft's hulls of which the design and main dimensions are not regulated by these Rules, are subject to special consideration by the Register.

The scantlings of the hull members of planing craft and catamarans shall additionally meet the requirements of the Rules for the Classification and Construction of High-Speed Craft.

2.1.1.2 The scantlings of hull members in this Part of the Rules are determined by the formulae for minimum scantlings depending on either the craft's length or the spacing of the craft's hull. The determination of scantlings using the formulae in relation to the external loadings and geometrical characteristics of hull structures is carried out to verify the minimum scantlings assumed, and also in cases when the formulae for the minimum scantlings of hull members are not specified in this Part of the Rules (in this case, refer to 2.1.1.3 and 2.1.1.4 in this Part of the Rules).

2.1.1.3 For the purpose of the present Part of the Rules, the design characteristics assumed for the material of steel hull structures are the following:

R_{eH} = upper yield stress of ordinary shipbuilding steel equal to 235 MPa;

σ_n = design specified yield stress for normal stresses equal to 235 MPa for ordinary shipbuilding steel;

τ_n = design specified yield stress for shear stresses equal to 0,57 σ_n.

2.1.1.4 The requirements for the strength of structural members and structures as a whole in determining their scantlings and strength characteristics are set in the present Rules by specifying the normative values of permissible stresses for the design normal $\sigma_p = k_\sigma \sigma_n$ and shear $\tau_p = k_\tau \tau_n$ stresses (where k_σ and k_τ = factors of permissible normal and shear stresses, respectively).

The values of k_σ and k_τ are given in the relevant Chapters of this Part of the Rules.

2.1.1.5 The thickness of the craft's hull structural members determined according to the requirements of this Part of the Rules shall be no less than the minimum thickness specified for particular structures in the relevant Chapters of this Part of the Rules.

The minimum thickness of hull members may be reduced for the craft of design categories **A2**, **B**, **C**, **C1**, **C2**, **C3** and **D**, but no more than specified in Table 2.1.1.5.

Table 2.1.1.5

Permissible reduction of minimum hull member thickness

Hull members	Design category	
	A2 and **B**	**C, C1, C2, C3** and **D**
primary support members in way of ballast compartments	15 %	30 %
Others	10 %	20 %

In all cases, unless expressly provided otherwise, the hull member thickness shall be no less than 4 mm.

2.1.1.6 In present Part of the Rules, the requirements on determining the hull member scantlings are based on the assumption that during the craft's construction and operation provisions are made for protecting the hull against corrosion in accordance with current standards and other current normative documents.

In all cases, internal surfaces of the tanks shall have protective epoxy or equivalent anticorrosive coatings applied according to the manufacturer's recommendations approved by the Register. Light colours are most preferable for coatings. When needed, the coatings may be supplemented with an anodic protection against corrosion.

2.1.2 Corrosion allowance.

2.1.2.1 The corrosion allowance Δs, in mm, is set for the structures of which the planned service life exceeds 12 years and is to be determined by the formula:

$$\Delta s = u\,(T - 12) \tag{2.1.2.1}$$

where u = average annual reduction in thickness of the member, in mm per annum, due to corrosion wear or tear to be taken considering operational conditions;

T = planned service life of the structure, in years; if the service life is ignored, it is assumed equal to 24 years.

Where the service life for structures is planned less than 12 years, it is assumed $\Delta s = 0$.

2.1.2.2 When there are no special requirements for operational conditions and the means of corrosion prevention of the hull protection for determining the scantlings of the hull members , the data on the average annual reduction in the member thickness u given in Table 2.1.2.2 shall be used in determining the scantlings of hull members according to the Rules.

For the webs separating the different purpose compartments, the value of u is determined as the average value for adjacent compartments.

The value of u may be reduced 2,5 times for the craft of the restricted area of navigation intended for operating in fresh water basins only; for the craft intended for operating in fresh water basins only for a part of time, the value of u shall be determined by linear interpolation in proportion to that part of time.

When justified and agreed by the shipowner, the reduction of scantlings for single hull members down to the values approved by the Register may be allowed. The hull structure drawings to be submitted for the Register for review shall include the calculated scantlings along with the reduced ones.

A special entry shall be made in the Classification Certificate for the craft with the hull members of reduced scantlings allowed by the Register (refer to 2.2.9, Part I "Classification").

Table 2.1.2.2

Average annual reduction in thickness of structural members

Nos.	Structural member	u, mm per annum
1	2	3
1	**Plating of decks and platforms**	
1.1	Upper deck	0,1
1.2	Lower deck	0,11
1.3	Deck in accommodation spaces	0,14
2	**Side plating**	
2.1	Hull side:	
2.1.1	freeboard	0,1
2.1.2	in way of alternating waterlines	0,17
2.1.3	below alternating waterlines	0,14
3	**Bottom plating**	
3.1	Bottom (no inner bottom):	
3.1.1	including bilge	0,14
3.1.2	in way of fuel oil tanks	0,17
3.1.3	in way of ballast tanks	0,2
3.2	Bottom (inner bottom is provided):	
3.2.1	including bilge	0,14
3.2.2	in way of fuel oil tanks	0,15
3.2.3	in way of ballast tanks	0,2
4	**Inner bottom plating**	
4.1	Inner bottom:	
4.1.1	in way of fuel oil tanks	0,12
4.1.2	in way of ballast tanks	0,15
4.1.3	in way of boiler room	0,3
4.1.4	in way of engine room	0,2
4.2	Margin plate:	
4.2.1	margin plate (inclined and horizontal)	0,2
4.2.2	margin plate in boiler room: inclined	0,28
5	**Bulkheads between ballast compartments:**	0,13
5.1	top strake (0,1 D from the upper deck)	0,15
5.2	middle strake	0,16
5.3	bottom strake	
6	**Framing of decks and platforms**	
6.1	Deck longitudnals and beams of decks and platforms bounding:	0,12
6.1.1	holds	0,15
6.1.2	fuel oil tanks	0,18
6.1.3	ballast compartments	
6.2	Carlings, deep beams of decks and platforms bounding:	0,12
6.2.1	holds	0,19
6.2.2	fuel oil tanks	0,21
6.2.3	ballast compartments	
7	**Framing of sides and bulkheads**	
7.1	Longitudinals, main and web frames, cross ties, vertical webs and horizontal girders of sides and bulkheads bounding:	
7.1.1	holds	0,1
7.1.2	fuel oil tanks	0,18
7.1.3	ballast compartments	0,21
8	**Framing of bottom and inner bottom**	
8.1	Vertical keel, side girders, floors and bottom longitudinals (no inner bottom):	
8.1.1	in dry compartments	0,14
8.1.2	in ballast compartments	0,2
8.1.3	under boilers	0,3

Table 2.1.2.2 – continued

1	2	3
8.2	Vertical keel, side girders, floors, bottom and inner bottom longitudinals in double bottom compartments:	
8.2.1	not intended for flooding	0,14
8.2.2	in fuel oil tanks	0,15
8.2.3	in ballast tanks	0,2
8.2.4	under boilers	0,25
9	**Superstructures, deckhouses and bulwark**	
9.1	Shell plating	0,1
9.2	Framing	0,1

2.1.2.3 The factor ω, which takes into account the corrosion allowance with regard to the cross-sectional area of a web and to the section modulus of the members of rolled section, is determined by the formula

$$\omega = 1 + \alpha_c \Delta s \qquad (2.1.2.3)$$

where $\alpha_c = 0{,}07 + 6/W' \le 0{,}25$ if $W' < 200$ cm^3;
$\alpha_c = (0{,}01 + 1/W')/0{,}15$ if $W' > 200$ cm^3;
where W' = section modulus of the member in question according to 2.1.6.4.2;
for Δs, refer to 2.1.2.1.

2.1.3 Materials.

2.1.3.1 The materials used for hull members regulated by this Section of the Rules shall comply with the requirements of Part XIII "Materials" of the Rules for the Classification and Construction of Sea-Going Ships.

2.1.3.2 The hull members shall be fabricated of ordinary structural steel with the yield stress R_{eH} = 235 MPa.

2.1.4 Design loads.

2.1.4.1 This Section contains the basic formulae for determining the design weather loads on hull , the craft accelerations at motions, as well as the loads from fuel oil and liquid ballast.

2.1.4.2 Wave induced losds on the forward portion of the bottom and the flare, as well as emergency loads are given in the items relating to the relevant structures.

2.1.4.3 Rules for determining the design load value and the load point are specified in the chapters pertaining to particular structures. Where such provisions are unavailable, the load is assumed to be applied to the lower edge of a plate, in the middle of the design span of the member or at the centre of the area under distributed pressure.

2.1.4.4 The basic parameter of the design load and accelerations the craft's hull exposed to weather is the wave factor c_w to be determined, depending on the craft's length, by the formula

$$c_w = 0{,}0856\,L. \qquad (2.1.4.4)$$

2.1.4.5 For the craft of restricted area of navigation the wave factor c_w shall be multiplied by the reduction factor φ_r obtained from Table 2.1.4.5.

Table 2.1.4.5

Area of navigation	φ_r
A1	1
A2	$1{,}25 - 0{,}25L \cdot 10^{-2} \le 1$
B	$1{,}0 - 0{,}207L \cdot 10^{-2}$
C and **C1**	$0{,}86 - 0{,}18L \cdot 10^{-2}$
C2, C3 and **D**	$0{,}75 - 0{,}18L \cdot 10^{-2}$

2.1.4.6 Wave loads.

2.1.4.6.1 The design pressure p, in kPa, on the craft's hull exposed to weather is determined by the formulae:

for the points of application of the loads below the maximum summer waterline:

$$p = p_{st} + p_w, \qquad (2.1.4.6.1\text{-}1)$$

for the points of application of the loads above the maximum summer waterline:

$$p = p_w \qquad (2.1.4.6.1\text{-}2)$$

where p_{st} = static pressure, in kPa, to be determined by the formula:
$p_{st} = 10z_i$;
z_i = distance from of application of the loads to the maximum summer waterline, in m;
for p_w, refer to 2.1.4.6.2.

2.1.4.6.2 The design pressure p_w, in kPa, due to the craft's hull motion about the wave contour is determined by the formulae:

for the points of application of the loads below the maximum summer waterline:

$$p_w = p_{w0} - 1{,}5\,c_w z_i/d, \qquad (2.1.4.6.2\text{-}1)$$

for the points of application of the loads above the maximum summer waterline:

$$p_w = p_{w0} - 7{,}5\,a_x z_i \qquad (2.1.4.6.2\text{-}2)$$

where $p_{w0} = 5\,c_w a_v a_x$;
for c_w, refer to 2.1.4.4;
$a_v = 0{,}8\,\upsilon_0 (L/10^3 + 0{,}4)/\sqrt{L} + 1{,}5$;
$a_x = k_x (1 - 2x_1/L) \ge 0{,}267$;
k_x = factor equal to 0,8 and 0,5 for the hull sections forward and aft of the midship section, respectively;
x_1 = distance of the considered section from the nearest fore or after perpendicular, in m;
for z_i, refer to 2.1.4.6.1.
In any case, the product $a_v a_x$ shall be assumed no less than 0,6.

Distribution of the load p_w around the craft's hull section contour is shown in Fig. 2.1.4.6.2.

2.1.4.7 Accelerations at motions.

Design acceleration a, in m/s^2, at motions in waves is determined by the formula

$$a = \sqrt{(a_c^2 + a_p^2 + 0{,}4\,a_r^2)} \qquad (2.1.4.7\text{-}1)$$

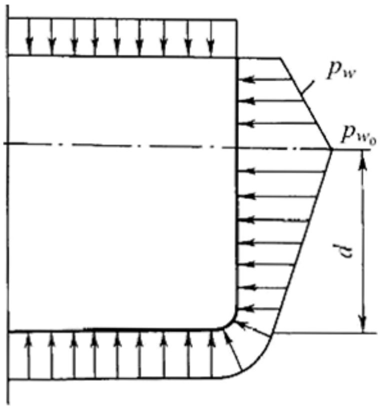


Fig. 2.1.4.6.2

where a_c = projection of the craft's centre of gravity acceleration on the appropriate direction;
a_p and a_r = projections of pitching and rolling accelerations on the appropriate directions at the point under consideration.

Acceleration projections for the considered member on the vertical (index z), horizontal-transverse (index y) and horizontal-longitudunal (index x) directions are determined by the following formulae:

$$\begin{aligned} a_{cx} &= 0{,}1\,(100L)^{1/3}\,g\,\varphi_r; \\ a_{cy} &= 0{,}2\,(100L)^{1/3}\,g\,\varphi_r; \\ a_{cz} &= 0{,}2\,(100L)^{1/3}\,g\,\varphi_r; \\ a_{px} &= (2\,\pi/T_p)^2\,\psi\,z_0; \\ a_{py} &= 0; \\ a_{pz} &= (2\,\pi/T_p)^2\,\psi\,x_0; \\ a_{rx} &= 0; \\ a_{ry} &= (2\,\pi/T_r)^2\,\theta\,z_0; \\ a_{rz} &= (2\,\pi/T_r)^2\,\theta\,y_0 \end{aligned} \tag{2.1.4.7-2}$$

where φ_r is given in Table 2.1.4.5 (φ_r = 1 for the craft of unrestricted navigation);
T_p and T_r = pitching and rolling periods, respectively, in s, to be determined by the formulae:

$$\begin{aligned} T_p &= 0{,}8\,\sqrt{L}\,/\,(1 + 0{,}4\,\upsilon_0\,(L/10^3 + 0{,}4)/\sqrt{L}); \\ T_r &= cB\,/\,\sqrt{h} \end{aligned} \tag{2.1.4.7-3}$$

where c = numerical factor determined on the basis of the data for the similar type craft; as the first approximation,
c = 0,8;
h = metacentric height for the most unfavourable operational conditions for the fully loaded craft; $h \approx 0{,}07\,B$ unless more detailed data are available.
$\Psi = 0{,}164\,\varphi$ – design angle of trim, in rad;
φ – refer to Table 1.4.4.3, Part II "Hull", Rules for the Classification and Construction of Sea-Going Ships (φ = 1 for the craft of unrestricted area of navigation);
$\theta = 0{,}50\,\varphi$ – design angle of heel, in rad;
x_0 = distance of the considered point from the transverse plane passing through the craft's centre of gravity, in m;
y_0 and z_0 = distance of the considered point from the centreline and the horizontal plane passing through the craft's centre of gravity, respectively, in m.

The total acceleration in the vertical direction a_z, in m/s^2, at all types of motions can be determined by the formula

$$a_z = 0{,}21\,g\,(1 + k_a) \tag{2.1.4.7-4}$$

where $k_a = 1{,}6\,(1 - 2{,}5x_1\,/\,L) \geq 0$ in the forward region of the craft;
$k_a = 0{,}5\,(1 - 1{,}33x_1\,/\,L) \geq 0$ in the aft region of the craft;
for x_1, refer to 2.1.4.6.2.

2.1.4.8 Fuel oil and ballast loads.

Design pressure p_f, in kPa, on the structures of fully loaded compartments is determined by the following formulae:

$$p_f = \rho_f\,g\,(1 + a_z\,/\,g)\,z_i; \tag{2.1.4.8-1}$$

$$p_{\mathrm{f}} = \rho_f\,g\,(z_i + b\,\theta); \tag{2.1.4.8-2}$$

$$p_f = \rho_f\,g\,(z_i + l\,\psi); \tag{2.1.4.8-3}$$

$$p_f = 0{,}75\,\rho_f\,g\,(z_i + \Delta z); \tag{2.1.4.8-4}$$

$$p_f = \rho_f\,g z_i + p_v \tag{2.1.4.8-5}$$

where ρ_f = fuel oil or water ballast density, in t/m^3, whichever is appropriate;
a_z = design acceleration in the vertical direction according to 2.1.4.7;
z_i = distance, in m, from the member concerned to the deck level (top of the tank) measured at the centreline;
θ and ψ = refer to Formula (2.1.4.7-2);
Δz = height, in m, of an air pipe above the deck (top of the tank), but not less than 1,5 m for ballast tanks and fresh water tanks, 2,5 m for fuel oil and lubricating oil tanks; no minimum values of Δz are established for small expansion tanks and lubricating oil tanks of less than 3 m^3 capacity;
p_v = pressure, in kPa, the safety valve is set for, if fitted, but no less than 15 kPa for ballast tanks and fresh water tanks, 25 kPa for fuel oil and lubricating oil tanks; no minimum values of p_v are established for small expansion tanks and lubricating oil tanks of less than 3 m^3 capacity;
l and b = length and breadth, in m, of the compartment measured at its mid-height; where the values of l and/or b change step-wise through the compartment height, l and/or b are measured at the mid-height of each part of the compartment where their variations are insignificant; Formulae (2.1.4.8-2) and (2.1.4.8-3) are used for each measured value of l and b accordingly, whichever is greater.

2.1.5 General longitudinal and transverse strength.

2.1.5.1 The longitudinal strength of the hull for the craft of traditional structural configuration, including the undecked craft of less than 6 m long having the ratio $L/D \leq 10$, is not regulated by these Rules. The craft's hull of unusual structural configuration, including the undecked craft of more than 6 m long, shall be verified with regard to their general longitudinal strength in compliance with the applicable requirements of the Rules for the Classification and Construction of Sea-Going Ships.

2.1.5.2 Where needed, the Register can demand calculating the general transverse strength of the craft's hull according to the Register-approved procedure.

2.1.6 Geometrical characteristics of welded structures.

2.1.6.1 General.

2.1.6.1.1 This Section contains the general requirements for plating and framing.

2.1.6.1.2 Plate structure means a portion of plating bounded by stiffening members. By plate structures are meant portions of the deck, platform and inner bottom plating and portions of the bottom, side, bulkhead plating as well as webs of primary support members.

2.1.6.1.3 In the present Part of the Rules the term "framing" includes primary members and primary support members strengthening the plate structures. Primary support members also serve as supporting structures for primary members. Primary members are deck longitudinals, side longitudinals, bulkhead longitudinals, inner bottom plating and bottom longitudinals, as well as vertical and horizontal stiffeners of bulkheads, frames, beams,

reverse and bottom frames of bracket floors, etc. Primary support members are deck trans-verses, deck girders, web frames, side stringers, floors, side girders, centre girder, vertical webs and horizontal girders of bulkheads, etc.

2.1.6.1.4 The scantlings of primary and primary support members are based on the required section modulus,

moment of inertia, web sectional area, thicknesses of web and face plate, as well as width of the face plate.

Geometric parameters of the member section, unless stated otherwise, are determined taking into account the effective flange.

If the member is so arranged that it is not normal to the effective flange, the section modulus shall be

increased in proportion to 1/cos α (where α is the angle, in degrees, between the member web and the perpendicular to the effective flange at the section considered). If α < 15°, no increase of section modulus is required.

2.1.6.1.5 Rounding off the required scantlings of structural members generally shall be made in the direction of increase. Plate thickness shall be rounded off to the nearest 0,5 or integer of millimetres.

2.1.6.2 Symbols.

For the purpose of this Chapter, the following symbols have been adopted:

l = length of span of the concerned member determined from 1.6.3.1, in m;

p = design pressure at the point of load application, determined in the relevant chapters of this Section, in kPa;

a = spacing, in m, of concerned primary or primary support members of a longitudinal or transverse framing system; where this varies, a is a half-sum of distances of adjacent members from the member concerned;

h = depth of the member web, in cm;

σ_n = design specified yield stress for normal stresses, in MPa, determined from 2.1.1.3;

τ_n = design specified yield stress for shear stresses, in MPa, determined from 2.1.1.3;

Δs = corrosion allowance, in mm, determined from 2.1.2.1;

s = plate thickness, in mm;

W = section modulus of a member, in cm^3;

I = moment of inertia of a member, in cm^4;

B_1 = width of a compartment, in m, measured at the middle of its length as a distance between the craft's sides at the level of the top edge of a floor.

2.1.6.3 Span and effective flange of member.

2.1.6.3.1 The span of a primary and primary support member l is measured along the member face plate as the distance between span points. Unless provided otherwise, where the end brackets are fitted, the span points shall be taken at the mid-length section of the bracket. In this case, the span point posiiton shall be such that the height of the end bracket in that section does not exceed the web depth of the member considered (refer to Fig. 2.1.6.3.1).

For curvilinear members the span shall be taken equal to the chord connecting the span point centres.

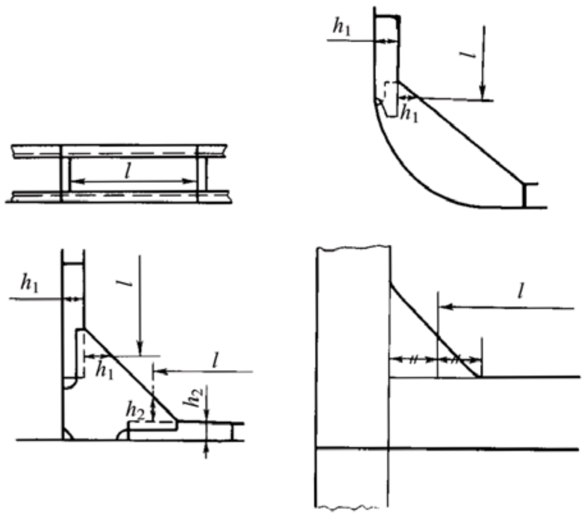


Fig. 2.1.6.3.1

2.1.6.3.2 The thickness of the effective flange shall be taken equal to its mean value in the considered section of the member.

2.1.6.3.3 The width of the effective flange a_f, in m, of primary members shall be determined by the formulae:

$$a_f = l/6; \tag{2.1.6.3.3-1}$$

$$a_f = 0,5\,(a_1 + a_2) \tag{2.1.6.3.3-2}$$

where a_1 and a_2 = distance of the considered member from the nearest members of the same direction located on both sides of the considered member, in m, whichever is less.

2.1.6.3.4 The width of the effective flange c_f, in m, of primary support members shall be determined by the formula

$$c_f = kc \qquad (2.1.6.3.4)$$

where $c = 0{,}5(c_1 + c_2)$;
c_1 and c_2 = distance of the considered primary support member from the nearest primary support members of the same direction located on both sides of the considerd member, in m,
k = factor obtained from Table 2.1.6.3.4 depending on c, the given span l_{sp} and the number n of the members supported by considered primary support member.

Table 2.1.6.3.4

Number of members n	k values at l_m / c						
	1	2	3	4	5	6	≥ 7
≥ 6	0,38	0,62	0,79	0,88	0,94	0,98	1
≤ 3	0,21	0,40	0,53	0,64	0,72	0,78	0,80
Note. The factor k for intermediate values of l_{sp} / c and n is determined by linear interpolation.							

For simply supported primary support members, the given span $l_{sp} = l$, and for fixed primary support members, $l_{sp} = 0{,}6\,l$.

The way in which the framing members shall be supported (simple supporting or fixing) is determined proceeding from the general engineering principles with regard for the actual structure (presence of brackets, welding of webs, face plates, etc.) and is characterized by the presence or absence of bending moment effects in the span point of the member.

2.1.6.4 Scantlings of structural members.

2.1.6.4.1 The section modulus W, in cm^3, of primary members of rolled section shall be not less than

$$W = W'\omega_c \qquad (2.1.6.4.1)$$

where W' = section modulus of the member considered, in cm^3, determined according to 2.1.4.6.2;
ω_c = multiplier taking into account the corrosion allowance determined according to 2.1.2.3.

The section modulus of built-up welded members shall meet the requirements in 2.1.4.6.2. In this case, the thickness of section elements shall be increased by the value of the corrosion allowance Δs.

2.1.6.4.2 The section modulus of the member considered, in cm^3, without corrosion allowance is determined by the formula

$$W' = Q\,l\,10^3/(m\,k_\sigma\,\sigma_n) \qquad (2.1.6.4.2)$$

where $Q = pat$ – transverse load on the member considered, kN;
m, k_σ = factors of the bending moment and permissible stresses, respectively, determined in the relevant chapters of this Part of the Rules.

2.1.6.4.3 The net sectional area (excluding openings) f_c, in cm^2, of primary and primary support member webs shall be not less than:

for members of rolled section:

$$f_w = f'_w\,\omega \qquad (2.1.6.4.3\text{-}1)$$

where $f'_w = 10\,N_{max}/(k_\tau\,\tau_n)$; (2.1.6.4.3-2)
N_{max} and k_τ = maximum value of the shear force and the permissible shear stress factor, respectively, defined in the relevant chapters of this Part of the Rules;
for ω, refer to 2.1.2.3;

for built-up welded members, the web cross-section area required shall be determined by Formula (2.1.6.4.3-2) with a subsequent increase in thickness by the value of Δs followed.

2.1.6.4.4 The thickness s, in mm, of the plates under transverse loads shall be not less than

$$s = mak\,\sqrt{(p/k_\sigma\,\sigma_n)} + \Delta s \qquad (2.1.6.4.4)$$

where m, k_σ = bending moment and permissible stress factors, as defined in the relevant chapters of this Part of the Rules;
$k = 1{,}2 - 0{,}5\,a/b$, but not more than 1;
a and b = smaller and greater sizes, in m, of the supporting contour sides of a plate structure.

2.1.7 Welded structures and joints.

2.1.7.1 General.

2.1.7.1.1 Any change in the shape or section of the members of hull welded structures shall be gradual. All openings shall have rounded corners and smooth edges.

2.1.7.1.2 The scantlings of sections and the thickness of plates used for longitudinal members shall change gradually along the hull length.

2.1.7.1.3 Continuity shall be ensured for as many of main longitudinal members as possible, and a gradual change of their sections is required in way of the ends together with other arrangements contributing to the reduction of stress concentration.

2.1.7.1.4 In tight structures, as well as in the non-tight ones in the areas of intense vibration, provision shall be made for stiffeners and details which prevent the formation of hard spots in plating at the edges of the face plates of members and at bracket toes.

2.1.7.1.5 The length of unsupported plating be tween the end of a longitudinal and the nearest web normal to direction member shall be as short as possible, however, not more than $4\,s$ or 60 mm, whichever is less (s = plate thickness, in mm).

2.1.7.1.6 For the purpose of this Part of the Rules, the hull structures subject to intense vibration are those situated in way of machinery and equipment which constitute a source of vibration.

Considered as regions with high level of vibration in all ships are the regions situated below the lower platform continuous within the engine room and bounded:

at aft end, by a section forward of the edge of propeller boss at twice the propeller diameter, but not less than to the after peak bulkhead;

in the engine room, by the bulkheads of this space.

The bulkheads forming boundaries of engine room, the after peak bulkhead and the lower continuous platform in the above regions throughout the length of the ship are considered to be structures subject to intense vibration.

2.1.7.1.7 In way of the ends of bulwark, bilge keels, and other details welded to the hull, as well as generally of gutterway bars, their height shall decrease on a length of at least 1,5 times the height of these members. The ends of bulwarks shall be tapered. This is also recommended for the portions of the ends of the gutter bars.

2.1.7.1.8 Welded joints, welding consumables and procedures, testing and inspection methods of welded joints shall comply with requirements of Part XIV "Welding" of the Rules for the Classification and Construction of Sea-Going Ships.

2.1.7.2 Connections of framing members.

2.1.7.2.1 In general, the framing members shall have butt-welded joints. Overlapping joints may be allowed on agreement with the Register, except in regions with high level of vibration, primary support member connections and in way of heavy concentrated loads.

2.1.7.2.2 Connections of primary members.

2.1.7.2.2.1 Unless provided otherwise, the size of brackets c, in cm, measured according to Fig. 2.1.7.2.2.1 shall be determined by the formula

$$c = 5\sqrt{(W/s)} \qquad (2.1.7.2.2.1)$$

where W = section modulus of the member attached as required by the Rules, in cm^3;
s = thickness of the bracket, in mm.

The thickness of bracket is taken equal to that of the member web. Where the web thickness is more than 7 mm the bracket thickness may be reduced by 1 mm; where the web thickness is more than 12 mm, the bracket thickness may be reduced by 2 mm.

Where the bracket connects two members of a different profile, the the characteristics of the smaller profile shall be used for determining the bracket size.

The bracket height h (refer to Fig. 2.1.7.2.2.1) shall be no less than 0,7 times the required size c.

The size of brackets determined as indicated above, refers to the case when the members to be interconnected are not welded to each other or the member butts are not welded to the plating. The allowable gap shall not exceed 40 mm or 25 per cent of size c, whichever is less. Otherwise, c may be required to be increased.

2.1.7.2.2.2 If the free edge l, in mm, of a bracket (refer to Fig. 2.1.7.2.2.1) exceeds $45s$ (s = thickness of the bracket, in mm), the bracket shell have a flange (face plate). The

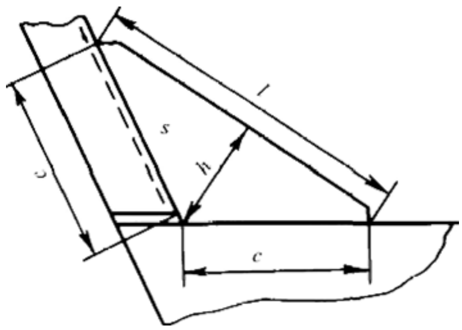


Fig. 2.1.7.2.2.1

width of the flange shall be not less than 50 mm, the width of the face plate, not less than 75 mm. The thickness of the face plate shall not be less than that of the bracket. The width of the flange (face plate) shall meet the requirements of 2.1.7.3.1.

2.1.7.2.2.3 The size of brackets dimensions may be reduced:

by 10 per cent, where the framing members are welded to each other or to the plating;

by 15 per cent, where the flange or face plate is provided;

by 25 per cent, where the framing members are welded to each other and the brackets are provided with a face plate or flange.

2.1.7.2.2.4 Where there is a gap between the beam butt and the frame in way of side strengthening of ships being moored at sea, the beam bracket shall be provided with a face plate or flange.

2.1.7.2.3 Primary support members are recommended to be connected by rounded brackets with smooth change of web depth and face plate size.

2.1.7.2.3.1 The height and width of brackets interconnecting the members, or attaching them to bulkheads are, unless provided otherwise, to be not less than the members web depth (or the lesser web depth of the members connected). The bracket thickness is assumed equal to the lesser of the member web thicknesses. In member connections no gaps are permissible.

2.1.7.2.3.2 The brackets connecting the members shall have a face plate or flange along the free edge In places of transition from the face plates of brackets to those of members, the width and thickness of the face plate along the free edge at different sizes of the member face plates shall change smoothly The area of face plate (or flange) of tripping bracket shall be taken not less than 0 8 times the area of lesser face plate of the members connected.

If the distance in mm between bracket ends exceeds $160s\sqrt{\eta}$ (s = thickness of bracket, in mm), a stiffener shall be fitted parallel to the line connecting the bracket ends at the distance a equal to 1/4 of the bracket height or 35 times the bracket thickness (whichever is less).

Brackets shall be additionally stiffened depending on their size and configuration.

2.1.7.2.3.3 The radius of rounding shall not be less than the depth of the smaller members connected.

2.1.7.2.3.4 The constructions used for the attachment of primary members to their supporting primary support members shall comply with the standards in force.

2.1.7.3 Primary support members.

2.1.7.3.1 The depth h and thickness s_w of primary support member webs (as well as of built-up primary members), and also their sectional area are specified in the relevant chapters of this Part of the Rules. The width of a face plate b, in mm, for the primary support member measured from its web shall not be more than

$$b = 13 s_{fp}$$

where s_{fp} = thickness of the face plate of a primary support member, in mm.

The face plate thickness shall not generally exceed the triple thickness of the web plate.

2.1.7.3.2 Lightening holes, cut-outs for the passage of primary support members, etc. are permitted in the webs of primary support members.

The total depth of openings in the same section shall not exceed 0,6 of the member depth.

The distance from the edges of all openings in primary support members to those for the passage of primary members shall not be less than the depth of the latter. The openings in primary support member webs, excepting the cutouts for the passage of primary members, shall be at least half the primary support member depth away from the toes of the bracket attaching the member. Where it is impracticable to meet that requirement, compensation shall be provided by local thickening of the web, fitting of collars, etc.

In all cases, the sectional area of a primary support member (excluding cutouts) shall be no less than the required in the relevant chapters of this Part of the Rules.

The requirements for the openings in floors, bottom stringers and the vertical keel are given in 2.4.2.6.

2.1.7.4 Details of welded structures.

2.1.7.4.1 The face plates and/or webs of the primary support member shall be snipped at the member ends depending on the construction used for attachment of members.

2.1.7.4.2 The width of flange (face plate) shall not be less than eight knee (bracket) thicknesses unless expressly provided otherwise in the relevant chapters of this Part of the Rules.

2.1.7.4.3 The edges of brackets, face plates and webs of the members shall be welded all around and be free of craters. The above is also applicable to air and drain holes and to the cutouts for primary support members and welded joints getting through. Where those openings are carried to the deck or bottom shell plating, their length as measured along the plating shall comply with the requirements of 2.1.7.5.7.

2.1.7.4.4 Welded jointss shall be arranged in the least stressed structural sections, as far as practicable from the abrupt changes of sections, openings and details which were subject to cold forming.

2.1.7.4.5 The butt joints of the face plates of the intersection girders under variable dynamic loads (e.g. in regions with high level of vibration) shall be made with smooth transitions by means of diamond plates.

2.1.7.4.6 It is recommended that local concentration of welds, crossings of welds at an acute angle, as well as close locations of parallel butts or fillet welds and butt welds, be avoided. The distance between parallel welded joints, whatever their direction, shall not be less than:

200 mm between parallel butt welds;

75 mm between parallel fillet and butt welds;

50 mm between parallel fillet and butt welds on a length not exceeding 2 m.

The distance between welds may be reduced if agreed by the Register. The angle between two butt welds shall not be less than 60° (refer to Fig. 2.1.7.4.6).

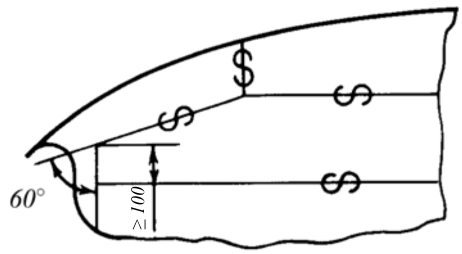


Fig. 2.1.7.4.6

2.1.7.4.7 The butts (seams) in assembling joints of the plating shall be located at a distance not less than 200 mm from the bulkheads, decks, inner bottom plating, promary support members fitted parallel to the above-mentioned joints.

In assembling joints, the welded butts of built-up members shall be arranged so that the butts of a member web are not less than 150 mm clear of the butts of this member face plate.

On agreement with the Register, the butts of webs and face plates may be arranged in the same plane

provided that:

full penetration welding is ensured at the connection of the web to face plate on a length of at least 100 mm each side of the butt by non-destructive testing of the welded butt in every third member;

overlapping of the butt by the primary support members (knees, brackets, etc., fitted in line with the web) is ensured on a length not less than the face plate width each side of the butt.

2.1.7.5 Types and dimensions of fillet welds.

2.1.7.5.1 The design throat thickness a, in mm, of fillet welds for tee-connections for manual and semi-automatic welding shall not be less than

$$a = \alpha \beta s \qquad (2.1.7.5.1)$$

where α = weld strength factor according to Table 2.1.7.5.1-1;
β = factor according to Table 2.1.7.5.1-2 depending on the ratio of the weld pitch t, in mm, to the weld length l , in mm (refer to Fig. 2.1.7.5.1-1);
s = lesser thickness of the parts to be joined, in mm.

Table 2.1.7.5.1-1

Nos.	Connection of structural members	Weld strength factor α
1	2	3
1	**Double bottom**	
1.1	Centre girder and duct keel to plate keel	0,35
1.2	Ditto to inner bottom plating	0,25
1.3	Ditto to inner bottom plating in the engine room and in way of thrust bearings	0,35
1.4	Floors to vertical keel and duct keel under engines, boilers, thrust bearings and within 0,25 L from the fore perpendicular	0,35
1.5	Floors to centre girder and duct keel elsewhere	0,25
1.6	Floors to margin plate and inner bottom plating	0,35
1.7	Watertight floors, portions of side girders or centre girder round the boundaries of tanks, plating of bilge wells to their bottom plates and to inner bottom, floors and side girders	0,35
1.8	Floors and side girders to shell plating within 0,25 L from the fore perpendicular	0,25
1.9	Ditto elsewhere	0,2
1.10	Floors and side girders to inner bottom plating under engines, boilers and thrust bearings	0,25
1.11	Ditto elsewhere	0,15
1.12	Floors to side girders within 0,25 L from the fore perpendicular	0,25
1.13	Ditto elsewhere	0,2
1.14	Margin plate to shell plating	0,35
1.15	Inclined margin plate to inner bottom plating	0,35
1.16	Bracket floors: bottom frames and brackets to shell plating	0,15
1.17	Reverse frames and brackets to inner bottom plating	0,1
1.18	Brackets, frames (refer to 2.4.4.5) to duct keel, plate keel, shell and inner bottom plating	0,35
1.19	With longitudinal framing, bottom transverses to shell, inner bottom plating, centre girder and duct keel, margin plate where the floor spacing is less than 2,5 m outside the regions defined in 1.4 and 1.7	0,25
1.20	Ditto, with floors spaced 2,5 m and over apart, in all regions	0,35
1.21	Longitudinals to shell plating within 0,25 L from the fore perpendicular	0,17
1.22	Ditto in elsewhere	0,13
1.23	Longitudinals to inner bottom plating	0,1
1.24	Brackets (refer to 2.4.2.4.2) to shell plating, margin plate, inner bottom plating and longitudinals	0,25
2	**Single bottom**	
2.1	Centre girder to plate keel	0,35
2.2	Centre girder to face plate	0,25
2.3	Floors to centre girder and longitudinal bulkheads	0,45
2.4	Floors and side girder webs to their face plates and to shell plating under engines, boilers and thrust bearings, and also in the after peak	0,25
2.5	Floors and side girder webs to shell plating in other areas	Refer to 1.8, 1.9, 1.19 and 1.20
2.6	Ditto, to their face plates elsewhere	0,15
2.7	Side girder webs to floors	0,20
2.8	Bottom longitudinals to shell plating	Refer to 1.21 and 1.22
3	**Side framing**	
3.1	Frames (including web frames) and side stringers to side plating within 0,25 L from the fore perpendicular, in tanks, engine room, in way of ice strengthening, and also in way of side strengthening of craft mooring at sea alongside other craft or offshore units	0,17
3.2	Ditto elsewhere	0,13
3.3	Frames (including web frames) and side stringers to their face plates in regions specified in 3.1	0,13
3.4	Ditto elsewhere	0,1
3.5	Frames (including web frames) and side stringers to shell plating in the after peak	0,25
3.6	Ditto to their face plates	0,17
3.7	Side stringers to web frames	0,25
3.8	Side longitudinals to shell plating	0,17
3.9	Ditto to their face plates	0,15
3.10	Bilge brackets to margin plate and face plates of floors outside double bottom	0,351
3.11	Ditto to shell plating	0,25
4	**Deck framing and decks**	
4.1	Deck transverses and girders to deck plating	0,17
4.2	Ditto to their face plates	0,13

1	2	3
4.3	Cantilever beams to deck plating and to their face plates	0,25
4.4	Webs of deck transverses to girder webs and bulkheads	0,25
4.5	Beams in way of tanks, fore and after peaks, and hatch end beams to deck plating	0,15
4.6	Ditto, elsewhere	0,1
4.7	Deck longitudinals to deck plating and their face plates	0,1
4.8	Stringer plate of strength deck to shell plating	0,45[2]
4.9	Ditto for other decks and platforms	0,35[1]
4.10	Hatch coamings to deck at hatch corners	0,45[2]
4.11	Ditto, elsewhere	0,35[3]
4.12	Face plates of hatch coamings to vertical plates of same	0,25
4.13	Stays, horizontal and vertical stiffeners to vertical plates of hatch coamings	0,2
4.14	Side and end bulkheads of superstructures and deckhouses to deck plating	0,35
4.15	Other bulkheads of superstructures and deckhouses to deck plating	0,25
4.16	Bulwark stays to bulwark plating	0,2
4.17	Bulwark stays to deck and guard rail	0,35
4.18	Pillars to deck and inner bottom, pillar brackets to pillars, decks, inner bottom and other members	0,35
5	**Bulkheads and partitions**	
5.1	Fore and after peak bulkheads, tank (cargo oil tank) boundaries, bulkheads (including wash bulkheads) inside after peak around the perimeter	0,35
5.2	Other watertight bulkheads (including wash bulkheads) to bottom shell or inner bottom plating, shell plating in way of the bilge	0,35
5.3	Ditto to sides and deck	0,25
5.4	Vertical box corrugations of corrugated bulkheads to inner bottom plating or upper strake of lower stool	0,35
5.5	Shaft tunnel plating all round	0,35
5.6	Vertical and horizontal stiffeners to bulkhead plates under 5.1, and to wash bulkheads	0,15
5.7	Ditto of other bulkheads	0,1
5.8	Vertical webs and horizontal girders to bulkhead plates according to 5.1, and to wash bulkheads	0,17
5.9	Ditto to their face plates	0,13
5.10	Vertical webs and horizontal girders to plating of other bulkheads	0,13
5.11	Ditto to their face plates	0,1
5.12	Transverse bulkheads to wash bulkheads	0,35[1]
6	**Brackets and stiffeners**	
6.1	Brackets for interconnection of primary support members	0,35[1]
6.2	Stiffeners and tripping brackets (refer to 2.1.7.3.2) of primary support members, floors, etc.	0,1
7	**Foundations for main engines, boilers and other machinery**	
7.1	Vertical plates to shell plating, inner bottom and deck plating	0,35[4]
7.2	Top plates (face plates) to longitudinal girders, brackets and knees	0,45[2]
7.3	Brackets and knees of foundations to vertical plates, shell plating, inner bottom (floor face plates) and deck plating	0,35[4]
7.4	Brackets and knees to their face plates	0,25

[1] Double continuous weld required.
[2] Full penetration welding required.
[3] Fillet welds attaching face plates to member webs shall shall be welded in way of brackets with weld factor of 0,35. The face plates shall be welded to the brackets by the same weld as the one used for welding the member in the the span between the brackets.
[4] The structures under the girder webs, brackets and knees of foundations shall be welded to the inner bottom and deck plating by a double continuous fillet weld with the weld strength factor of 0,35.

Table 2.1.7.5.1-2

Type of fillet weld	β
Double continuous	1,0
Staggered, chain and scalloped	t/l
Single continuous	2,0
Single intermittent	$2t/l$

The relationship between the leg length of the fillet weld and the height of the isosceles triangle inscribed in the bead cross-section (refer to Fig. 2.1.7.5.1-2) shall be assumed as $k = 1{,}4\,a$ or $a = 0{,}7\,k$. When automatic welding is used instead of the proposed manual welding, the weld throat or leg length (whichever is adopted in calculations) may be reduced, but no more than by 30 per cent for single-run welds. The above reduction for multirun welds is subject to special consideration by the Register.

Where the thickness of the thinner of the items to be joined is less than half the thickness of the thicker one, the leg length are subject to special consideration by the Register.

The fillet weld throat a shall be no less than:

2,5 mm for $s \le 4$ mm;

3,0 mm for $4 < s \le 10$ mm;

3,5 mm for $10 < s \le 15$ mm;

$0{,}25\,s$ for $s > 15$ mm.

The dimensions of fillet weld assumed from calculations shall not exceed $a \le 0{,}7\,s$ ($k \le s$).

2.1.7.5.2 Overlapping connections, if allowed (refer to 2.1.7.2.1), shall be welded all around by the continuous weld having a weld strength factor of 0,4. The overlap value shall be no less than $b = 2\,s + 25$, but not more than 50 mm (s = thickness of the thinner of the plates to be joined, in mm).

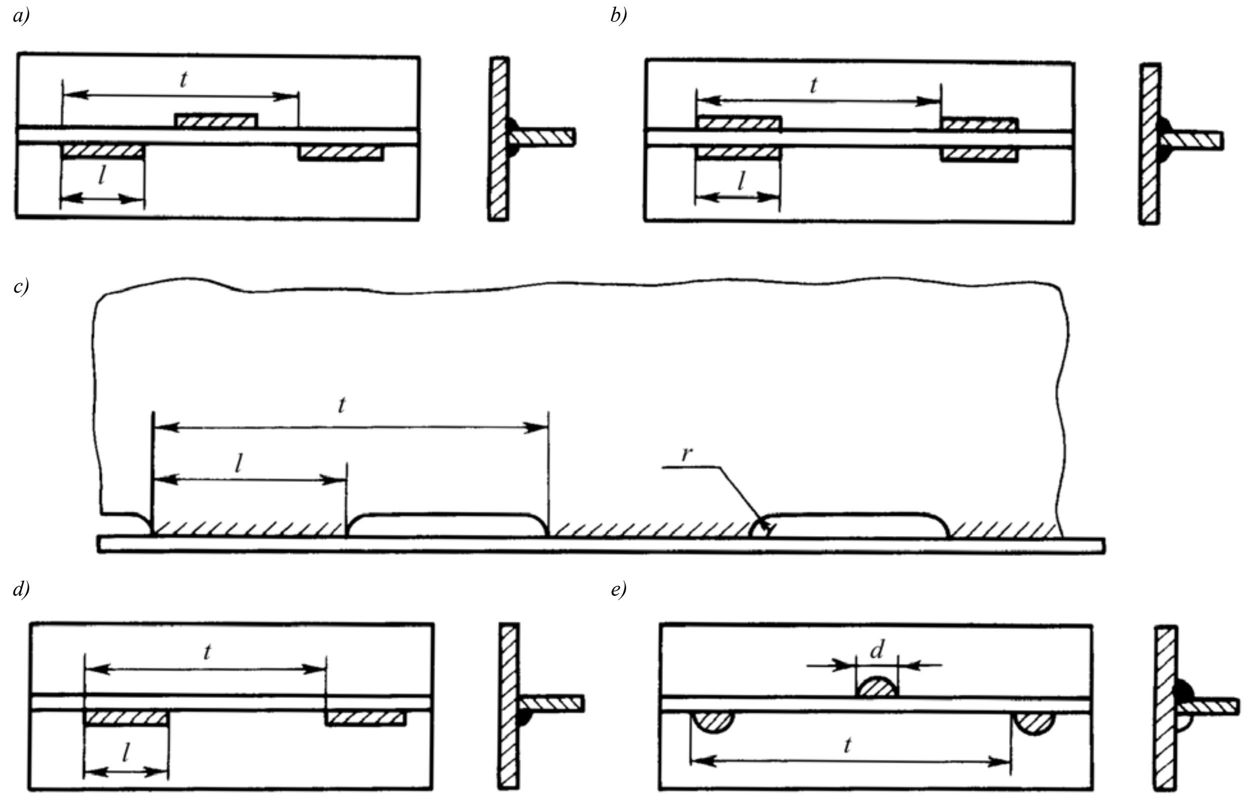


Fig. 2.1.7.5.1-1

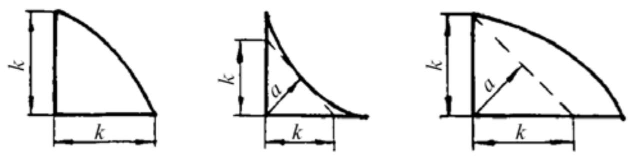


Fig. 2.1.7.5.1-2

2.1.7.5.3 The primary members (beams, deck longitudinals, frames, bulkhead stiffeners, etc.) shall be connected to their primary support members (deck girders, deck transverses, side stringers, horizontal girders, etc.) by the weld having a weld strength factor of 0,35.

In this case, the sectional area f, in cm^2, of the welds connecting the primary member webs to their primary support members shall not be less than the determined by the formula

$$f = 25pal/\sigma_n \qquad (2.1.7.5.3)$$

where p = conditional pressure specified in the relevant chapters of this Part of the Rules, in kPa;
a = spacing of members, in m;
l = span of members, in m;
for σ_n, refer to 2.1.1.3.

The weld sectional area f of welds is determined as the sum of the products of the fillet weld throat by the weld length for each portion of the connection between the member and its primary support member.

2.1.7.5.4 The primary support members cut at the intersection with the other ones shall be in good alignment. The misalignment shall not exceed half the thickness of the member cut. Where the continuity of these members is ensured by their direct welding to the web of the structure, they are cut at, the fillet weld throat shall be determined depending on the thickness of the cut member or welding with full penetration shall be used. If the thickness of the thinner of the parts to be joined is less than 0,7 times the thickness of the the other part, the fillet weld throat shall be calculated considering the particular loading conditions in way of the intersection.

Where longitudinals are cut at transverse bulkheads, the construction used for their attachment shall meet the following requirements:

.1 where the brackets are fitted in line on both sides of the bulkhead, the area f_1, in cm^2, of the weld connecting the brackets (and butts of longitudinals if welded) to the transverse bulkhead (refer to Fig. 2.1.7.5.4, *a*) shall be no less than the determined by the formula

$$f_1 = 1{,}75\,S_0 \qquad (2.1.7.5.4.1)$$

where S_0 = cross-sectional area of the longitudinal (no effective flange), in cm^2.

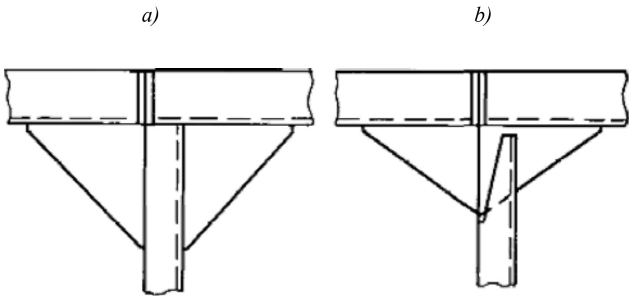


Fig. 2.1.7.5.4

.2 if one continuous bracket plate welded in the appropriate slot of the bulkhead plating is fitted (refer to Fig. 2.1.7.5.4, *b*), the sectional area of the bracket in the bulkhead plane shall not be less than 1,25 S_0;

.3 the arm length l_{br}, in mm, of brackets lengthwise of longitudunals shall not be less than the determined by the formula

$$l_{br} = ((1{,}75\,S_0 - S_1) \cdot 10^2)/2a \qquad (2.1.7.5.4.3)$$

where S_1 = area of the weld connecting the longitudinal butt to the transverse bulkhead, in cm^2;
a = assumed design thickness of the fillet weld connecting the bracket to the longitudinal, in mm.

2.1.7.5.5 Double continuous welds shall be used in the following regions (refer also to Note 1 to Table 2.1.7.5.1-1):

.1 in way of foundations for arrangements, machinery and equipment being the potential source of vibration: for connecting the primary support members to the bottom plating and the inner bottom plating, and the deck framing to the deck plating;

.2 in the after peak;

.3 in way of supports and the ends of members: for connecting the primary support members to the plating (refer to 2.1.7.5.7);

.4 for structures ensuring tightness.

2.1.7.5.6 Single continuous welds shall not be used:

.1 within 0,2 L from the fore perpendicular: for connecting the side framing to the shell plating; and within 0,25 L from the fore perpendicular: for connecting the bottom framing to the shell plating;

.2 in way of intense vibration (refer to 2.1.7.1.6);

.3 for welding the side framing in the craft mooring at sea alongside other craft or offshore units;

.4 for connections wherein the angle between the member web and the plating differs by more than 10° from a right angle.

2.1.7.5.7 The welding length l for all types of intermittent welds (refer to Fig. 2.1.7.5.1-1) shall not be less than 15 a (for a, refer to 2.1.7.5.1) or 50 mm, whichever is greater. The spacing of welds $(t - l)$ for chain and scalloped welds, $(t - 2\,l)/2$ for staggered welds shall not exceed 15 s (s = thickness of the plate or member web, whichever is less, in mm). In any case, the spacing of weldis or the scallop length (where scalloped frames are used) shall be within 150 mm.

Intermittent or single continuous welds connecting the primary support members to the plating shall be substituted in way of the supports and member ends by double continuous welds with the same throat as that of the intermittent (single continuous) weld within the rest length of the member. The length of joints welded by double welds shall not be less than the sum of the bracket arm and web depth if a bracket is fitted, and shall be twice the web depth if no bracket is fitted. Where the primary support members pass through supporting structures (deep transverses, deck girders, floors, etc.) the above reinforcement shall be provided on both sides of the supporting member. Where single continuous welds are used, back runs at least 50 mm long and spaced not more than 500 mm apart shall be welded on the reverse side of the web of the detail to be joined. The welding throat thickness shall be the same as that of the single continuous weld.

2.1.7.5.8 Staggered spot welds and single intermittent welds (refer to Fig. 2.1.7.5.1-1, *d* and *e*) are allowed in the structures of the deckhouses and superstructures of the second tier and above, on decks inside the first tier superstructure, casings and enclosures inside the hull, which are not subjected to intense vibration and impact loads, and not affected by active corrosion, provided that the maximum plate or member web thickness is not more than 7 mm.

The spot diameter d, in mm, shall be not less than the determined by the formula

$$d = 1{,}12\,\sqrt{(\alpha\, t\, s)} \qquad (2.1.7.5.8)$$

where t = pitch of a spot weld (refer to 2.1.7.5.1-1);
t_{max} = 80 mm;
for α and s, refer to 2.1.7.5.1.

If $d > 12$ mm, as determined by Formula (2.1.7.5.8), the weld pitch shall be reduced or another type of weld shall be chosen.

2.1.7.5.9 Scalloped construction shall not be used :

.1 for the side framing within 0,2 L from the fore perpendicular and for connecting the primary support members to the bottom plating within 0,25 L from the fore perpendicular;

.2 in way of intense vibration (refer to 2.1.7.1.6);

.3 for the side framing in the craft mooring at sea alongside other craft or offshore units;

.4 for connecting the bottom centre girder to the plate keel;

.5 for the upper deck framing under deckhouses in way of their ends at a distance of less than 0,25 of the deckhouse height from the intersection of the deckhouse side and end bulkheads.

2.1.7.5.10 In scalloped construction (refer to Fig. 2.1.7.5.1-1) the welding shall be carried round the ends of lugs. The depth of a scallop in the member web shall not exceed 0,25 of the member depth or 75 mm, whichever is less. The scallops shall be rounded with a radius of no less than 25 mm. The spacing between the edges of adjacent scallops *l* (the lug length) shall not be less than the scallop length. The scallops in frames, beams, stiffeners and similar structures shall be kept clear of the member ends, as well as intersections with primary support members (deck and side stringers, carlings, etc.) by at least twice the member depth, and from the bracket toes, by at least half the member depth.

2.1.7.5.11 Provision shall be made for openings in the framing of tanks (including double bottom tanks) to ensure the free air flow to air pipes and the overflow of fluid.

The openings in longitudinals are recommended to be of an elliptical shape and their edge shall be away from the deck plating or bottom plating by no less than 20 mm.

Double welding shall be used on both sides of the cutout within 50 mm in way of the cutouts for air and drain holes, for passing framing members and welds.

2.1.7.5.12 Where the welding of tee-joints by a fillet weld is impracticable, plug welds (refer to Fig. 2.1.7.5.12, *a*) or tenon welds (refer to Fig. 2.1.7.5.12, *b*) may be used.

The length *l* and the pitch *t* shall be specified as for the scalloped frames under 2.1.7.5.10.

For plug welding, the slots shall be of a circular or linear shape and the throat shall be 0,5 of the plate thickness. In this case, the slot ends shall generally be of a semicircular shape. The linear slots shall be arranged with longer side in the direction of the parts to be jopined (refer to Fig. 2.1.7.5.12, *b*).

Complete filling of a slot shall not be permitted.

In regions of intense vibration (refer to 2.1.7.1.6), the welded joints with complete root penetration on a permanent backing ring(refer to Fig. 2.1.7.5.12, *c*) is recommended instead of tenon welds or plug welds.

The tests of craft's hulls shall be carried out in compliance with Appendix 1 to Part II "Hull" of the Rules for the Classification and Construction of Sea-Going Ships, as appropriate.

2.2 SHELL PLATING

2.2.1 General.

2.2.1.1 This Chapter contains the requirements for the thickness of bottom and side shell plating, the thickness and width of the sheerstrake, plate keel, gar-board strakes, as well as the requirements for the minimum structural thickness of these members and for the design of openings therein. The requirements apply to all the regions along the craft's length and throughout the craft's depth unless additional requirements for the shell plating thickness are stipulated.

2.2.1.2 For the purpose of this Chapter the following symbols have been adopted:

p_{st} = design static pressure according to 2.1.4.6.1;

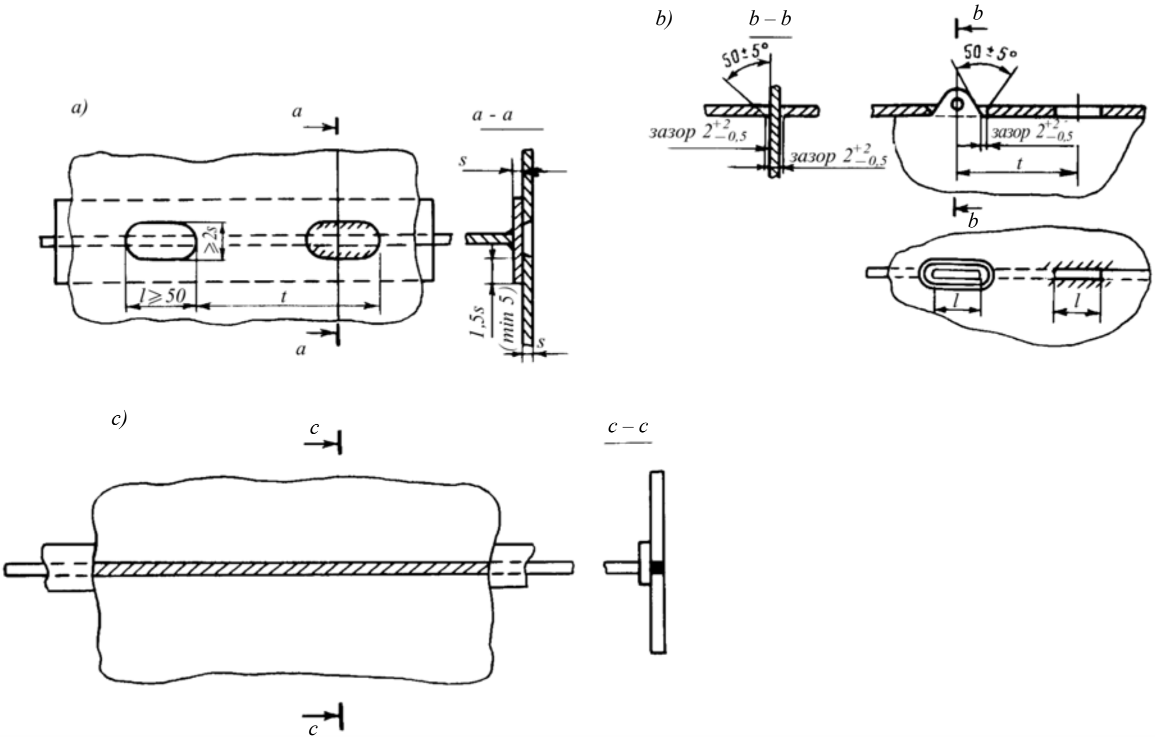


Fig. 2.1.7.5.12

p_w = design pressure due to the motion of craft's hull about the wave contour according to 2.1.4.6.2;

p_F = design pressure due to ballast or fuel oil according to 2.1.4.8.

2.2.2 Construction.

2.2.2.1 No openings shall be cut in the upper edge of sheerstrake or in the side shell plating if the distance between the upper edge of opening and the strength deck is less than half the opening depth. All other cases shall be specially considered by the Register.

Rectangular openings in the side shell plating shall have their corners rounded with the radius equal to at least 0,1 of the opening depth or width, whichever is less, but no less than 50 mm.

In all cases when the openings may result in considerable reduction of longitudinal or local strength of the ship, provision shall be made for reinforcement of such areas.

Reinforcement by means of thickened insert plates is required for openings located within 0,35L from the midship region, the distance from their upper edge to the strength deck being less than the depth of opening. The minimum width of thickened insert plates, as measured from the upper or lower edge of opening, shall be equal to 0,25 of the depth or length of the opening, whichever is less; the total width measured outside the opening shall be greater than the minimum thickness by at least 0,25 of the depth or length of the opening, whichever is less. The minimum distance from the end of the thickened insert plate to the nearest edge of opening, as measured along the length, of the ship shall be equal to at least 0,35 of the depth or length of opening, whichever is less. The corners of the thickened insert plate shall be rounded. The thickened insert plate thickness shall be no less than 1,5s. The thickened insert plate may be fitted around the entire cutout perimeter.

2.2.3 Loads on shell plating.

The external pressure p, in kPa, on the bottom and side shell plating is determined by the formula

$$p = p_{st} + p_w \qquad (2.2.3\text{-}1)$$

As the design pressure, the external or internal one may be adopted, whichever is greater.

The pressure p_w above the maximum summer waterline shall not be less than $p_{\min}$, in kPa, determined by the formula

$$p_{\min} = 0{,}03\,L + 5. \qquad (2.2.3\text{-}2)$$

For the craft of the design categories of a restricted area of navigation, the value of $p_{\min}$ may be reduced by multiplying by the factor φ_r obtained from Table 2.1.4.5.

2.2.4 Scantlings of plate structures of shell plating.

2.2.4.1 The thickness of bottom and side shell plating shall not be less than the determined by Formula (2.1.6.4.4) taking

m = 15,8;

for bottom shell plating:

k_σ = 0,6 in the midship region of the craft of 12 m long with the transverse framing system;

k_σ = 0,56 in the midship region of the craft of 24 m long with the transverse framing system;

where 12 m < L < 24 m, k_σ is determined by linear interpolation;

k_σ = 0,6 in the midship region of the craft with the longitudinal framing system;

k_σ = 0,7 at the craft's ends within 0,1 L from the fore or after perpendicular.

For the regions between the midship region and the above portions of craft's ends, k_σ is determined by linear interpolation;

for side shell plating in way of (0,4 – 0,5) D from the base line:

k_σ = 0,6 in the midship region of the craft;

k_σ = 0,7 at the craft's ends within 0,1 L from the fore or after perpendicular.

For the regions between the midship region and the above portions of craft's ends, k_σ is determined by linear interpolation;

for the region below 0,4 D from the base line, k_σ is determined by linear interpolation between the values of k_σ for the bottom shell plating and side shell plating in way of (0,4 – 0,5) D from the base line;

for the region above 0,5 D from the base line, k_σ is determined by linear interpolation between the values of k_σ for the upper deck level and side shell plating in way of (0,4 – 0,5) D from the base line.

2.2.4.3 The thickness of a bilge strake shall be adopted equal to that of the bottom or side shell plating,whichever is greater.

2.2.4.4 The width of a plate keel b_k, in mm, shall not be less than that determined by the formula

$$b_k = 800 + 5\,L. \qquad (2.2.4.4)$$

The plate keel thickness shall be by 2 mm greater than that of the bottom shell plating.

2.2.4.5 The width of a sheerstrake b_s, in mm, shall be no less than the determined by Formula (2.2.4.4). The sheerstrake thickness amidships shall not be less than that of the adjoining strakes of side shell or deck plating (stringer plate), whichever is greater. The sheerstrake thickness at craft's ends may be equal to that of the side shell plating in the given region.

2.2.4.6 The shell plates adjoining to the sternframe, as well as the plates to which the arms of propeller shaft brackets are attached shall have a thickness s, in mm, not less than that determined by the formula

$$s = 0{,}1\,L + 4{,}4. \qquad (2.2.4.6)$$

The aforesaid thickness shall be ensured after hot bending, if applied.

2.2.4.7 The thickness of garboard strakes directly adjoining the bar keel shall not be less than the required for the plate keel, and their width, not be less than half the width required for the plate keel according to 2.2.4.4.

2.2.4.8 In any case, the thickness of shell plating s_{min}, in mm, shall be less not than that determined by the formula

$$s_{min} = 3,1 + 0,12L. \qquad (2.2.4.8)$$

Where the spacing adopted is less than the standard one (refer to 2.1.1.1), the minimum thickness of shell plating for the craft of design categories **A** and **A1** may be reduced proportionally to the ratio of the adopted spacing to the standard one, but no more than by 10 per cent.

2.2.5 Special requirements.

2.2.5.1 The upper edge of sheerstrake shall be smooth, and their corners shall be well rounded in the transverse direction.

2.2.5.2 Bilge keels shall be attached to the shell plating by means of an intermediate member, i.e. a flat bar welded to the shell plating with an all-round continuous fillet weld. Connection of the bilge keel to this member shall be weaker than that of the member to the shell plating. However, the connection shall be strong enough to keep the bilge keels under the ordinary operating conditions of the craft. The intermediate member shall be made continuous over the length of bilge keel. Bilge keels shall terminate in the stiffened area of shell plating and shall be gradually tapered at ends.

2.2.5.3 In bottom-and-side fittings, the welded branch wall thickness shall not be less than that of shell plating determined according to 2.2.4.8, or 12 mm, whichever is greater.

2.3 SINGLE BOTTOM

2.3.1 General.

2.3.1.1 This Chapter contains the requirements for the bottom framing of ships having no double bottom and in way where it is omitted, as well as for the floors, centre girder, bottom longitudinals and the brackets by which they are connected.

2.3.1.2 For the purpose of this Chapter the following symbols have been adopted:

L_1 = length of the compartment concerned (hold, tank, engine room, etc.), in m;

B_Y = breadth of the compartment concerned, in m;

B_x = breadth of craft in m, in way of considered section at the level of maximum summer waterline.

2.3.2 Construction.

2.3.2.1 The structure of centre girder shall satisfy the following requirements:

.1 the centre girder shall extend throughout the craft's length as far as practicable;

.2 when the bottom is framed longitudinally, the centre girder shall be stiffened on both sides with flanged brackets fitted between the bottom trans-verses and between bottom transverse and transverse bulkhead. The distance between brackets, between bracket and bottom transverse or between bracket and transverse bulkhead shall not exceed 1,2 m.

The brackets shall be carried to the face plate of the centre girder if the web of the latter is stiffened vertically or to the second horizontal stiffener from below if the centre girder web is stiffened horizontally.

In way of bottom plating, the brackets shall extend to the nearest bottom longitudinal and shall be welded thereto.

2.3.2.2 When the bottom is framed transversely, floors shall generally be fitted at every frame.

Where the floors are cut at the centre girder, their face plates shall be butt-welded to the face plate of the centre girder. If the actual section modulus of floors exceeds the value required by 2.3.4.1.2 less than 1,5 times, the width of their face plates shall be doubled, where attached to the centre girder face plate, or horizontal brackets of adequate size shall be fitted.

The floor face plates may be replaced by flanges.

Flanged floors are not permitted in way of engine room, in the after peak.

2.3.2.3 When the bottom is framed longitudinally, brackets shall be fitted in line with the bottom transverse web on both sides of the centre girder where the girder is higher than the bottom transverse at the place of their connection. A bracket shall be welded to bottom transverse face plate and to centre girder web and face plate. The free edge of the bracket shall be stiffened with a face plate, and the angle of its inclination to bottom transverse face plate shall not exceed 45°.

Similar requirements apply to the connections of the stringer to bottom transverse where the stringer is higher than the bottom transverse at the place of connection

2.3.2.4 The spacing of side girders and the distance from the centre girder or ship's side to the side girder shall not exceed 2,2 m.

The side girder plates shall be cut at floors and welded thereto.

The face plates of side girders shall be welded to those of floors

2.3.2.5 In the engine room, the centre girder may be omitted if the longitudinal girders under engine seating extend from the fore to the after bulkhead of the engine room and terminate with brackets beyond the bulkhead according to 2.3.5.1.

2.3.2.6 The webs of centre girder, side girders and floors shall be stiffened in accordance with 2.1.7.3.

2.3.2.7 Connections of bottom longitudinals to transverse bulkheads shall be such that the effective sectional area of the longitudinals is maintained.

2.3.3 Single bottom loading.

2.3.3.1 The static pressure p_{st} in Formula (2.2.3-1) shall be determined at the maximum summer draught.

2.3.4 Scantlings of single bottom members.

2.3.4.1 The bottom with transverse framing shall satisfy the following requirements:

.1 the depth of floors at the centreline shall not be less than $0{,}055\,B_1$. In any case, B_1 shall not be assumed less than $0{,}6\,B_x$. Allowable reduction of floor depth shall not be more than 10 per cent, the required floor section modulus being maintained.

In the engine room, the height of floor web between longitudinal girders under the seating shall not be less than 0,65 of the required depth at the centreline. In this case, the reduction of the floor section modulus by more than 10 per cent as compared to that required by 2.3.4.1.2 is not permitted.

At a distance of $0{,}37\,B_x$ from the centreline, the depth of floors shall not be less than 50 per cent of the required depth of the centreline floors.

.2 at the centreline, the section modulus of floors shall not be less than determined according to 2.1.6.4.1 and 2.1.6.4.2. In this case:

$m = 13$;

$k_\sigma = 0{,}6$;

$l = B_1$ but not less than $0{,}6\,B_x$;

for p, refer to 2.3.3.1, but not less than 35 kPa.

On portions equal to $0{,}05\,B_x$ from the craft's side the floor web sectional area shall not be less than determined according to 2.1.6.4.3 taking

$N_{max} = 0{,}4pal$;

$k_\sigma = 0{,}6$.

When determining p and l the above limitations shall be used:

.3 in accordance with 2.3.4.1.2, the section modulus of centre girder shall be at least 1,6 times greater than the section modulus of a floor at the centreline. The depth of centre girder shall be equal to that of a floor at the place of their connection;

.4 the section modulus of a side girder shall not be less than the section modulus of a floor at the centreline in accordance with 2.3.4.1.2. The depth of side girder shall be equal to that of the floor at the place of their connection.

2.3.4.2 The thickness of single bottom members s, in mm, shall not be less than that determined by the formula

$$S_{min} = 5{,}3 + 0{,}04\,L. \qquad (2.3.4.2)$$

The value s_{min} for the the vertical keel shall be increased by 1,5 mm, but shall not exceed the thickness of the plate keel; the thickness of the floor web need not exceed that of the bottom shell plating.

2.3.5 Special requirements.

2.3.5.1 End attachments of bottom members and primary support member web stiffening shall satisfy the following requirements:

.1 centre girder and side girders shall be attached to transverse bulkheads by brackets. For size of brackets, refer to 2.1.7.2.3;

.2 the height of brackets may be reduced to half the centre girder depth if the face plate of centre girder is welded to the transverse bulkhead. In case the centre girder face plate is widened to at least twice the normal value in way of abutting upon the transverse bulkhead, the brackets need not be fitted. If the centre girder is not fitted in the engine room, then at discontinuities beyond bulkheads it shall be terminated in gradually tapered brackets of a length equal to twice the centre girder depth, but not less than three spacings.

2.3.5.2 If transverse system of framing is adopted, the holes cut in floors shall have a diameter not exceeding 0,5 of the floor depth in this location. The distance between the hole edge and floor face plate shall not be less than 0,25 times the floor depth in this location. The distance between the edges of adjacent holes shall not be less than the floor depth. Floor plates provided with holes shall be strengthened with vertical stiffeners.

2.3.5.3 The webs of side girders and floors shall be provided with drain holes.

2.4 DOUBLE BOTTOM

2.4.1 General.

This Chapter contains the requirements for double bottom structures including bottom framing up to the top of bilge rounding, inner bottom plating and framing, centre girder and duct keel, side girders and half-height girders, margin plate with stiffeners, brackets, knees and intermediate vertical stiffeners in the double bottom space, sea chests and drain wells.

2.4.2 Construction.

2.4.2.1 The centre girder shall extend fore and aft as far as practicable to the stem and sternframe and shall be attached to them whenever possible. The centre girder shall generally be continuous within at least $0{,}6\,L$ amidships. Where longitudinal framing is adopted in the double bottom, brackets shall be fitted on both sides of centre girder, which shall be spaced not more than 1,2 m apart, extended to the nearest longitudinal or ligthened side girder and welded thereto.The distance between brackets shall not exceed 1,2 m.

2.4.2.2 In lieu of centre girder, a duct keel may be fitted consisting of two plates arranged on both sides of the centreline. The duct keel shall be wide enough for the access to all its structures to be ensured. A duct keel of more than 1,9 m in width is subject to special consideration by the Register.

Transverse members with brackets shall be fitted at every frame in way of the bottom and inner bottom plating between the side plates of the duct keel.

If longitudinal system of framing is adopted, brackets shall be fitted at every frame on both sides of the duct keel, similar to those used for the centre girder.

Where the duct keel fitted only over a part of the ship's length terminates and is transformed into the centre girder, the duct keel and centre girder plates shall overlap over a length of at least one frame spacing and shall terminate in brackets with face plates. In this case, the length of the brackets shall not be less than three spacings if the transition areas lie within 0,6 L amidships, and not less than two spacings elsewhere.

2.4.2.3 The design of side girders and margin plate shall satisfy the following requirements:

.1 the spacing of side girders and the distance between a side girder and centre girder or margin plate, as measured at the level of the double bottom plating, shall not exceed 4,2 m for transversely framed double bottom and 5,0 for longitudinally framed double bottom;

.2 if longitudinal framing is adopted in the double bottom, lightened side girders may be fitted on bottom and double bottom instead of longitudinals (for panels with large openings, refer to 2.4.2.7.2 and 2.4.2.7.4);

.3 where there are two tunnels symmetrical with regard to the centreline, their design is subject to special consideration by the Register;

.4 in the engine room, the arrangement of side girders shall be consistent with that of the engine, boiler and thrust block seatings, so that at least one of the longitudinal girders under the seating is fitted in line with the side girder. In this case, an additional side girder shall be provided under the seating in line with the second longitudinal.

Where side girders cannot be arranged under the seatings in line with longitudinal girders, additional side girders shall be fitted under each longitudinal girder.

Additional side girders may be replaced by half height side girders welded to the inner bottom plating and floors only, if approved by the Register;

.5 inclined margin plate, if fitted, shall extend throughout the double bottom length.

2.4.2.4 The arrangement and design of floors shall meet the following requirements:

.1 if transverse framing is adopted in the double bottom, plate floors shall be fitted at every frame:

in engine and boiler rooms;

at the fore end within 0,25 L from the fore perpendicular;

in the craft which may get on the ground being anchored during the falling tide.

The solid floors may be fitted in other regions in five spacings or 3,6 m, whichever is less. In this cases, open (bracket or lightened) floors shall be fitted between them.

Bracket floors consist of bottom and reverse frames connected with brackets at centre girder, side girders and margin plate (refer to Fig. 2.4.2.4.1-1).

Lightened floors consist of plate panels having large openings of a smooth shape between side girders (refer to Fig. 2.4.2.4.1-2);

.2 where the double bottom is longitudinally framed, solid floors shall generally be fitted at a distance not exceeding two spacings:

in engine and boiler rooms;

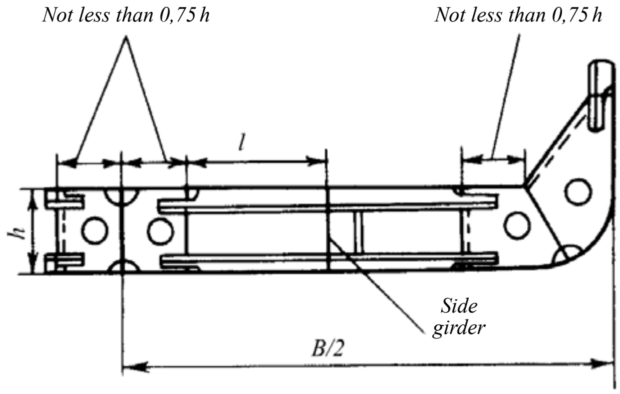


Fig. 2.4.2.4.1-1

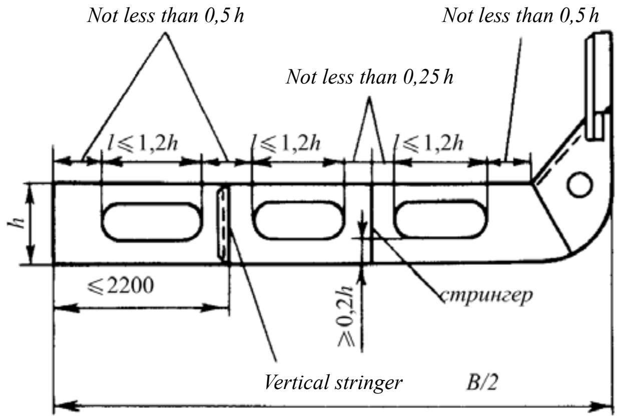


Fig. 2.4.2.4.1-2

at the fore end within 0,25 L from the fore perpendicular;

in craft which may happen to be aground due to the ebb-tide in ports.

In other regions, plate floors may be fitted five spacings or 3,6 m apart, whichever is less. Where lightened side girders are fitted in lieu of bottom and double bottom longitudinals (refer to 2.4.2.3.2), the above spacing may be increased, but not more than twice.

When the ship's side is framed transversely and double bottom is framed longitudinally, brackets shall be fitted at every frame between plate floors to stiffen the margin plate, which shall be carried to the nearest bottom and inner bottom longitudinals or to the nearest additional side girder, and welded thereto (refer to Fig. 2.4.2.4.2).

Under the seating of main engine, plate floors shall be fitted at every frame and carried to the nearest side girder outside the main engine seating;

.3 regardless of the requirements in 2.4.2.4.1 and 2.4.2.4.2, the plate floors shall be fitted:

under pillars and ends of longitudinal partial bulkheads;

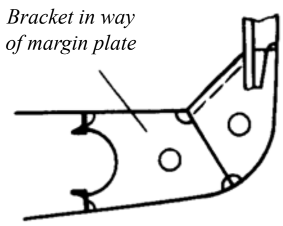


Fig. 2.4.2.4.2

under bearers and boiler bearer ends;

under transverse bulkheads and sloping plates of low trapezoidal stools of corrugated bulkheads;

under block bearing seatings.

In the above cases, the floors need not be fitted throughout the ship's breadth. Partial floors may be fitted and carried to the side girder nearest to the structure being stiffened.

2.4.2.5 Arrangement of stiffeners on centre girder and duct keel, side girders and floors shall satisfy the following requirements:

.1 stiffeners shall be provided where transverse system of framing is adopted and plate floors are more than 900 mm in depth. The spacing of stiffeners shall not exceed 1,5 m. The spacing of stiffeners of lightened floors shall not exceed 2,2 m.

If longitudinal system of framing is adopted, the stiffeners on plate floors shall be fitted in line with bottom and inner bottom longitudinals. The stiffeners shall be carried to the longitudinals and welded thereto.

The stiffeners shall be fitted under the pillars, at bracket toes of end stiffeners of longitudinal partial bulkheads, etc;

.2 watertight floors shall be fitted with vertical stiffeners spaced not more than 0,9 m apart.

2.4.2.6 Holes (manholes) shall satisfy the following requirements:

.1 an adequate number of holes (manholes) shall be provided in the inner bottom plating, side girders and floors for access to all portions of double bottom. The size of the holes, including lightening holes, shall satisfy the requirements of standards or other normative documents recognized by the Register.

Air and drain holes, cut-outs for the passage of welded joints, refer to 2.1.7.5.11;

.2 the holes in centre girder, side girders and floors shall have a smooth rounded shape. The minimum allowable height of the plate adjoining bottom shell plating or inner bottom plating is indicated in Table 2.4.2.6.2. Besides, the minimum height of the plate in way of the hole shall not be less than 1/8 of the length of the hole. The plate height indicated in Table 2.4.2.6.2 may be reduced if suitable stiffening is provided. Besides lightened side girder and floor plates shall satisfy the requirements of 2.4.4.5.4 and, where the plate height h_0, in mm, exceeds $25\,s$ (s = thickness of the web thickness, in mm, of a lightened side girder or floor), the free edge of the plate shall be stiffened;

Table 2.4.2.6.2

Member	Tle least height of panel (as fraction of member height)
Vertical keel	0,30
Bottom stringers	0,25
Lightened stringers	0,15
Floors:	
solid	0,25
lightened	0,20

.3 the distance between the edges of adjacent openings in centre girder, side girders and plate floors shall not be less than half the length of the largest opening.

The distance of the edges of openings in the floors from longitudinal bulkheads, centre girder, side girders, inclined margin plate and inner edges of hopper side tanks shall not be less than half the centre girder depth in this region. The distance of the edge of opening in a lightened floor from the side girder shall not be less than one-quarter of centre girder depth.

In exceptional cases, deviation from the above requirements is permitted;

.4 one or more consecutive openings may be permitted in a lightened side girder web between adjacent floors or in a lightened floor web between adjacent side girders. In the latter case, vertical stiffened shall be fitted between openings. The length of one opening shall not exceed 1,2 times the accepted depth of centre girder or 0,7 times the distance between floors (side girders) or between a floor (side girder) and vertical stiffener, whichever is less (refer to Fig. 2.4.2.4.1-2). The distance of the edges of openings in lightened side girders and floors from each other shall not be less than half the centre girder depth in this region;

.5 normally, openings are not permitted:

in centre girder over a length of 0,75 L from the fore perpendicular;

in centre girder and side girders (lightened side girders) under pillars and in sections adjoining transverse bulkheads (between the bulkhead and extreme floor for double bottom with transverse framing and on a length equal to the depth of double bottom with longitudinal framing);

in floors under pillars and in way of partial longitudinal bulkheads;

in floors at the toes of brackets transversely supporting main machinery seatings;

in floors between the side (inner side) and the nearest lightened side girder, provided the spacing of floors is increased in accordance with 2.4.2.4.2.

In exceptional cases, openings are permitted in the above members provided the webs in way of the openings are suitably stiffened;

.6 circular lightening openings are permitted for brackets, having a diameter not greater than 1/3 of the width or height of the bracket, whichever is less.

2.4.2.7 Connections of bottom and inner bottom longitudinals to watertight floors shall be such that the effective sectional area of these members is maintained.

2.4.3 Double bottom loads.

2.4.3.1 The external pressure on double bottom structures is determined by Formula (2.2.3-1).

2.4.3.2 Double bottom loads from inside are determined by the formula for testing

$$p = 7{,}5\,h_p \qquad (2.4.3.2)$$

where h_p = vertical distance, in m, from the inner bottom plating to the top of an air pipe.

2.4.4 Scantlings of double bottom members.

2.4.4.1 The double bottom depth h, in m, at the vertical keel shall be determined by the formula

$$h = (L - 40)/570 + 0{,}04B + 3{,}5\,d/L \qquad (2.4.4.1)$$

but not less than 0,65 m.

2.4.4.2 The centre girder and side girders shall meet the following requirements:

.1 the thickness, in mm, of centre girder shall be not less than the determined by the formula

$$s = \alpha_k h^2/h_a + \Delta s \qquad (2.4.4.2.1)$$

where h = depth of the vertical keel as required in 2.4.4.1, in m;
h_a = actual depth of the vertical keel, in m;
for Δs, refer to 1.1.5.1;
$\alpha_k = 0{,}03L + 8{,}3$, but not more than 11,2.

In any case, the centre girder thickness shall be 1 mm greater than that of a plate floor.

.2 the thickness of side girders shall be not less than that of plate floors;

.3 at the ends within 0,1 L from the fore and after perpendiculars, the centre girder web thickness may be by 10 per cent less than that in the mdship region, but not less than the minimum thickness as per 2.4.4.9.

The thickness of side plates of the duct keel shall not be less than 0,9 of that required for the centre girder in this region;

.4 the thickness of the watertight sections of the centre girder and side girders shall not be less than that determined by Formula (2.1.6.4.4). In this case:

p = according to Formulae (2.1.4.8-4) and (2.1.4.8-5) at the mid-depth of the centre girder (side girder), whichever is greater (assumed $p_v = 0$ if a safety valve is not fitted);

$m = 15{,}8$;

if the centre girder (side girder) is stiffened with vertical brackets or stiffeners amidships:

$k_\sigma = 0{,}75$ if $L = 12$ m;

$k_\sigma = 0{,}73$ if $L = 24$ m;

for 12 m < L < 24 m, k_σ shall be determined by linear interpolation;

if the centre girder (side girder) is stiffened with horizontal stiffeners amidships:

$k_\sigma = 0{,}75$;

at the ends within 0,1 L from the fore or after perpendicular:

$k_\sigma = 0{,}85$.

For the regions between the midship region and the above portions of the craft's ends, k_σ shall be determined by linear interpolation.

The thickness of the watertight sections of the centre girder and side girders need nolt be greater than that of adjacent shell plating.

2.4.4.3 Floors shall meet the following requirements:

.1 the thickness of solid floors, in mm, shall not be less than the determined by the formula

$$s = \alpha k a + \Delta s \qquad (2.4.4.3.1)$$

where $\alpha = 0{,}12L - 1{,}1$ but not greater than 6,5 for the transverse framing system;
$\alpha = 0{,}023L + 5{,}8$ for the longitudinal framing system;
$k = k_1 k_2$ – coefficients given in Tables 2.4.4.3.1-1 and 2.4.4.3.1-2, respectively;
a = spacing, in m, of stiffeners, but no greater than the actual depth of the double bottom;
for Δs, refer to 2.1.2.1.

Table 2.4.4.3.1-1

Coefficient k_1

Framing system	a_f/a				
	1	2	3	4	5
Transverse	1	1,15	1,20	1,25	1,30
Longitudinal	–	1,25	1,45	1,65	1,85

Symbols:
a_f = distance, in m, between plate floors;
a = spacing, in m.

Table 2.4.4.3.1-2

Coefficient k_2

Framing system	Number of girders per craft'side			
	0	1	2	3 and above
Transverse	1	0,97	0,93	0,88
Longitudinal	1	0,93	0,86	0,80

.2 the floors shall be strengthened with stiffeners.

The thickness of plate floors, s_{min}, in mm, between the forepeak bulkhead and 0,25 L from the forward perpendicular, in the engine room and peaks, and in the holds of the crafts which may happen to be aground due to ebb-tide shall not be less than:

for the transverse framing system:

$$s_{min} = 0{,}035L + 5; \qquad (2.4.4.3.2\text{-}1)$$

for the longitudinal framing system:

$$s_{min} = 0{,}035L + 6; \qquad (2.4.4.3.2\text{-}2)$$

.3 the thickness of watertight floors shall not be less than the determined by Formula (2.1.6.4.4). In this case:

p = according to Formula (2.1.4.8-5) for the mid-depth of the floor;

m = 15,8;

k_σ = 0,85.

In any case, the watertight floors shall not be less than that the required for plate floors in the craft's given region.

2.4.4.4 The inner bottom plating and margin plate shall meet the following requirements:

.1 the thickness of the inner bottom plating, including the margin plate, shall not be less than determined by Formula (2.1.6.4.4). In this case:

m = 15,8;

p = maximum design pressure according to 2.4.3.2;

k_σ = 0,8 in the midship region for L = 12 m and transverse framing system;

k_σ = 0,77 in the midship region for L = 24 m and transverse framing system.

If 12 m < L < 24 m, k_σ shall be determined by linear interpolation;

k_σ = 0,8 in the midship region for a longitudinal framing system;

k_σ = 0,9 at the ends within 0,1 L from the fore or after perpendicular.

For the regions between the midship region and the above portions of the craft's ends, k_σ is determined by linear interpolation.

.2 in any case, the thickness of the inner bottom plating s_{min}, in mm, shall not be less than that determined by the formula

$$s_{min} = 3,8 + 0,05\,L. \qquad (2.4.4.4.2)$$

Where the adopted spacing is less than the standard one (refer to 2.1.1.1), it is allowed for the craft of design categories **A** and **A1** to reduce the minimum thickness of the inner bottom plating proportionally to the ratio of the adopted spacing to the standard one, but no more than by 10 per cent. In any case, the minimum thickness shall not be less than 5,5 mm.

In the engine room where no wooden sheathing is provided, s_{min} shall be increased by 2 mm.

2.4.4.5 The primary members of the bottom and inner bottom shall meet the following requirements:

.1 the section modulus of bottom and inner bottom longitudinals, as well as of the bottom and reverse frames of bracket floors and duct keel shall not be less than stipulated under 2.1.6.4.1. In this case:

p = design pressure, in kPa, determined for the bottom longitudinals and the bottom frames of bracket floors and the duct keel according to 2.4.3.1, and for the inner bottom longitudinals and the reverse frames of bracket floors and the duct keel according to 2.4.3.2;

m = 12;

l = design span, in m, of longitudinal, defined as the spacing of floors for bottom and inner bottom longitudinals, as the distance betwen bracket toes or between a bracket toe and side girder for the bottom and reverse frames of bracket floors, as the spacing of webs for duct keel;

for bottom longitudinals:

k_σ = 0,45 in the midship region;

k_σ = 0,65 at the ends within 0,1 L from the fore or after perpendicular.

For the regions between the midship and the above portions of the craft's ends, k_σ is determined by linear interpolation;

for inner bottom longitudinals:

k_σ = 0,6 in the midship region;

k_σ = 0,75 at the ends within 0,1 L from the fore or after perpendicular.

For the regions between the midship and the above portions of the craft's ends, k_σ is determined by linear interpolation;

for bottom frames of bracket floors and the duct keel:

k_σ = 0,65;

for reverse frames of bracket floors and the duct keel:

k_σ = 0,75;

.2 where intermediate struts are fitted at a mid-span between the bottom and inner bottom longitudinals, the section modulus of these longitudinals may be reduced by 35 per cent;

.3 where the ratio of the span of a bottom or inner bottom longitudinal to its depth is less than 10, the sectional area of the longitudinal web shall not be less than that determined by Formula (2.1.6.4.3-1) at $N_{max} = 0,5\,pal$ (p, l = design pressure and design span, respectively, of the longitudinal as per 2.4.4.5.1), k_τ = 0,56 for bottom longitudinals and k_τ = 0,75 for inner bottom longitudinals;

.4 at the centre of openings in lightened side girders and floors, the section modulus of the plate adjoining the shell plating or inner bottom plating shall comply with the requirements of 2.4.4.5.1 for bottom and inner bottom longitudinals and transverses respectively. In this case, the design span l shall be taken equal to the greatest opening length minus its rounding-off radius. The plate section shall include the effective flange of shell plating (inner bottom plating), as described under 2.1.6.3.3 and 2.1.6.3.4, as well as the flange or horizontal stiffener of the free edge of the plate, if these are fitted.

2.4.4.6 The stiffeners on the watertight sections of centre girder (duct keel), side girders and floors shall satisfy the following requirements:

.1 the section modulus of vertical stiffeners on the watertight sections of centre girder (duct keel), side girders and floors shall not be less than stipulated under 2.1.6.4.1. In this case:

p = as determined by Formula (2.1.4.8-5) for the mid-height of the vertical stiffener;

l = span, in m, of stiffener, defined as the spacing of longitudinals to which the stiffener is welded or as double bottom depth if the stiffener is not in line with bottom or inner bottom longitudinals;

m = 8 and 10 for stiffeners sniped at ends, and welded to the bottom and inner bottom primary members, respectively;

$k_\sigma = 0{,}75$;

.2 the section modulus of horizontal stiffeners centre girder (duct keel) and side girders shall not be less than the determined as per 2.1.6.4.1. In this case:

p = as determined by Formula (2.1.4.8-5) at the level of the longitudinal stiffener in question;

l = distance, in m, between floors or between floors and brackets (refer to 2.4.2.2);

m = 12;

k_σ = 0,5 in the midship region;

k_σ = 0,75 at the ends within 0,1 L from the fore or after perpendicular.

For regions between the midship and the above portions of the craft's ends, k_σ is determined by linear interpolation.

2.4.4.7 The intermediate struts between bottom and inner bottom longitudinals, and also between the bottom and reverse frames of bracket floors shall meet the following requirements:

.1 the sectional area f, in cm^2, of intermediate struts shall not be less than the determined by the formula

$$f = 5pal/(k_\sigma \sigma_n) + 0{,}1\,h\,\Delta s \qquad (2.4.4.7.1)$$

where p = design pressure, in kPa, determined as the greatest of the values p or p_T according to 2.4.3.1 or 2.4.3.2, whichever is greater;
l = design span of the longitudinal to be stiffened, in m;
k_σ = 0,6;
h = height, in cm, of the strut cross section;

.2 the inertia moment i, in cm^4, of intermediate struts shall not be less than that determined by the formula

$$i = 0{,}01\,fl^2\sigma_n \qquad (2.4.4.7.2)$$

where f = sectional area of the intermediate strut as per 2.4.4.7.1;
l = length, in m, of the intermediate strut.

2.4.4.8 The thickness of brackets of centre girder (duct keel) and margin plate, as well as of the brackets of bracket floors and the brackets connecting bottom and inner bottom longitudinals to watertight floors, if the longitudinals are cut at the floors, shall not be less than the thickness of plate floors adopted in this region.

The arm length of the brackets in way of centre girder and margin plate the thickness of brackets fitted in line with the bracket floor shall not be less than 0,75 of the centre girder depth. The free edges of brackets shall be provided with flanges or face plates. The side girder fitted in line with the bracket floor shall be provided with a vertical stiffener whose profile shall be selected in the same way as that of the reverse frame of the floor.

The arm length of brackets connecting longitudinals on the bottom and inner bottom plating to watertight floors shall not be less than 2,5 times the bottom longitudinal depth (refer to Fig. 2.4.4.8).

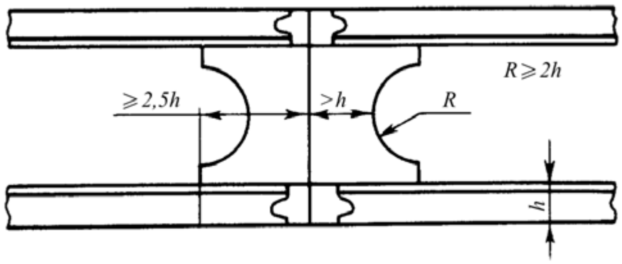


Fig. 2.4.4.8

The scantlings of knees by which bottom and reverse frames of the duct keel are secured shall be determined in accordance with 2.1.7.2.2.

2.4.4.9 The structural members, including primary members, stiffeners, brackets, etc., inside the double bottom shall have the thickness s_{min}, in mm, not less than the determined by the formula

$$s_{min} = 0{,}045\,L + 3{,}9. \qquad (2.4.4.9)$$

For the centre girder, s_{min} shall be increased by 1,5 mm.

2.4.5 Special requirements.

2.4.5.1 Partial double bottom and stiffening in way of variable double bottom depth shall satisfy the following requirements:

.1 where the double bottom terminates, gradual transition from longitudinal members of double bottom to those beyond it shall be ensured.

The inner bottom plating shall be gradually tapered (on a length of at least three frame spaces) into the face plates of centre girder and side girders of single bottom. In way of the double bottom boundary, the width of these face plates shall be not less than half the distance between adjacent side girders.

The margin plate shall extend beyond the double bottom as a bracket with the height equal to the margin plate width and the length equal to at least three frame spaces, with a face plate or flange along its free edge;

.2 where the double bottom depth changes in the form of a knuckle, one end of the knuckle shall be in way of a transverse bulkhead and the other, on the plate floor. However, both the knuckles may be arranged on plate floors in which case the structure is subject to special consideration by the Register;

.3 where the double bottom depth changes in the form of a step, the latter shall normally be arranged on a transverse bulkhead.

At the step, the inner bottom plating of the lower section shall extend for a length of two frame spaces under the step. Forward (or aft) of the end of the extension the general requirements for partial double bottom shall be complied with.

If the step is arranged beyond 0,5 L amidships or if the height of the step is less than 660 mm, the double bottom structure in way of the extension is in each case subject the special consideration by the Register;

.4 continuity and reduction of stress concentrations shall be ensured in way of the step where a variation of the depth of centre girder, side girders, margin plate and inner bottom longitudinals takes place (if longitudinal system of framing is adopted.

2.4.5.2 Bilge wells, sea chests and ice boxes shall meet the following requirements:

.1 the capacity of bilge (drain) wells is specified in Part VIII "Systems and Piping" of the Rules for the Classification and Construction of Sea-Going Ships.

The thickness of the walls and bottom plates of a bilge well shall exceed that of watertight floors by not less than 2 mm;

.2 the thickness of floors, side girders and inner bottom plating forming the walls of sea chests and ice boxes shall be by 2 mm greater than the required in 2.4.4.2 to 2.4.4.4.

In any case, the thickness of sea chest and ice box walls shall be no less than the required in 2.2.4.1 for the shell plating in the region under consideration.

2.4.5.3 When oil fuel tanks are arranged in the double bottom, the manholes in the tank tops arranged within the engine and boiler rooms for access to the tanks shall be provided with coamings not less than 0,1 m in height, besides the general provisions for the arrangement of fuel oil tanks.

2.4.5.4 Where the bed plate of main engine and the thrust block are seated directly on the inner bottom plating, insert plates having a thickness not less than stipulated under 2.11.3.1 shall be welded to the plating under the supporting parts of bed plate and thrust block. The size of welded inserts shall be such as to ensure an adequate arrangement of supports and the attachment of machinery, and shall in any case be not less than that of the supporting parts of bed plate. Where the engine bed plate and thrust block are fitted on the inner bottom plating, two girders, or one girder and a half-height girder shall be provided in way of their arrangement along each welded insert plate. The upper part of the girder webs shall have the same thickness as the welded insert for at least 0,2 of the girder depth, or alternatively, the thickness of the webs throughout their depth shall be as required by 2.11.3 for the vertical plates of seatings.

Between the girders, a horizontal stiffener of the size required in the foregoing for the upper part of girder webs shall be fitted, account being taken of the holes for the holddown bolts of the bed plate.

On agreement with the Register, only one side girder may be fitted under the welded insert plate for small power engines.

2.4.5.5 The plating of the recess under the engine crankcase, as well as the side girders and floors by which it is confined, shall have a thickness 2 mm greater than that of the inner bottom plating in this region. The minimum distance from the recess plating down to the bottom shell plating shall not be less than 460 mm.

2.5 SIDE FRAMING

2.5.1 General.

2.5.1.1 The requirements of this Chapter apply to side frames, web frames, side longitudinals, side stringers.

2.5.2 Construction.

2.5.2.1 When the craft's side is transversely framed, side stringers may be provided.

Web frames may be fitted if the ship's side is framed transversely, and they shall be fitted, if the craft's side is framed longitudinally. They shall be fitted in line with plate floors, as well as with deep beams, if any.

2.5.2.2 In the engine room, the side framing shall be strengthened by fitting of web frames and side stringers.

The web frames shall be fitted not more than 5 standard spacings or 3 m apart, whichever is the greater. The web frames shall be arranged taking into account the location of main engine, i.e. they shall be fitted at the extremities of the engine at least. In the engine room, the web frames shall be carried to the nearest continuous platform. Deep beams shall be fitted in line with web frames.

In the engine room the side stringers shall be arranged so that the vertical distance between them, and also between the side stringer and the deck or tank top (upper edge of a floor) does not exceed 2,5 m.

2.5.3 Side loads.

2.5.3.1 The design pressure on side structures shall be be determined according to 2.2.3. In way of tanks, the pressure determined in accordance with 2.1.4.8 shall additionally be taken into consideration.

2.5.4 Member scantlings of side structures.

2.5.4.1 The section modulus of hold frames with the transverse framing shall not be less than the determined in 2.1.6.4.1. In this case:

p = as per 2.5.3; the value of p for the side shell shall not be less than that determined by the formula

$$p_{min} = 10z + 0{,}3L + l \qquad (2.5.4.1)$$

where z = distance, in m, from the frame mid-span to the maximum summer waterline;

l = span, in m, between adjacent supports as measured according to 2.1.6.3.1; unless expressly provided otherwise, the frame supports are the bottom, deck or platform, side stringers;

m = 12 in determining the section modulus of the supporting section of a frame allowing for a bracket at the section, if any;

m = 18 in determining the section modulus in the frame span;

k_σ = 0,65.

For the craft of the design categories of a restricted area of navigation the value of p_{min} may be reduced by multiplying by the factor φ_r obtained from Table 2.1.4.5.

2.5.4.2 The section modulus of tween deck frames shall not be less than the determined in 2.1.6.4.1. In this case:

p = design pressure according to 2.5.3;

l = span, in m, between adjacent supports as measured according to 2.1.6.3.1; the frame supports are decks and platforms;

m = 10;

k_σ = 0,65.

The above applies to the case when the lower end of the tween deck frame is not stiffened by a bracket. If the lower end of the frame is stiffened by a bracket of a height not less than 0,1 L and the section modulus of the frame in way of deck is not less than 1,75 of the section modulus determined above, taking the bracket into consideration, the section modulus of 'tween deck frame may be reduced by 30 per cent.

2.5.4.3 The section modulus of side longitudinals shall not be less than the determined in 2.1.6.4.1. In this case:

p = according to 2.5.3;

a = spacing of longitudinals, in m;

l = average spacing of web frames or diaphragms, in m;

m = 12;

k_σ = 0,65 within (0,4 – 0,5) D from the base line.

For the region below 0,4 D from the base line, k_σ shall be determined by linear interpolation between the value of k_σ for bottom longitudinals according to 2.4.4.5.1 and the value of k_σ in the region (0,4 – 0,5) D from the base line.

For the region above 0,5 D from the base line, k_σ shall be determined by linear interpolation between the value of k_σ for strength deck longitudinals according to 2.6.4.2 and the value of k_σ in the region (0,4 – 0,5) D from the base line.

2.5.4.4 The section modulus of side stringers with the transverse side framing shall not be less than the determined in 2.1.6.4.1. In this case:

k_σ is determined in the same way as for side shell longitudinals according to 2.5.4.3;

p = as defined in to 2.5.3.1;

l = spacing, in m, of web frames, and if these are lacking, between transverse bulkheads, including end brackets;

a = spacing, in m, of side stringers;

m = 18.

The cross-sectional area, in cm^2, of a side stringer web less the cutouts shall not be less than the determined in 2.1.6.4.3. In this case:

$N_{max} = npal$;

n = 0,5;

k_τ = 0,65.

Given the web frames, the scantlings of the side stringer section may be determined by calculating the side grillage as a framed structure. The design loads shall be adopted according to 2.5.3.1, permissible stress factors, according to this paragraph.

2.5.4.5 The section modulus of web frames in holds and 'tween decks shall not be less than the determined in 2.1.6.4.1 and 2.1.6.4.2. In this case:

p = as defined in 2.5.3.1;

l = distance, in m, between the upper edge of a single bottom floor or the inner bottom plating and the lower edge of a deep beam;

a = spacing of web frames, in m;

m = 10 for 'tween deck frames;

m = 11 for holds;

k_σ = 0,65.

The cross-sectional area, in cm^2, of a side transverse (web frame), excluding openings, shall not be less than the determined in 2.1.6.4.3. In this case:

$N_{max} = npal$;

n = 0,5;

k_σ = 0,65.

When the side is transversely framed, the scantlings of web frames may be determined on the basis of the side grillage calculation in accordance with the requirements of 2.5.4.4. In this case, the permissible

stress factors shall be selected in accordance with the requirements of this paragraph.

In single-deck craft, the depth of web frame (side transverse) webs may be taken variable over the craft's depth with reducing at the top end and increasing at the bottom end. Variation of web depth shall not exceed 10 per cent of its mean value.

For stiffening of web frames (side transverses), refer to 2.1.7.3.

2.5.4.6 The side framing in the engine room and tanks shall meet the following requirements:

.1 the scantlings of main frames in the engine room are determined in accordance with 2.5.4.1. In this case:

l = span measured between side stringers or between the lower side stringer and inner bottom plating

(upper edge of floor), or between the upper side stringer and the lower edge of beam.

The scantlings of longitudinals shall be determined in accordance with 2.5.4.3.

The scantlings of web frames (side transverses) shall be determined in accordance with 2.5.4.5 taking:

l = span measured from the inner bottom plating (upper edge of a floor) to the lower edge of a deep beam.

.2 in the engine room, the web frames and side stringers required according to 2.5.2.2 may not be fitted provided the section modulus, in cm^3, of the main frame is not less than the determined by the formula

$$W = 1{,}8\,W_1 \qquad (2.5.4.6.2)$$

where W_1 = section modulus of the main frame according to 2.5.4.6.1;

.3 in the engine room, the web frames shall have a depth not less than 0,1 of the span and a web thickness not less than 0,01 of the web depth plus 3,5 mm;

.4 the web depth of a side stringer in the engine room shall be equal to that of a web frame.

The web thickness of a side stringer may be 1 mm less than that of a web frame. The side stringer face plate thickness shall be equal to the face plate thickness of a web frame.

2.5.5 Special requirements.

2.5.5.1 If transverse system of framing is adopted, efficient connection of lower ends of frames to bottom structures shall be ensured by means of bilge brackets or other structures of equivalent strength. The bilge brackets shall comply with the following requirements:

.1 the depth of bilge brackets shall not be less than that of the bilge as a whole. The free edge of a bilge bracket shall be flanged or stiffened with a face plate the dimensions of which shall be in compliance with 2.1.7.2.2.2.

The thickness of a bilge bracket is taken equal to that of plate floors in the hull region under consideration, but it need not exceed the frame web thickness more than 1,5 times.

Holes cut in bilge brackets shall be such that the width of plating outside the hole is nowhere less than 1/3 of the bracket width.

In any case, the size of bilge brackets shall not be less than that required by 2.1.7.2.2;

.2 the end attachments of a frame to bilge bracket shall be designed so that at no section the section modulus is less than required for a frame;

.3 where an inclined margin plate is fitted in the double bottom, the bilge bracket shall be carried to the inner bottom plating, and its face plate (flange) shall be welded to the plating;

.4 where a horizontal margin plate is fitted in the double bottom or transverse system of framing is adopted in the single bottom, the width of bilge brackets shall be determined proceeding from the condition that their section moduli at the point of connection to the inner bottom plating or upper edge of floor shall be at least twice those of the frame.

The face plate (flange) of a bilge bracket may be welded to either the inner bottom plating or the face plate (flange) of a floor, or it may be sniped at ends. If the face plate (flange) is welded, the floor web shall be stiffened with a vertical stiffener or a bracket at the point of welding, also welded to the inner bottom plating or to the floor face plate (flange).

The depth of a bilge bracket shall not be less than its width;

.5 if longitudinal system of framing is adopted in the single bottom, the bilge bracket shall be carried at least to the bottom longitudinal nearest to the side and shall be welded thereto. The section modulus of the bracket at the section perpendicular to the shell plating where the bracket width is the greatest shall be at least twice the section modulus of the frame.

2.5.5.2 In all the spaces, the upper ends of frames shall be carried to the decks (platforms) with mini mum gaps if they are cut at the decks (platforms). The beams of transversely framed decks (platforms) shall be carried to the inner edges of frames with minimum gaps.

The uppermost decks of ships (except for those secured alongside other ships at sea) may be designed with beams carried to the shell plating with minimum gaps, and frames carried to the beams.

The brackets by which the upper ends of frames are attached shall be sized in accordance with the requirements of 2.1.7.2.2. If the deck is framed longitudinally, the bracket shall be carried at least to the deck longitudinal nearest to the deck and welded to that longitudinal.

2.5.5.3 If the frame is cut at deck, its lower end shall be attached by a bracket complying with the requirements of 2.1.7.2.2 The bracket may be omitted if the ends of this frame are welded to the deck plating from above and below, and full penetration is ensured.

2.5.5.4 Side stringers shall be attached to web frames by brackets carried to the web frame face plate and welded thereto.

2.6 DECKS AND PLATFORMS

2.6.1 General.

This Chapter contains the requirements for the deck and platform structures of the craft with large single openings having a width of no more than 0,7 times the craft's breadth in way of the opening.

Chapter includes the requirements for plating, primary members and web framing of decks and platforms: deck longitudinals, beams, deck transverses, deck girders, hatch-end beams.

Additional requirements for upper deck areas under the superstructures are given in 2.12.5.1 to 2.12.5.3.

2.6.2 Construction.

2.6.2.1 Provision shall be made for the structural continuity of deck girders of the strength deck in the midship region. If the deck girders are cut at transverse bulkheads, their web plates shall be welded to the transverse bulkheads and attached thereto by brackets.

The face plates of deck girders shall be connected to the face plates of hatch end beams by means of diamond plates whose thickness shall be equal to the greater face plate thickness.

2.6.2.2 The deck girders and deck transverses in way of pillars shall be strengthened by stiffeners or tripping brackets.

Where deck girders are connected to deck transverses and their web height is different, the deck girder web shall be strengthened by brackets fitted in line with the deck transverse. The brackets shall be welded to the face plate of deck transverse, to the web and face plate of deck girder.

Where deck girders are attached to conventional beams, the web of deck girder shall be strengthened by vertical stiffeners.

2.6.2.3 In the case of connection of deck longitudinals to transverse bulkheads, the effective sectional area of the longitudinals shall be maintained.

2.6.3 Deck loads.

2.6.3.1 The design pressure on the weather deck shall not be less than that determined by the formula

$$p = 0{,}7\, p_w \geq p_{\min} \qquad (2.6.3.1)$$

where p_w = wave load at the deck level according to 2.1.4.6.2;
$p_{\min}$ = 0,1 L + 7 at the fore end within 0,2 L from the fore perpendicular;
$p_{\min}$ = 0,015 L + 7 amidships and aft of the midship region; for the regions between the fore end and the midship region $p_{\min}$ shall be determined by linear interpolation.
For the craft of a restricted area of navigation the value of $p_{\min}$ may be reduced by multiplying by the factor φ_r obtained from Table 2.1.4.5.

2.6.3.2 For the decks and platforms intended for the accommodation of crew, passengers and equipment, the design pressure shall not be less than 3,5 kPa.

For the platforms in the engine room, the minimum design pressure shall be 18 kPa.

Watertight lower decks and platforms shall additionally be calculated for test loads, in kPa, determined by the formula

$$p = 7{,}5\, h_t \qquad (2.6.3.2)$$

where h_t = vertical distance from the deck (platform) plating to the top of an air pipe, in m.

2.6.4 Scantlings of deck members.

2.6.4.1 Thickness of deck plating.

2.6.4.1.1 The thickness of the strength deck plating outside the line of hatch openings considering the deck longitudinals of primary members and web framing shall be determined taking into account 2.1.5.

2.6.4.1.2 The plating thickness for decks and platforms shall not be less that determined by Formula (2.1.6.4.4). In this case:

m = 15,8;

p = as defined in 2.6.3;

for the strength deck amidships with the transverse framing system:

k_σ = 0,6 for craft of 12 m long;

k_σ = 0,56 for craft of 24 m long.

When 12 m < L < 24 m, k_σ is determined by linear interpolation.

k_σ = 0,6 amidships with the longitudinal framing system;

k_σ = 0,7 at the craft's ends within 0,1 L from the fore and aft perpendicular.

For the regions between the midship region and the above portions of the craft's ends, k_σ is determined by linear interpolation;

for the second continuous deck situated above 0,5D from the base line:

k_σ = 0,8 amidships for the transversely framed craft of 12 m long;

k_σ = 0,78 amidships for the transversely framed craft of 24 m long.

When 12 m < L < 24 m, k_σ is determined by linear interpolation.

k_σ = 0,8 amidships for the longitudinally framed craft;

k_σ = 0,9 at the craft's ends within 0,1 L from the fore and aft perpendicular.

For the regions between the midship region and the above portions of the craft's ends, k_σ is determined by linear interpolation;

for other lower decks and platforms:

k_σ = 0,9.

2.6.4.1.3 When the engine room is located aft, the plating thickness and the scantlings of deck longitudinals at the poop and the after deckhouse shall be maintained abaft their front within the length of no less than the width of the machinery casing opening.

Where the forward edge of the machinery casing opening is away from the poop front (after deckhouse) for less than the opening width, the deck in this area may be additionally strengthened.

2.6.4.1.4 If the thickness of the strength deck plating is assumed less than that of the side plating, the deck stringer plate shall be provided. The width of the upper deck stringer plate b, in mm, shall not be less than the determined by the formula

$$b = 5\, L + 800 \leq 1800 \qquad (2.6.4.1.4)$$

and the thickness of the deck stringer plate shall not be less than that of the side plating.

2.6.4.1.5 The thickness of deck plating and platforms $s_{\min}$, in mm, shall not be less than:

for the upper deck between the craft's side and the line of large openings amidships:

$$s_{\min} = 4 + 0{,}05\, L; \qquad (2.6.4.1.5\text{-}1)$$

for the upper deck at the craft's ends and inside the line of large openings, and also for the second deck:

$$s_{\min} = 4 + 0{,}04\, L; \qquad (2.6.4.1.5\text{-}2)$$

for the third and other lower decks and platforms:

$$s_{\min} = 5 + 0{,}01\, L. \qquad (2.6.4.1.5\text{-}3)$$

Where the spacing assumed is less than the standard one (refer to 2.1.1.1), the minimum thickness of deck plating and platform for the craft of design categories **A** and **A1** may be reduced proprtionally to the ratio of the assumed spacing to the standard one, but not more than by 10 per cent.

In any case, the minimum thickness shall not be less than 5,5 mm.

2.6.4.2 The section modulus of deck longitudinals shall not be less than the determined according to 2.1.6.4.1 and 2.1.6.4.2. In this case:

p = as defined in 2.6.3;

$m = 12$;

for the weather deck

$k_\sigma = 0,45$ amidships;

$k_\sigma = 0,65$ at the craft's ends within $0,1L$ from the fore and aft perpendicular.

For the regions between the midship region and the above portions of the craft's ends, k_σ is determined by linear interpolation;

for other decks

$k_\sigma = 0,75$.

2.6.4.3 The section modulus of beams with the transversely framed deck shall not be less than the determined according to 2.1.6.4.1. In this case:

p = as defined in 2.6.3;

$m = 10$;

$k_\sigma = 0,65$.

2.6.4.4 The scantlings of deck web framing members, i.e. deck transverses, deck girders and hatch-end beams shall be determined by calculating the deck grillage as a framed structure, excepting the cases specified in 2.6.4.5 to 2.6.4.7. The design loads shall be specified according to 2.6.3. Given the pillars, the interaction between the deck grillage and the upper and/or lower structures shall be taken into account depending on the pillars arrangement.

The permissible stress factors shall be assumed as follows:

for the strength deck in calculating the deck girders

$k_\sigma = 0,65$ amidships for the craft of 12 m long;

$k_\sigma = 0,61$ amidships for the craft of 24 m long.

When 12 m < L < 24 m, k_σ is determined by linear interpolation;

$k_\sigma = 0,65$ at the craft's ends within $0,1L$ from the fore and aft perpendicular.

For the regions between the midship region and the above portions of the craft's ends, k_σ is determined by linear interpolation;

in calculating the deep beams and half-beams, and also the end deep beams:

$k_\sigma = 0,65$;

in calculating the primary support members for shear stresses

$k_\tau = 0,65$.

for the primary support members of other decks and platforms

$k_\sigma = k_\tau = 0,7$.

2.6.4.5 The deep half-beams, deep beams and hatch deep beams, which may be handled as the members with rigid supports, shall have the section modulus not less than the determined in 2.1.6.4.1 and 2.1.6.4.2, the sectional area of a web, excluding openings, not less than the determined in 2.1.6.4.3. In this case:

p = as defined in 2.6.3;

k_σ and k_τ = as defined in 2.6.4.4;

$m = 10$;

$N_{max} = 0,5pal$.

2.6.4.6 Deck girders shall meet the following requirements:

.1 deck girders and longitudinal hatch coamings, which may be handled as the members with rigid supports, shall have the section modulus not less than the determined in 2.1.6.4.1 and 2.1.6.4.2, the sectional area of a web, excluding openings, not less than the determined in 2.1.6.4.3. In this case:

p = as defined in 2.6.3;

k_σ and k_τ = as defined in 2.6.4.4;

$N_{max} = 0,5pal$;

$m = 10$ for intercostal deck girders;

$m = 12$ for continuous deck girders in calculating the section modulus at a supporting section taking into account the bracket, if any, included in this section;

$m = 18$ for continuous deck girders in calculating the section modulus in the span of a deck girder;

.2 the deck girder web thickness may be assumed not more than that of the deck plating.

2.6.4.7 If the deck promay support member may be handled separately from others, its section modulus shall not be less than the determined in 2.1.6.4.1 and 2.1.6.4.2. In this case, the design loads and the factor k_σ are determined in the same way as in 2.6.4.4; $m = 10$.

The sectional area of such member shall not be less than the determined by the formula (2.1.6.4.3-1). In this case, the factor k_τ is determined in the same way as in 2.6.4.4;

$N_{max} = 0,5pal$;

p = as defined in 2.6.3.

2.6.5 Special requirements.

2.6.5.1 The requirements given below for the design of single openings refer to those of which dimensions do not exceed the specified in 2.6.1.

The openings are supposed to be arranged in the fore-and-aft direction with their greater side. Otherwise, the corner design of openings will be subject to special consideration by the Register.

2.6.5.1.1 The minimum corner radius r (refer to Fig. 2.6.5.1.1) including the openings of engine and boiler casings may be assumed equal to 0,15 m.

2.6.5.1.2 In the area A (refer to Fig. 2.6.5.1.1), the plate butts of deck plating, the butt joints of primary and deep longitudinal members, openings, welding the clamps, eyes, etc.as well as mounting parts to deck plating should be avoided.

In the area C (refer to Fig. 2.6.5.1.1), butts of deck plating and coaming plates, butt welds of primary and deep longitudinal members, openings welding of shackles,

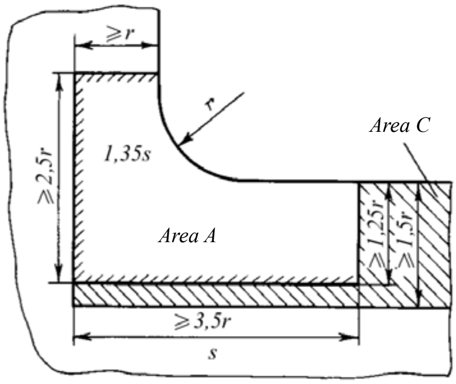


Fig. 2.6.5.1.1

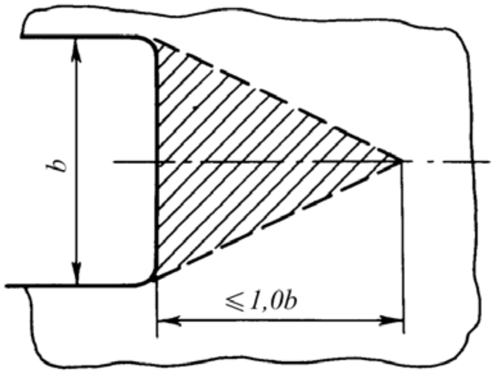


Fig. 2.6.5.1.4

frames, etc., as well as mounting parts, to deck plating are not permitted.

Where the deck plating terminates at a engine casing and welded thereto, the full penetration welds shall be used.

2.6.5.1.3 If the lost cross-sectional area of deck shall be compensated in way of an isolated opening, reinforcement shall be applied as shown in Fig. 2.6.5.1.3. The value of factor k shall be selected proceeding from the relationship between the deck plating thickness *s*, insert plate thickness S_1 and opening width *b*, but shall not be taken less than $k = 0{,}35\,s/C_1$.

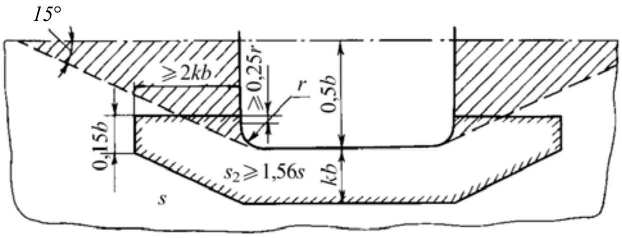


Fig. 2.6.5.1.3

2.6.5.1.4 The deck plating thickness between the transverse edges of adjacent successive openings and engine casings (refer to 2.6.5.1.1) within their width less the transverse dimensions of a rounding shall not be less than that specified in 2.6.4.1.5.

The thickness $s_{\min}$ at the transverse edges of isolated openings is allowed in the area shown in Fig. 2.6.5.1.4.

2.6.5.2 The thickness *s*, in mm, of the coamings of ventilators (ventilating tubing, ducts, trunks, etc.) on the freeboard deck and quarter deck, and also on the open decks of superstructures located within 0,25 *L* from the fore perpendicular shall not be less than that determined by the formula

$$s = 0{,}01\,d_c + 5 \qquad (2.6.5.2\text{-}1)$$

where d_c = internal diameter or length of the greater side of the coaming section, in mm.

In this case, the thickness s shall not be less than 7 mm, but it need not be greater than 10 mm.

In the craft of design categories **A2**, **B**, **C**, **C1**, **C2**, **C3** and **D**, the ventilator coaming thickness *s*, in mm, shall not be less than that determined by the formula

$$s = 0{,}01\,d_c + 4 \qquad (2.6.5.2\text{-}2)$$

or

$$s = s_d + 1, \qquad (2.6.5.2\text{-}3)$$

whichever is greater,

where d_c = internal diameter or length of the greater side of the coaming section, in mm;
s_d = thickness of deck plating, in mm.

The thickness of coamings on the deck of the first tier superstructure located outside 0,25 *L* from the fore perpendicular may be by 10 per cent less than that required for the coamings on freeboard deck and raised quarterdeck.

Where the thickness of deck plating is less than 10 mm, a welded insert or doubling plate shall be fitted in way of the coaming, having a thickness equal to at least 10 mm, length and breadth not less than twice the diameter or twice the length of the greater side of the coaming section.

In case of an efficient connection of the coaming to the deck framing, fitting of welded insert or doubling plate is not required.

Where the height of a ventilator coaming is greater than 0,9 m and the coaming is not supported by adjacent hull structures, brackets shall be fitted to attach the coaming to the deck.

The structure of companionway and skylight coamings shall have strength equivalent to that of cargo hatches, whereas the thickness of the coamings shall not be taken less than 7 mm, but need not exceed the thickness of deck plating in way of the coaming.

2.7 BULKHEADS ANS PROPELLER SHAFT TUNNEL

2.7.1 General provisions and defintions.

2.7.1.1 This Chapter contains the requirements for bulkheads and a propeller shaft tunnel.

2.7.1.2 Definitions.

For the purpose of this Chapter the following definitions are adopted.

Watertight (emergency) bulkhead is a bulkhead restricting the flow of water through craft's spaces in case of emergency.

Tight bulkhead is a bulkhead proof against water and other liquids.

Tank bulkhead is a bulkhead bounding a ballast, fuel oil or other tank.

Partial bulkhead is a bulkhead fitted in a compartment or part thereof to ensure an additional support to deck structures.

2.7.1.3 Where compliance with subdivision requirements shall be ensured, the number and disposition of watertight bulkheads (and of partial watertight bulkheads) shall be determined proceeding from the requirements of Part V "Subdivision" of the Rules for the Classification and Construction of Sea-Going Ships.

All the transverse watertight bulkheads located between fore and after peak bulkheads shall generally be carried to the freeboard deck.

2.7.2 Construction.

2.7.2.1 For the construction of longitudinal tight bulkheads, as well as for the tight bulkheads of log and depth sounder wells, escape trunks, propeller shaft tunnel, etc., the same requirements apply as for transverse tight bulkheads.

In bulkheads, watertight steps and recesses are permitted.

Partial bulkheads shall be plain.

2.7.2.2 Plane bulkheads shall be strengthened by vertical or horizontal stiffeners. The vertical and horizontal stiffeners of plane bulkheads as well as the vertical and horizontal corrugations of corrugated bulkheads may be supported by horizontal girders or vertical webs respectively.

The horizontal girders and vertical webs shall be stiffened in accordance with the requirements of 2.1.7.3.

Partial bulkheads shall be strengthened by vertical webs.

2.7.2.3 The end attachments of bulkhead framing members shall comply with the following requirements:

.1 the ends of vertical webs and horizontal stiffeners of bulkheads shall generally be attached by brackets complying with the requirements of 2.1.7.2.2. Bracket attachments are required for the ends of main framing of forepeak bulkhead below the freeboard deck;

.2 if transverse system of framing is adopted, the brackets by which the vertical webs of transverse bulkheads are attached to deck plating and inner bottom plating (bottom plating) shall be carried to the beam or floor nearest to the bulkhead and welded thereto.

Where transverse framing system is adopted, the brackets by which the horizontal stiffeners of bulkheads are attached to the side or other bulkhead shall be carried to the frame or vertical stiffener nearest to the bulkhead and welded thereto;

.3 when the vertical stiffeners of bulkheads are cut at decks, platforms or horizontal girders and no brackets are fitted, the stiffener ends shall be welded to deck or platform plating, to horizontal girder web, or sniped at ends;

.4 the end attachments of vertical webs and horizontal girders shall comply with the requirements of 2.1.7.2.3.

Where there are no horizontal girders on longitudinal bulkheads and/or side stringers at the level of the horizontal girder brackets of transverse bulkheads, the brackets shall be carried to the nearest vertical web on longitudinal bulkhead and/or the nearest frame and welded thereto.

If the vertical web on a transverse bulkhead is not in line with the centre girder or side girder, a bracket shall be fitted in the double bottom under the bracket by which the lower end of the vertical web is attached.

2.7.3 Bulkhead loads.

2.7.3.1 The design pressure p, in kPa, on the structures of watertight bulkheads and a propeller shaft tunnel is determined by the formula

$$p = \alpha z_b \qquad (2.7.3.1)$$

where α = 10 for structures of a forepeak bulkhead;
α = 7,5 elsewhere;
z_b = as measured at the centreline, from the point of design load application to its upper level; the upper load level is: the bulkhead deck for watertight bulkheads and propeller shaft tunnel, the upper edge of forepeak bulkhead for the forepeak bulkhead. If partial watertight bulkheads are fitted on the bulkhead deck in line with the watertight bulkheads or in close vicinity to them, zb shall be measured to the upper edge of the watertight partial bulkheads.

In any case, the design pressure shall not be less than 12 kPa for watertight bulkhead structures and shall not be less than 16 kPa for forepeak bulkhead structures.

2.7.3.2 The design pressure on the tank bulkheads shall be determined according to 2.1.4.8.

2.7.4 Scantlings of bulkhead members.

2.7.4.1 The thickness of bulkhead plating shall not less than the determined by Formula (2.1.6.4.4). In this case:

p = as defined in 2.7.3;
m = 15,8;
k_σ = 0,9.

The plates of watertight bulkhead plating may have a thickness less by 1 mm.

The thickness of watertight bulkhead plating and lubricating oil bulkhead plating s_{min}, in mm, shall not be less than

$$s_{min} = 4 + 0{,}02L \qquad (2.7.4.1\text{-}1)$$

The thickness of bottom plates of bulkheads shall exceed the above value by 1 mm, but shall not be less than 6 mm.

For tank bulkheads (except lubricating oil tanks), the thickness smin, in mm, of plating, face plates and webs of framing members shall not be less than

$$s_{min} = 5 + 0{,}015L; \qquad (2.7.4.1\text{-}2)$$

$$6{,}0 \text{ mm} \le s_{min} \le 7{,}5 \text{ mm}.$$

Bulkhead plating may have a thickness not exceeding that of relevant shell plating strakes and deck plating, where the spans and yield stress values are identical. The same applies to the thickness relationship of bulkhead bottom plating and inner bottom plating (bottom plating).

The breadth of top and bottom strakes of bulkheads shall be determined in accordance with 2.7.5.1.

Where sterntubes penetrate through bulkhead plating, the thickness of the latter shall be doubled.

2.7.4.2 The section modulus of vertical and horizontal stiffeners of bulkheads shall not be less than stipulated under 2.1.6.4.1 and 2.1.6.4.2. In this case:

p as defined in 2.7.3;

m as obtained from Table 2.7.4.2;

k_σ 0,75.

Table 2.7.4.2

Primary support members	m
Single span vertical stiffeners:	
both ends sniped	8
upper end sniped, lower end welded to supporting structure	9
both ends welded to supporting structure	10
upper end welded to supporting structure, lower end	14
bracketed[1]	18
both ends bracketed	
Multispan vertical stiffeners:	18
within span	
within intermediate supporting section where stiffener is	12
continuous through supporting structure[2]	12
Horizontal stiffeners	

[1] Strength at the supporting section considring the presence of the bracket and assuming m = 12 shall additionally be verified.

[2] Considering the bracket, if any, at the supporting section.

For tank bulkheads (except lubricating oil tanks), the thickness of member webs and face plates as well as of their stiffening brackets shall not be less than required by Formula (2.7.4.1-2).

2.7.4.3 Bulkhead vertical webs and horizontal girders shall satisfy the following requirements:

.1 the section modulus and web sectional area, excluding openings, of the vertical webs of bulkheads whose structure does not include horizontal girders, and of the horizontal girders of bulkheads whose structure does not include vertical webs, shall not be less than stipulated under 2.1.6.4.1 to 2.1.6.4.3. In this case:

$N_{max} = npal$;

p = as defined in 2.7.3;

m, n = as obtained from Table 2.7.4.3.1;

l = span including brackets, in m;

$k_\sigma = k_\tau = 0{,}75$.

Table 2.7.4.3.1

Member	m	n
Vertical web:		
in holds	11	0,5
in ‘tween decks	10	0,5
Horizontal girder:		
in tanks	10	0,5

.2 where the bulkhead structure incorporates both vertical webs and horizontal girders, the scantlings of those members shall be determined on the basis of grillage calculation using beam models, with design loads as stipulated under 2.7.3 and permissible stress factors as stipulated under 2.7.4.3.1;

.3 for tank bulkheads (except lubricating oil tanks), the web and face plate thickness of girders and of their brackets and stiffeners shall not be less than required by Formula (2.7.4.1-2).

2.7.4.4 The scantlings of partial bulkhead members shall comply with the following requirements:

.1 the thickness of partial bulkhead plating shall not be less than that required by Formula (2.7.4.1-1);

.2 the partial bulkhead stiffeners supporting deck transverses and hatch-end beams shall meet the requirements for the relevant pillars (refer to 2.9).

In any case, the Euler stresses σ_e, in MPa, in a stiffener determined according to 2.9.4.1 shall not be less than

$$\sigma_e = 200. \qquad (2.7.4\ 4.2)$$

The moment of inertia and sectional area of the stiffener on the basis of which the Euler stresses therein are determined shall be calculated with regard for the face plate of partial bulkhead plating equal in width to half the distance between the stiffeners.

2.7.4.5 The scantlings of shaft tunnel members, its recess included, and those of the tight bulkheads of log and depth sounder wells, escape trunks, etc. shall comply with the requirements for the scantlings of watertight bulkhead members.

If the shaft tunnel passes through a compartment intended for the carriage of liquid cargo or ballast, the scantlings of its members shall comply with the requirements for the scantlings of the members of tight bulkheads bounding the compartment.

If the top plating is well curved, the thickness may be reduced by 10 per cent.

Under hatchways the top plating thickness shall be increased by 2 mm.

2.7.5 Special requirements.

2.7.5.1 The breadth of the bottom strake of bulkhead, as measured from inner bottom plating, or, where double bottom is omitted, from the bottom shell, shall be not less than 0,62 m for craft of 24 m, and not less than 0,4 m for craft of 12 m in length. For intermediate craft lengths, the breadth of this strake shall be determined by linear interpolation. If the double bottom extends to the bulkhead on one side only, the bottom strake of bulkhead plating shall extend for at least 0,3 m above the inner bottom plating.

2.8 FORE AND AFT ENDS

2.8.1 General provisions and symbols.

2.8.1.1 The requirements of this Chapter apply to the forepeak and bulb (if any), bottom within 0,25 *L* aft of the fore perpendicular, craft's side within 0,15 *L* aft of the fore perpendicular, structures located aft of the afterpeak bulkhead, as well as to the strengthening structures of the bottom and side forward exposed to impact pressure.

It is assumed in this Chapter that the tight deck or platform located directly above the maximum summer waterline forms the upper boundary of the forepeak and afterpeak.

2.8.1.2 For the purpose of this Chapter the following symbols are adopted:

d_f = minimum design draught (at the fore perpendicular), in m;

α_x = angle, in deg, between the vertical and the straight line connecting the cross points of the maximum summer waterline and the weather deck with the craft's side at the cross section situated within 0,05 *L* from the fore perpendicular (refer to Fig. 2.8.1.2-1);

β_x = angle, in deg, between the tangent to the waterline at the vertical mid-distance between the maximum summer waterline and the weather deck at the fore perpendicular, and the line parallel to the centreline at the cross section situated 0,05 *L* from the fore perpendicular (refer to Fig. 2.8.1.2-2).

2.8.2 Construction.

2.8.2.1 The following framing systems are adop ted at ends:

transverse system of framing for bottom in peaks;

transverse or longitudinal system of framing for other structures.

2.8.2.2 Fore peak floors shall be fitted at every frame. Their height shall not be less than stipulated under 2.4.4.1, but need not exceed 2,25 m, and the thickness shall not be less than required by Formula (2.4.4.3.1) at $k = 1$ and a = 0,6 m; however, they need not be thicker than the bottom shell plating in this region. Floor webs shall be strengthened with vertical stiffeners to be spaced not more than 0,6 m apart.

Floor face plates shall have a thickness not less than the floor thickness and a breadth required by 2.1.7.3.1.

At the centreline an intercostal side girder with a face plate shall be fitted as an extension of centre girder in way of the holds. The height and thickness of girder plates as well as the thickness and width of girder face plate shall be equal to those of the floors.

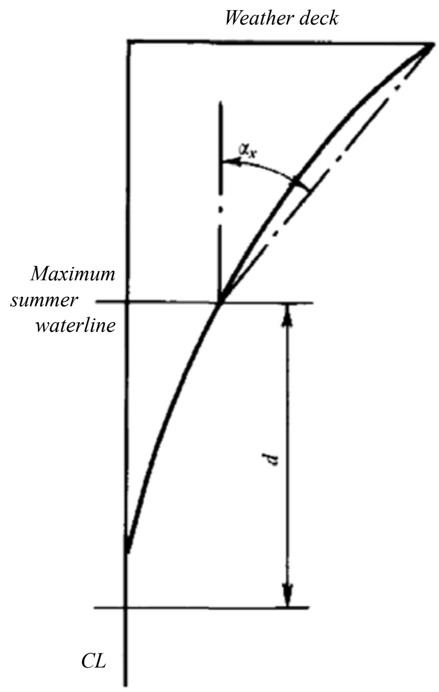


Fig. 2.8.1.2-1
Diagram for determining an angle α_x

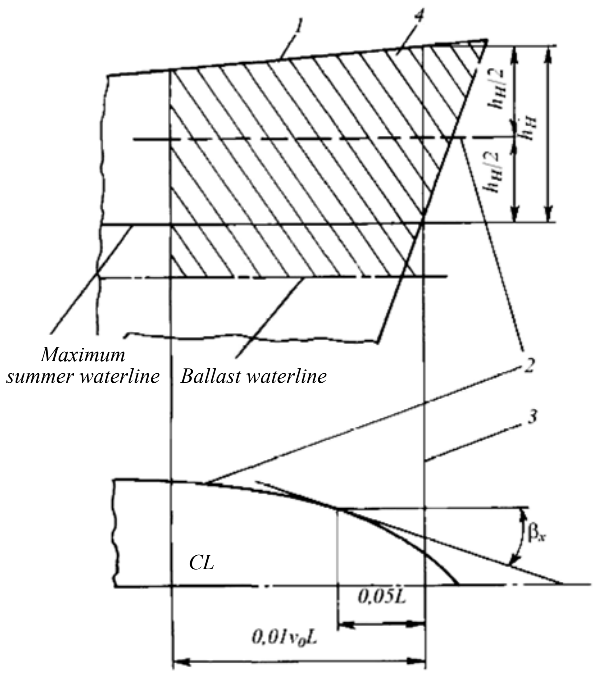


Fig. 2.8.1.2-2
Diagram for determining an angle β_x and an area (lined) exposed to wave impact pressure:
1 – weather deck; *2* – waterline for determining the angle β_x;
3 – fore perpendicular; *4* – impact pressure area;
h_f – vertical distance between the maximum summer waterline and the weather deck at the fore perpendicular

Where the webs of the girder cannot be arranged, the floor face plates shall be interconnected at the centreline by an angle, tee section, etc. the flanges of which have the same width and thickness as the floor face plates.

2.8.2.3 Where the forepeak side is transversely framed, side stringers shall be provided at least up to the deck directly above the maximum summer waterline. The vertical spacing of these stringers shall generally not exceed 2 m.

The side stringers shall be supported with panting beams fitted at alternate frames and being supported on a longitudinal bulkhead in the centreline where possible.

The free edge of side stringers shall be stiffened by the face plate having a thickness not less than that of the stringer web and a width according to 2.1.7.3.1. The stringer web shall be stiffened at every frame with brackets having the side dimensions not less than half the stringer web height, and where panting beams are fitted, these shall be not less than the required in 2.1.7.2.2. The thickness of brackets shall not be less than that of the stringer web.

Instead of panting beams, the side stringers may be supported by web frames spaced not more than 3 m apart.

Non-tight platforms are recommended instead of side stringers with panting beams or web frames. In this case, the platforms may be spaced up to 2,5 m apart. The beams of non-tight platforms shall be fitted at every frame.

Where the forepeak side is longitudinally framed, web frames shall be spaced not more than 2,4 m apart. Deck transverses shall be fitted in the places where web frames get through decks and platforms or are attached thereto.

The floors in the plane without web frames shall be connected to the nearest side longitudinal with brackets.

2.8.2.4 The bow bulb shall be strengthened with platforms spaced no more than 2 m apart. The plarform beams shall be fitted at every frame.

If the bulb extent forward from the fore perpendicular exceeds 0,03 L, a non-tight bulkhead strengthened with stiffeners at every frame shall be fitted in the centreline.

If the above extent is less than 0,03 L, the bulb may be strengthened with a girder in the centreline which is to continue the vertical keel.

Given the bulb, the fore end design shall ensure the free passage of an anchor by the bulb with the craft listed 5 degrees to either side.

In way of the potential bulb impact by the anchor, provisions shall be made for intermediate frames and the increased thickness of the bulb shell plating.

2.8.2.5 The bottom design at the fore end of single-bottom craft outside the forepeak shall meet the requirements of 2.3.2 and 2.3.4 and additionally of the following one:

.1 if transverse system of framing is adopted, the spacing of side girders, and also a distance from the centre girder or the craft's side to a side girder shall not exceed 1,1 m within 0,25 L from the fore perpendicular.

2.8.2.6 The double bottom design at the fore end outside the forepeak shall meet the requirements of 2.4.2 and those given below.

Within 0,25 L from the fore perpendicular, the distance between side girders shall not extens 2,2 m apart. If transverse framing system is adopted, in this region half-height side girders shall additionally be fitted and welded to the bottom and floors. The distance between side girders stringers and half-height girders shall not exceed 1,1 m. These half-height girders shall be extended as far forward as practicable and their free edges shall be reinforced with flanges or face plates.

If longitudinal system of framing is adopted, the floors shall be strengthened with stiffeners in line with each half-height side girder and each bottom longitudinal.

2.8.2.7 If transverse framing system is adopted, intercostal side stringers shall be fitted within 0,15 L from the forward perpendicular, outside the fore peak, at the level of the fore peak side stringers. The depth and thickness of a stringer plate shall be equal to those of the frame. The intercostal brackets fitted as stringer plates shall be welded to the webs of frames at both ends and to the shell plating. On the free edge of a stringer, a face plate shall be fitted with the thickness not less than that of the web and the breadth in accordance with 2.1.7.3.1.

The intercostal side stringer may be of the same profile as the frames.

The stringer face plate (flange) shall not be welded to the face plate of frames.

Intercostal stringers shall be attached to bulkheads with brackets.

Intercostal stringers may have no face plate or flange if the spacing of frames does not exceed their double depth. In this case, their thickness s, in mm, shall not be less than $s = l / 4 s + \Delta s$ or $s = 0{,}05\, h$ whichever is greater, where l = length of the free edge of the stringer between frames, in mm; h = stringer depth, in mm.

In craft with the characteristic $(v_0 / \sqrt{L}) > 1{,}5$ or having a significant bow flare, provision shall be made for web frames and side stringers which the web frames support. The spacing of web frames shall not exceed 5 frame spaces.

If longitudinal side framing is used forward outside the forepeak, the spacing of side transverses shall be no more than 3 m. In the holds, as well as in 'tween decks and superstructures of the craft having the characteristic $(v_0 / \sqrt{L}) > 1{,}5$ or a significant bow flare, provision shall be made for a vertical intercostal member between web frames which is dimensioned as side longitudinals. The member design shall be similar to that of intercostal side stringers required at transverse framing. The intercostal member may terminate at the upper and lower side longitudinals of the hold, tweendeck and superstructure. Every second side longitudinal shall be connected to side transverses with brackets brought to the face plate of the frame.

2.8.2.8 Within 0,1 L from the fore perpendicular, the span of the weather deck transverses shall not exceed 3 m and ther deck girder span shall not exceed 3,6 m.

Within 0,2 L from the fore perpendicular, the section modulus of the weather deck transverse shall not be less than the required for deck girders with the same span and spacing of members.

2.8.2.9 The structure located aft of the after peak bulkhead shall be sufficiently rigid in the vertical and horizontal plane. For this purpose, fitting of additional longitudinal bulkheads or platforms, thickening of deck plating and shell plating, as well as connection of bottom and upper deck longitudinals with pillars or struts may be required. If the stern overhang is large or the after peak width exceeds 20 m at any section, fitting of additional longitudinal non-tight bulkheads is recommended port or star board.

Given the flat part of the bottom, additional strengthening may be required to resist the loads due to impact pressure.

2.8.2.10 Afterpeak floors shall meet the requirements in 2.8.2.2.

In single-screw craft, the floors shall be extended above the sterntube, but in any case to a height of not less than 0,8 m. If this is impracticable, transverse tie plates with face plates on both edges shall be fitted at every frame above the sterntube. The thickness of these tie plates shall not be less than that of the floor. The tie plate of over 1,5 m long shall have a stiffener at the midspan.

Floors with flanged edges are not allowed.

The oppening in floors for the sterntube shall be reinforced with a face plate along the edges. The openings in floors below the sterntube shall be reinforced with face plates or stiffeners.

2.8.2.11 If transverse framing is adopted in the after peak side, panting beams and side stringers, beam knees, frame to side stringer attachments, arrangement and structure of web frames and non-tight platforms shall comply with the requirements of 2.8.2.3. The vertical distance between side stringers shall not exceed 2,5 m, and the frame span, as measured on the side plating, shall not exceed 3,5 m.

In twin- and multi-screw craft having a cruiser or transom stern, the distance between stringers, as measured on the side plating, shall not exceed 2 m. In this case, one of the stringers shall be fitted at the top edge of propeller shaft bossing or in line with a shaft bracket. Where web frames are fitted, their spacing shall not exceed 2,4 m.

If longitudinal side framing is adopted in the afterpeak, the relevant requirements in 2.8.2.3 shall be met.

2.8.2.12 The ends of afterpeak members (including deck, platform and bulkhead framing), and also the ends of horizontal and, where possible, vertical stiffeners of floors shall be fixed.

The face plates of floors and deck transverses in the afterpeak shall be sniped in way of their attachment to longitudinal bulkheads. Bulkhead stiffeners shall therewith be attached to the floor face plates with brackets fitted on both sides of the bulkhead.

The above also applies to deck girder and side girder attachment to transverse bulkheads.

2.8.2.13 The spacing of ordinary and bevel frames may be the same as in the midship region, but shall not exceed 750 mm. A side girder of the same depth as that of floors shall be fitted at the centreline. In case of transom stern and/or flat of the bottom, the side girders shall be spaced not more than 2 m apart.

In full cruiser sterns and where the frame span from the upper edge of floors to the nearest deck exceeds 2,5 m, additional strengthening shall be provided by means of web frames and a side stringer.

2.8.2.14 Where peaks are used as tanks, a wash bulkhead at the centreline is recommended.

2.8.3 Loads on structures at craft's ends.

2.8.3.1 The design pressure on the structures at ends is determined using the design loads specified in 2.2 to 2.7 and the extreme loads specified in 2.8.3.2.

The scantlings of fore end members exposed to impact pressure shall be verified at extreme loads according to 2.8.3.2 for the craft having the characteristic $(v_0/\sqrt{L}) > 1{,}5$ or having a significant bow flare.

2.8.3.2 Under the wave impact on the side at the fore end, the extreme values of the design hydrodynamic pressure p_{SL}, in kPa, shall be determined by the formula

$$p_{SL} = 0{,}9\,C_3\,C_4^2 \tag{2.8.3.2}$$

where $C_3 = 2{,}2 + 1{,}5\,\mathrm{tg}\,\alpha_x$;
$C_4 = v_0(0{,}6 - 20/L)\,(1{,}2 - 0{,}2\,\beta_x/60)\sin\beta_x + 0{,}6\sqrt{L}$;
for v_0, refer to 1.1.2;
α_x and β_x = as defined in 2.8.1.2.

The impact pressure is applied throughout the depth of the craft's side above a ballast waterline and lengthwise, to the craft's side extended afterward till the cross section at $0{,}01\,v_0\,L$ from the fore perpendicular and forward till the intersection of the upper deck with the stem (refer to Fig. 2.8.1.2-2).

2.8.4 Scantlings of structural members at craft's ends.

2.8.4.1 The shell plating thickness, the scantlings of single bottom and double bottom members and also of side framing under the loads potential in operation, as determined in 2.2, 2.3, 2.4, 2.5, shall meet the requirements in 2.2.4, 2.3.4, 2.4.4 and 2.5.4. In addition, the following requirements shall be met in determining the scantlings of fore and after peak members:

.1 the section modulus of frames is determined by Formulae (2.1.6.4.1) and (2.1.6.4.2). In this case:

$m = 12$;

l = spacing of side stringers, as measured along shell plating;

.2 scantlings of panting beams shall be comply with the requirements in 2.9.4.1;

.3 in calculating the section modulus and the cross-section area of web frames, it shall be assumed:

$m = 10$;
$N_{max} = 0{,}5\,pal$

where p = design pressure, in kPa, according to 2.5.3;

a = spacing of web frames, in m;
l = web frame span, in m, as measured between the top edge of a floor and the deck (platform) bounding the forepeak (afterpeak) or the non-tight platform, if any, nearest to the bottom, or between non-tight platforms, the deck and non-tight platform less the deep beam depth of the relevant deck (platform);

.4 the plating thickness and framing of a non-tight platform shall meet the requirements in 2.6.4 for platforms at the craft's ends. The design load therewith shall not be assumed less than 3,5 kPa.

The thickness s_{min}, in mm, of non-tight platform plating shall be determined by the formula

$$s_{min} = 5 + 0{,}02L \tag{2.8.4.1.4}$$

but not less than 5 mm;

.5 where the forepeak (afterpeak) is used as a tank, its structural members shall also be dimensioned according to the requirements imposed on the structural components of tanks.

2.8.4.2 The side framing members of the fore end exposed to extreme loads according to 2.8.3.2 shall be dimensioned in compliance with the requirements in 2.2.4 and 2.5.4 and also with the following additional requirements:

.1 the shell plating thickness shall be determined by Formula (2.1.6.4.4). In this case:

$$p = 0{,}5p_{SL} \tag{2.8.4.2.1}$$

where p_{SL} is determined by Formula (2.8.3.2);
m = 15,8;
k_σ = 0,7;

.2 the section modulus of primary members, in cm^3, shall not be less than that determined by the formula

$$W = 0{,}75pal^2\omega_k/(mk_\sigma\sigma_n) \tag{2.8.4.2.2}$$

where p is determined by Formula (2.8.4.2.1);
k_σ = 0,65;
m = 16, if the members are continuous through the webs of supporting structures;
m = 8, if the members are cut at supports;
m = 28, if the members are reinforced at the supporting sections with brackets on both sides of the supporting structure; the depth and length of brackets are no less than 1,5 times the member depth;
for ω_k, refer to 2.1.2.3;

.3 the cross-section area, in cm^2, of a primary member or welds which join intercostal members and supporting structures shall not be less than that determined by the formula

$$f = 5pa\,(l - 0{,}5a)/(k_\tau\tau_n) + 0{,}05\,\Sigma h_i\Delta s \tag{2.8.4.2.3}$$

where p is determined by Formula (2.8.4.2.1);
k_τ = 0,65;
Σh_i = length of the member section perimeter, in cm;
Δs = according to 2.1.2.1.

2.8.4.3 The scantlings of frames within the are of stern counter shall not less than those in the afterpeak unless their span exceeds 2,5 m. With a greater span, the frame scantlings shall be increased accordingly. The thickness of floors and side girders shall not be less than the required according to 2.8.4.5.

2.8.4.4 The side stringers in the forepeak and afterpeak shall have the cross-section area of a web f_w, in cm^2, not less than that determined by the formula

$$f_w = 12 + 0{,}45L. \tag{2.8.4.4-1}$$

The depth of the side stringer web b, in m, shall not be less than that determined by the formula

$$B = 0{,}24 + 0{,}005L. \tag{2.8.4.4-2}$$

The web thickness of the the side stringer, in mm, shall not be less than

$$s_{min} = 5 + 0{,}02L \tag{2.8.4.4-3}$$

but not less than 5 mm.

2.8.4.5 The thickness of the bulb shell plating shall not be less than $0{,}08L + 6$.

2.8.5 Special requirements.

2.8.5.1 In craft provided with fixed propeller nozzles, transverse bulkheads or primary support members shall be fitted in way of the nozzle attachment to the hull.

2.8.5.2 Within the curved parts of the hull (deadrise, flare) the framing is recommended to fit at an angle close to 90° to the shell plating.

2.8.5.3 In multi-screw craft, the structural strength and rigidity in way of attaching the sterntube, shaft strut and shaft bossing are subject to special consideration by the Register.

2.9 PILLARS AND PANTING BEAMS

2.9.1 General provisions and symbols.

2.9.1.1 This Chapter contains the requirements for the scantlings of pillars fitted in the hull, superstructures and deckhouses, and for panting beams in peaks.

2.9.1.2 For the purpose of this Chapter, the following symbols are used:

l = length of a pillar (panting beam), in m, measured: for the pillar – between the face plate of a deck girder (or a deck transverse if supported by the pillar) and the deck plating (or inner bottom); for the panting beam – between the inner edges of starboard and port frames or from the inner edge of the frame to a secure support at the craft's centreline;

f = sectional area of the pillar (panting beam), in cm^2;

i = the least moment of inertia of the pillar (panting beam), in cm^4;

d_0 = outer diameter of the pillar, in mm.

2.9.2 Construction.

2.9.2.1 The pillar axes in 'tween deck spaces shall generally be arranged in the same vertical line and the pillar ends shall be bracketed.

Where the heel of a tubular pillar has no brackets, the deck (inner bottom) plating under it shall be reinforced with a doubling or an insert plate.

The web of a framing member to which the head of a pillar is attached shall be strengthened with brackets to transmit the load to the pillar.

The pillars shall be fitted on plate floors and side girders which shall be strengthened with vertical brackets. Openings in floors and side girders under the pillars are not permitted.

2.9.2.2 The pillars shall be attached at their heads and heels by brackets or other arrangements approved by the Register, in order to effectively transmit the loads to the hull structures below:

in tanks, under watertight platforms, deckhouses, ends of superstructures, windlasses, winches, capstans, etc.;

at the fore end of the craft having the specified speed $v_0 > 1{,}5\sqrt{L}$ or a large bow flare.

2.9.3 Design loads.

2.9.3.1 The pillar loads P, in kN, is determined by the formula

$$P = p\,l_m b_m + \Sigma\,(p\,l_m b_m)_i \qquad (2.9.3.1)$$

where p = design pressure on the above deck according to 2.6.3, in kPa;
l_m = distance measured along carlings between their midpoints, in m;
b_m = mean width of the deck area (including the hatchways in the region concerned) supported by the pillar, in m;
$\Sigma\,(p\,l_m b_m)_i$ = sum of loads from the pillars fitted above, determined allowing for 2.6.3 which may be transferred to the pillar considered, in kN.

2.9.3.2 Loads on the panting beam P, in kN, is determined by the formula

$$P = p\,a\,c \qquad (2.9.3.2)$$

where $p = p_{st} + p_w$ – design pressure on the craft's side in way of the panting beam to be determined according to 2.1.4.6.1 and 2.1.4.6.2;
a = spacing of frames on which panting beams are fitted, in m;
c = half-sum of frame spans measured vertically above and below the panting beam considered, in m.

2.9.4 Scantlings of pillars and panting beams.

2.9.4.1 The section area of pillars and panting beams f, in cm^2, shall not be less than that determined by the iterative method according to the formula

$$f = 10\,k\,P/\sigma_{cr} + \Delta f \qquad (2.9.4.1)$$

where P = according to 2.9.3;
k = 2 – buckling strength margin;
σ_{cr} = critical stress determined by the formulae:
$\sigma_{cr} = \sigma_e$ if $\sigma_e \le 0{,}5\,R_{eH}$;
$\sigma_{cr} = R_{eH}(1 - R_{eH}/4\,\sigma_e)$ if $\sigma_e > 0{,}5\,R_{eH}$;
where the Euler stress σ_e is determined by the formula
$\sigma_e = 206\,i/(f\,l^2)$;
Δf = wear allowance, in cm^2, determined by the formulae:
for tubular pillars $\Delta f = 0{,}03\,d_0\,\Delta s$;
for box-shaped pillars $\Delta f = 0{,}1\,\Sigma h_i\,\Delta s$
where Σh_i = length of the cross-section perimeter, in cm;
for built-up (H-section, channel, etc.) pillars and panting beams $\Delta f = 0{,}05\,\Sigma h_i\,\Delta s$;
for Δs, refer to 2.1.2.1.

2.9.4.2 The wall thicknes s, in mm, for tubular pillars shall be assumed not less than that determined by the formula

$$s = (d_0/50) + 3{,}5. \qquad (2.9.4.2\text{-}1)$$

The wall thickness s, in mm, for built-up pillars (box-shaped, made of channels or I-beams, etc.) shall not be less than

$$s = h_p/50; \qquad (2.9.4.2\text{-}2)$$

where h_p = height of the pillar wall, in mm.

The pillar wall thickness shall generally not be less than 6 mm.

In small craft, if agreed with the Register, the wall thickness of pillars may be reduced down to 5 mm, provided the sectional area required is maintained.

2.10 STEMS, STERN FRAMES, KEELS, RUDDER HORNS AND SHAFT STRUTS, FIXED NOZZLES OF PROPELLERS

2.10.1 General.

Requirements are given in this Chapter for the construction and scantlings of the stem, sternframe (rudder post, propeller post), solepiece of the sternframe, rudder horn of semi-spade rudders, propeller shaft brackets, bar keel, fixed nozzles of propellers.

2.10.2 Construction.

2.10.2.1 It is recommended to use a bar or plate type welded stem. The lower part of the stem shall be efficiently connected to the bar or plate keel and, whenever possible, to the centre girder.

The welded stem plates shall be stiffened with transverse brackets. Arrangement of transverse brackets of the stem shall, as far as possible, be consistent with the hull framing. Transverse brackets stiffening the stem plate are fitted not more than 1 m apart below and not more than 1,5 m above the maximum summer waterline. The brackets shall overlap the joints of the stem with the shell plating and shall be extended and welded to the nearest frames.

The brackets which cannot be extended to the framing shall have their rear edge made along a smooth curve.

In case where the radius of curvature of the stem is sufficiently large, it is recommended to fit a centerline girder with a face plate.

2.10.2.2 The construction of sternframe of a single screw craft shall comply with the following requirements:

.1 the sternframe shall have such dimensions as to provide the clearances between sternframe and propeller, and between propeller and rudder (refer to Fig. 2.10.2.2.1) not less than specified in Table 2.10.2.2.1;

Table 2.10.2.2.1

Dimension	*a*	*b*	*c*	*d*	*e*
Clearance, in mm	$0,2R_p$	$0,42R_p$	$0,36R_p$	$0,08R_p$	200 – 250
R_p = radius of a propeller, in mm					

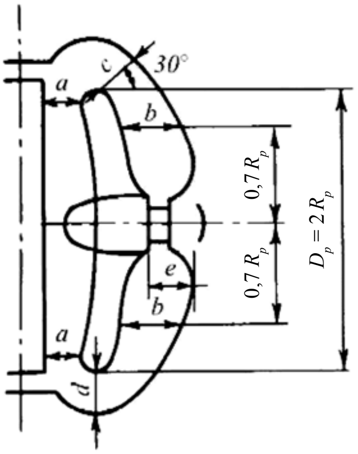


Fig. 2.10.2.2.1

.2 the solepiece shall be made with a smooth rise in the aft direction;

.3 the propeller post shall be provided with transverse brackets in the case of welded sternframe and webs in the case of cast sternframe. The brackets and webs shall be spaced at least 1 m apart; their arrangement shall be consistent with the hull framing;

.4 the stern frame shall be efficiently attached to the craft's hull.

The lower part of the sternframe shall be extended forward from the propeller post and shall be attached by its brackets (webs) to one floor as a minimum.

The rudder post shall be extended over the stern counter to attach it to the transom floor.

The thickness of transom floor and additional transom floor shall be increased as compared to that of the floors in the after peak. In general, the above floors shall be extended to the nearest deck or platform.

2.10.2.3 The sternframe in twin screw ships shall comply with the requirements for the sternframe in single screw craft, as specified in 2.10.2.2.

2.10.2.4 The sternframe of triple screw ships shall comply with the requirements for the sternframe of single screw craft, as specified in 2.10.2.2 and 2.10.4.2.

2.10.2.5 The rudder horn of a semi-spade rudder shall be securely connected to the corresponding floors of the afterpeak and its centreline wash bulkhead.

The welded rudder horn shall be provided inside with transverse brackets; its main supporting structures shall be extended to the nearest deck or platform; the thickness of the floors to which the rudder horn is connected shall be increased as compared to that of the floors in the after peak.

2.10.2.6 The struts of two-strut shaft brackets shall form an angle of approximately 90° to each other. Their axes shall intersect at the axis of the propeller shaft.

The construction of propeller shaft brackets with struts arranged at an angle less than 80° and greater than 100°, additional strengthening of the hull within the region of shaft brackets are subject to special consideration by the Register.

The propeller shaft brackets shall be so arranged in relation to the craft's hull that the clearance between the blade tip and the craft's hull is as large as possible and, but, not less than 25 per cent of the propeller diameter.

2.10.2.7 The outer and inner plating of propeller nozzle shall be strengthened by stiffeners whose arrangement and size as well as connection with outer and inner plating of the propeller nozzle shall be determined according to 2.4.2.2, Part III "Equipment, Arrangements and Outfit"of the Rules for the Classification and Construction of Sea-Going Ships.

In general, the transverse web plates shall be arranged in line with the floors of the after peak.

In way of attachment of the nozzle to the hull smooth transition from the nozzle to the craft's hull shall be provided. The bottom part of the nozzle shall be connected to the hull. If the propeller nozzle is attached to the hull by shaft brackets, provision shall be made for an efficient connection of the brackets with the framing in the aft region of the hull and the framing inside the nozzle. The construction of shaft brackets shall satisfy the requirements of 2.10.2.6. Drain plugs of non-corrosive material shall be fitted in the top and bottom parts of outer plating.

2.10.3 Design loads.

Design loads for the structures of the solepiece and rudder horn of semi-spade rudders is taken equal to the reaction force of lower support of the rudder R_4 according to 2.2.4.12, Part III "Equipment, Arrangements and Outfit"of the Rules for the Classification and Construction of Sea-Going Ships. In Formulae (2.2.4.7-2) to (2.2.4.7-4) the coefficient α_4 shall be taken equal to zero.

2.10.4 Scantlings of stem, sternframe, rudder horn and propeller shaft brackets, bar keel and fixed nozzle of propeller.

2.10.4.1 The stem shall meet the following requirements:

.1 the sectional area f, in cm^2, of a bar stem from the keel to the maximum summer waterline shall not be less than that determined by the formula

$$f = 1{,}3L - 4. \qquad (2.10.4.1.1)$$

The sectional area of the stem may be reduced for the craft of design categories:

A2 and **B** – by 10 per cent;

C, **C1**, **C2**, **C3** and **D** – by 20 per cent.

The sectional area of the stem above the maximum summer waterline may be gradually reduced down to 70 per cent of the above-specified area;

.2 the plate thickness s, in mm, of a welded stem shall be determined by the formula

$$s = 0{,}085L + 5{,}5 \qquad (2.10.4.1.2)$$

but not less than 7 mm.

The stem plate thickness may be reduced for the craft of design categories:

A2 and **B** – by 5 per cent;

C, **C1**, **C2**, **C3** and **D** – by 10 per cent.

The stem plate thickness above the maximum summer waterline may be gradually reduced down to that of the shell plates adjoining the stem.The thickness and width of the stem plates in way of their attachment the plate keel shall not be less than those of the latter.

When the distance between the brackets strengthening the stem is reduced by 0,5 m, as compared to that required by 2.10.2.1, the reduction of plate thickness of stem by 20 per cent may be permitted. If the reduction of the distance between the brackets is less than 0,5 m, the permissible reduction of plate thickness shall be determined by linear interpolation;

.3 the thickness of brackets strengthening the stem shall not be less than that of shell plating adjoining the stem.

The thickness of web and face plate of the girder stiffening the stem at the centreline shall not be less than that of the brackets.

2.10.4.2 The stern frame of single-screw craft shall meet the following requirements:

.1 the length l_s and width b_s, in mm, of rectangular solid propeller post section from the keel to the stern counter shall not be less than the determined by the formulae:

$$l_s = 1{,}30L + 95;$$
$$b_s = 1{,}60L + 20. \qquad (2.10.4.2.1)$$

The sternpost section scantlings may be reduced for the craft of design categories:

A2 and **B** – by 5 per cent;

C, **C1**, **C2**, **C3** and **D** – by 10 per cent.

Above the counter the sectional area of stern-frame may be gradually reduced. And nowhere its sectional area shall be less than 40 per cent of the required area of the propeller post, corresponding to the scantlings stated above;

.2 the scantlings of the propeller post cross section of a cast sternframe with the rudder having top and bottom supports shall be established in accordance with Fig. 2.10.4.2.2 depending on the value s_0, in mm, determined by the following formulae:

$$s_0 = 0{,}1L + 4{,}4. \qquad (2.10.4.2.2)$$

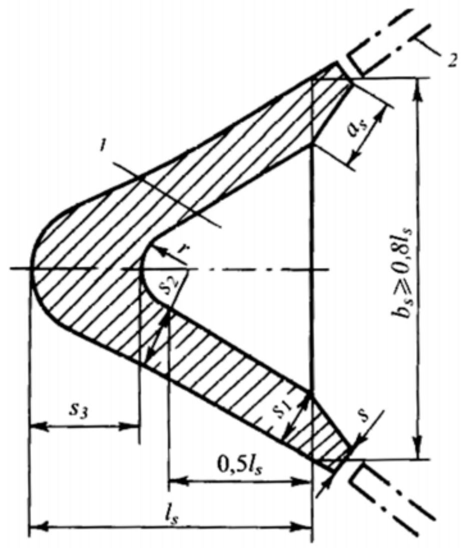


Fig. 2.10.4.2.2:
1 – web; *2* – adjoining plate of shell;
$s_1 = 1{,}5s_0$; $s_2 = 2{,}5s_0$; $s_3 = 3{,}5s_0$; $l_s \geq 1{,}9L + 135$ mm;
r – cast radius

The thickness of webs shall be at least 50 per cent greater than that of the shell plating adjoining the sternframe;

.3 the scantlings of the propeller post cross section of a welded sternframe with the rudder having top and bottom supports shall be established according to Fig. 2.10.4.2.3 where s_0 shall be determined in accordance with 2.10.4.2.2. The thickness of transverse brackets shall be at least 20 per cent greater than that of the shell plating adjoining the sternframe

Welded propeller post of other construction may be used, provided that its strength is equivalent to that of the abovementioned construction.

.4 the finished thickness of propeller boss shall not be less than 30 per cent of the shaft diameter;

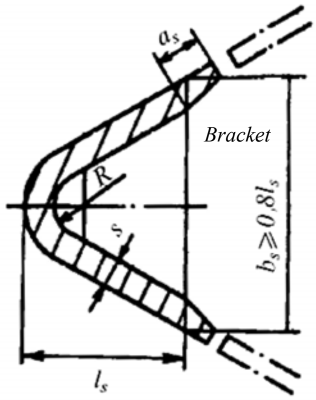


Fig. 2.10.4.2.3:
$s = 1{,}6s_0$; $l_s \geq 2{,}5L + 180$ mm; R – bending radius

.5 the section modulus W_s, in cm^3, of the sole piece of a stern frame about the vertical axis shall not be less than the determined by the formula

$$W_s = 8\,\alpha p_4 x_s. \qquad (2.10.4.2.5\text{-}1)$$

The section modulus W_{rp}, in cm^3, of the rudder post about the horizontal longitudinal axis shall not be less than the determined by the formula

$$W_{rp} = 8\,(1 - \alpha)\,R_4\,l_{rp} \qquad (2.10.4.2.5\text{-}2)$$

where α = 0,85, if there is a rudder post;
α = 1, if there is no rudder post or a bolted rudder post is fixed;
R_4 = as determined according to 2.10.3;
x_s = distance from the solepiece section concerned to the centre of the rudder, in m (to be assumed: $0{,}5\,l_s \le x_s \le l_s$);
l_s = span of the solepiece, measured from the centre of the rudder stock to the beginning of rounding of the propeller post, in m, in m;
l_{rp} = span of the rudder post measured vertically from the mid-thickness of the solepiece of a stern frame on the rudder rotation axis to the beginning of rounding in the upper part of the rudder post, in m.

The section modulus of the solepiece about the horizontal transverse axis shall not be less than 0,5 W_s where W_s shall be determined by Formula (2.10.4.2.5-1). The section modulus of the rudder post about the horizontal transverse axis shall not be less than 0,5 W_{rp} where W_{rp} shall be determined by Formula (2.10.4.2.5-2);

.6 the scantlings of the sternframe structural members may be determined on the basis of direct strength calculation taking the permissible stress factor k_σ = 0,55 and external loads according to 2.2, Part III "Equipment, Arrangements and Outfit" of the Rules for the Classification and Construction of Sea-Going Ships.

2.10.4.3 The scantlings of the sternframe of 'twin screw craft shall satisfy requirements for the scantlings of propeller post in single screw ships as given in 2.10.4.2 with the following amendments:

.1 the section width of the sternframe of a solid rectangular cross section may be reduced by 50 per cent as compared with that required by 2.10.4.2.1;

.2 the scantlings of the cast or welded sternframe may be reduced as compared with those required by 2.10.4.2.2 and 2.10.4.2.3 respectively, so that their section moduli about the horizontal longitudinal and transverse axes, are reduced by not more than 50 per cent. The thickness of the sternframe wall shall be at least 7 mm.

2.10.4.4 For semi-spade rudders with one gudgeon upon the horn, the section modulus, in cm^3, of the rudder horn about the horizontal longitudinal axis shall not be less than

$$W = 12\,R_4\,z_s \qquad (2.10.4.4)$$

where R_4 = as determined according to 2.10.3;
z_s = vertical distance from the mid-thickness of the horn gudgeon to the section concerned, in m (to be assumed: $0{,}5\,l_h \le z_s \le l_h$);
l_h = horn span measured vertically from the mid-thickness of the horn gudgeon to the point of intersection of the horn axis with shell plating, in m.

Where the rudder horn is welded of plates, the thickness of the plates, in all cases, shall be at least 7 mm.

The scantlings of the rudder horn may be determined on the basis of direct strength calculation taking the permissible stress factor k_σ = 0,35 and external loads according to 2.2, Part III "Equipment, Arrangements and Outfit" of the Rules for the Classification and Construction of Sea-Going Ships.

2.10.4.5 The sectional area of either strut of twostrut shaft brackets shall be equal to not less than 60 per cent of the propeller shaft section in the bracket plane, the strut thickness – to not less than 45 per cent, and the boss thickness – to not less than 35 per cent of the propeller shaft diameter. The length of the boss shall be in accordance with 5.6.1, Part VII "Machinery Installations" of the Rules for the Classification and Construction of Sea-Going Ships.

The strength of the welded shaft brackets shall not be less than that specified above. The plate thickness shall not be less than 7 mm.

The weld area of rivets attaching each strut to the hull shall not be less than 25 per cent of the propeller shaft sectional area. Where the struts are attachhed by means of flanges, the thickness of the latter shall be not less than 25 per cent of the propeller shaft diameter.

2.10.4.6 The height h_s and width b_s, in mm, of the bar keel cross section shall not be less than:

$$h_s = 1{,}3\,L + 100;$$
$$b_s = 0{,}7\,L + 8. \qquad (2.10.4.6)$$

The bar keel height and width may be reduced for the craft of design categories:

A2 and **B** – by 5 per cent;

C, **C1**, **C2**, **C3** and **D** – by 10 per cent.

2.10.4.7 The thickness of outer and inner plating of fixed propeller nozzle shall comply with the requirements of 2.4.2, Part III "Equipment, Arrangements and Outfit" of the Rules for the Classification and Construction of Sea-Going Ships, considering the following:

the width of middle belt of inner plating shall be not less than the distance from 0,03 D_0 forward of the propeller blade tips and 0,07 D_0 aft of the propeller blade tips, where D_0 is the internal diameter of the propeller nozzle;

the thickness of the forward part of the inner and outer plating shall not be less than required for side shell plating (refer to 2.2.4.1 for transverse framing system).

The width of attachment shall be at least 0,15 D_0.

The cross-sectional area of the joint shall be not less than required by 2.10.4.2.5 for the solepiece. If the solepiece serves as support of the rudder, the connection of the nozzle to the solepiece is subject to special consideration by the Register.

For twin screw craft when the propeller nozzle is not attached to the hull at its bottom part, the width of attachment at the top part shall be not less than $0{,}3\,D_0$.

If the propeller nozzle is attached to the hull by shaft brackets, their strength shall comply with the requirements of 2.10.4.5.

In way of attachment of the nozzle to the hull the thickness of framing members shall not be less than required by Formula (2.4.2.2-2), Part III "Equipment, Arrangements and Outfit" of the Rules for the Classification and Construction of Sea-Going Ships.

2.11 SEATING OF MACHINERY AND BOILERS

2.11.1 General.

2.11.1.1 Requirements are given in this Chapter for the construction and dimensions of the seatings in tended for main machinery and boilers, deck machinery, fishing installations, cargo handling gear, auxiliary machinery, etc.

2.11.1.2 The requirements laid down in this Chapter are minimum. Requirements concerning construction and dimensions of structural components of a seating, which are contained in the technical documentation of the machinery, unit or device to be installed on the seating concerned, shall also be complied with.

2.11.2 Construction of seatings.

2.11.2.1 The construction of seatings shall satisfy the following requirements:

.1 the seating shall be of substantial construction to ensure efficient attachment of machinery, gear or device and transmission of forces to the hull framing, which shall be sufficiently strong. If necessary, the framing may be strengthened;

.2 the seating shall be so constructed that the resonance vibration of the seating as a whole and of its structural components can be avoided under all specified running conditions;

.3 where the seating is installed on the continuous longitudinals of the strength deck and double bottom (bottom), its structural components shall not terminate at unsupported portions of plating. Attachment of the seating to the upper edge of sheerstrake is subject to special consideration by the Register;

.4 the seating shall be so designed that the plating beneath is accessible for inspection. Measures shall be taken to prevent water from accumulating under the seating.

In particular cases agreed with the Register, a hermetic construction of the seating is permitted, the inner space of the seating being filled with some chemically neutral material with good adhesion properties.

2.11.2.2 In general, a seating of main machinery and boilers shall comprise two vertical plates (girder webs) (for medium-speed and high power engines – four vertical plates (two – either side of the engine)) and horizontal face plates (top plates) to which the machinery (boiler) shall be attached directly. The vertical plates shall be strengthened with brackets (knees) having face plates (flanges) along the free edges.

Where the seating comprises four vertical plates, the top plate is attached to two vertical plates fitted on one side of the machinery; the outer plates shall have openings to provide access into the seating. In the case of medium-speed engines, such openings shall not extend to the top plate. The outer plates may be made sloped.

All the vertical plates shall be fitted in line with the main or additional side girders.

2.11.2.3 Machinery and equipment may be installed on shell plating of the hull, tight bulkheads, decks and platforms (including tank bulkheads and crown), inner bottom and shaft-tunnel platings on condition they are attached to the framing members and stiffeners, or on cantilevers connected to framing members or stiffeners.

Attachment of small-sized machinery and equipment directly to the above-mentioned structure

with the help of welded pads is not permitted.

2.11.3 Dimensions of seating structures.

2.11.3.1 The thickness s, in mm, of structural components of a seating of main machinery or boiler shall not be less than

$$s = k_0(\sqrt[3]{Q}) + k_1 \qquad (2.11.3.1)$$

where Q = mass of a mechanism (boiler) in working condition, in t;
k_0 = factor given in Table 2.11.3.1-1;
k_1 = factor given in Table 2.11.3.1-2.

Table 2.11.3.1-1

Seating of a mechanism (boiler)	k_0		
	Top plate	Vertical plate[1]	Brackets, knees
Main internal combustion engine	4,65	3,0	2,5
Main geared turbine set, main diesel generator and propulsion motor	4,15	2,7	2,7
Boiler	3,65	2,4	2,4

[1]In a seating with four vertical plates the thickness of the latter may be assumed equal to that of brackets and knees.

Table 2.11.3.1-2

Mass of a mechanism (boiler), in t	≤ 20	> 20 ≤ 50	> 50 ≤ 100	> 100 ≤ 200	> 200
k_1	4	3	2	1	0

2.11.3.2 The thickness s, in mm, of the structural components of the main internal combustion engine seating shall not be less than

$$s = k_2(\sqrt[3]{N}) + k_3 \qquad (2.11.3.2)$$

where N = specified power of the engine, in kW;
k_2 and k_3 = factors given in Table 2.11.3.2

but not less than those required in 2.11.3.1.

Table 2.11.3.2

N, kW	Number of vertical plates	Factor	Top plate	Vertical plate	Brackets, knees
≤ 1000	2	k_2	1,7	1,1	0,9
		k_3	6	4	3
	4	k_2	1,4	0,9	0,9
		k_3	5	3	3
> 1000	2	k_2	1,0	1,0	0,7
		k_3	13	5	5
	4	k_2	0,8	0,7	0,7
		k_3	11	5	5

2.12 SUPERSTRUCTURES, DECKHOUSES AND QUARTER DECKS

2.12.1 General provisions, definitions and symbols.

2.12.1.1 Requirements are given in this Chapter for bridges extending from side to side of the ship as well as to short bridges which do not extend to the sides of the ship, forecastle, poop, long forecastle and poop extending to ship's sides, short deckhouses and quarter decks.

The applicability of the requirements contained in this Chapter to long superstructures not extending from side to side of the ship as well as to long deckhouses shall be specially agreed with the Register.

2.12.1.2 For the purpose of this Chapter the following definitions have been adopted:

Quarter deck is the after part of an upper deck stepped up to a portion of a 'tween deck depth.

Ends of superstructures and deckhouses are the ends of the length measured from end bulkheads having a length, in m, no less than the determined by the formula

$$l_e = 1,5\,(B_2/2 + h). \qquad (2.12.1.2)$$

Transition area of quarter deck is an area measured from the forward edge of a break to the after edge of the upper deck plating and extended below the quarter deck.

2.12.1.3 For the purpose of this Chapter the following symbols have been adopted:

B_2 = breadth of a superstructure or deckhouse deck measured at its mid-length excluding the breadth of large openings, machinery casings, if any, in m;

h = height of the first tier of a superstructure or deckhouse, in m;

l_1 = length of a superstructure (deckhouse) measured between the end bulkheads; the length of a forecastle (poop) measured from the fore (after) perpendicular to the end bulkhead of the forecastle (poop), in m;

B_x = craft's breadth at the upper deck level at the section considered, in m;

b = breadth of a deckhouse, in m.

2.12.2 Construction.

2.12.2.1 For the first tier of long bridge outside the end portions, long forecastle (poop) outside the end portion, the requirements of 2.6 for the upper deck and the requirements of 2.2 and 2.5 for the craft's side in way of the upper 'tween deck space shall be complied with.

2.12.2.2 For the buttom strake of side plating and longitudinal bulkhead plating of bridges, the

bottom strake of side plating of deckhouses fitted on the strength deck, shall be made of the steel having the same as the strength deck in this region. The width of the bottom strake shall not be less than $0,5/L$.

2.12.2.3 Whenever practicable, the end bulkheads of superstructures and deckhouses shall be situated in line with the hull transverse bulkheads or as close to the latter as possible.

Web frames or vertical webs, bulkheads or partial bulkheads shall be fitted in superstructures and deckhouses in such a way as to be in line with girder webs or bulkheads of hull structures located below. The vertical webs of end bulkheads shall be fitted in line with the vertical webs of hull bulkheads.

2.12.2.4 The lower ends of vertical stiffeners of the end bulkheads of the 1st tier superstructures and deckhouses shall be welded to the deck. The lower ends of side vertical stiffeners of 1st tier houses shall be attached to the deck by brackets.

2.12.2.5 Adequate strengthening shall be provided for the structures of deckhouses and superstructures where launching and recovery appliances for survival craft and rescue boats are fitted.

2.12.3 Design loads.

2.12.3.1 The design loads on the superstructure sides and on the superstructure and deckhouse decks shall satisfy the following requirements:

.1 design pressure on superstructure sides is determined according to 2.2.3;

.2 design pressure on the weather areas of superstructure and deckhouse decks is determined by the formula

$$p = \alpha p_w \qquad (2.12.3.1.2\text{-}1)$$

but no less than p_{min}

where p_w = wave load at the deck level according to 2.1.4.6.2;
α = 0,9 for the forecastle deck, and also for the part of the bridge deck within $0,2\,L$ from the fore perpendicular;
α = 0,8 for the poop deck, and also for the part of the bridge deck within $0,2\,L$ from the aft perpendicular;
α = 0,7 for the bridge and deckhouse decks amidships.
For the bridge and deckhouse deck areas outside the midship and beyond $0,2\,L$ from the fore and aft perpendicular, the value of α is determined by linear interpolation.

For the 1st tier superstructure and deckhouse decks p_{min}, in kPa, is determined by the following formulae:

for the forecastle deck, and also for the part of the bridge deck within $0,2\,L$ from the fore perpendicular

$$p_{min} = 0{,}1\,L + 7; \qquad (2.12.3.1.2\text{-}2)$$

for the poop deck, and also for the bridge deck:

$$p_{min} = 0{,}015\,L + 4. \qquad (2.12.3.1.2\text{-}3)$$

For the decks of the superstructures and deckhouses of the 2nd and other upper tiers:

$$p_{min} = 2 \text{ kPa}. \qquad (2.12.3.1.2\text{-}4)$$

For the craft of design categories of restricted area of navigation the value of p_{min} may be reduced by multiplying by the factor φ_r obtained from Table 2.1.4.5.

2.12.3.2 Pressure on the end bulkheads of superstructures and deckhouses as well as on sides of deckhouses p, in kPa, is determined by the formula

$$p = 5{,}1\,n\,c_2\,(1{,}21\,k - z_1) \qquad (2.12.3.2)$$

where n = factor obtained from Table 2.12.3.2-1;
$c_2 = 0{,}3 + 0{,}7\,b/B_x$, in this case $c_2 \geq 0{,}5$;
$k = 1{,}0 + ((x_1/L - 0{,}45)/(C_b + 0{,}2))^2$ when $x_1/L \leq 0{,}45$;
$k = 1{,}0 + 1{,}5\,((x_1/L - 0{,}45)/(C_b + 0{,}5))^2$ when $x_1/L > 0{,}45$;
for the deckhouse sides the factor k is assumed to vary length of the bulkhead. For this purpose the deckhouse is subdivided into equal parts of no more than 0,15L in length each; in this case the value of x_1 is assumed as a distance between the aft perpendicular and the middle of the part in question;
C_b = shall be assumed as not less than 0,6 and nor greater than 0,8; for the aft end bulkheads forward of amidships it is assumed $C_b = 0{,}8$;
z_1 = vertical distance from the maximum summer waterline to the mid-point of the plate or stiffener span considered.

Table 2.12.3.2-1

Bulkhead	Structure		n
Front	Unprotected	1st tier	$2 + L_0 / 120$
		2nd tier	$1 + L_0 / 120$
		3rd tier	$0{,}5 + L_0 / 150$[1]
	Protected		
Aft end	Aft of amidships		$0{,}7 + L_0 / 1000 - 0{,}8\,x_1 / L$
	Forward of amidships		$0{,}5 + L_0 / 1000 - 0{,}4\,x_1 / L$

Note. 1. L_0 = length of craft, in m;
2. x_1 = distance from the bulkhead in question to the aft perpendicular, in m.
[1] The formula is also applicable to the deckhouse sides.

The above-stated values of the factor n apply to a craft having the freeboard equal to the minimum tabular freeboard of Type “B” ships, and the standard height of superstructures according to Section 4 of the Load Line Rules for Sea-Going Ships. If the deck, whereon is situated the superstructure tier in question, is above the standard position due to the increased freeboard as compared with the tabular one, factor n value corresponding to the deck position may be determined by linear interpolation between the values of that factor for the superstructures with the standard and actual position of the decks under the superstructures. In any case the design pressure shall be no less than in Table 2.12.3.2-2.

For the craft of the design categories of restricted area of navigation the design pressure may be reduced by multiplying by the factor φ_r obtained from Table 2.1.4.5.

Table 2.12.3.2-2

Design pressure p, in kPa	
for 1st tier unprotected fronts	elsewhere
15,6	7,8

2.12.4 Scantlings of superstructure, deckhouse and quarter deck structures.

2.12.4.1 The thickness of the side plating of bridges, a forecastle and poop shall be determined according to 2.2.4.1 at the design loads according to 2.12.3.1.1. For the bridges, forecastle and poop, $k_\sigma = 0{,}7$.

In any case the side plating thickness s_{min}, in mm, for the bridges, forecastle and poop shall not be less than:

for the superstructures of a lower tier:

$$s_{min} = 4{,}5 + 0{,}025\,L; \qquad (2.12.4.1\text{-}1)$$

for the superstructures of other tiers:

$$s_{min} = 4 + 0{,}02\,L. \qquad (2.12.4.1\text{-}2)$$

For the craft of design categories **A** and **A1**, if the spacing assumed is less than the standard one (refer to 2.1.1.1), the minimum thickness may be reduced in proportion to the ratio of the assumed spacing to the standard one, but not more than by 10 per cent.

2.12.4.2 The deck plating thickness for bridges, a forecastle and poop, and also for deckhouses shall be determined according to 2.6.4.1.1 and 2.6.4.1.2 at the design loads according to 2.12.3.1.2. For the bridges, forecastle and poop, and also for the deckhouses $k_\sigma = 0{,}7$.

In any case the deck plating thickness s_{min}, in mm, for the bridges, forecastle and poop, and also for the deckhouses shall not be less than:

for the open forecastle deck:

$$s_{min} = 4 + 0{,}04\,L; \qquad (2.12.4.2\text{-}1)$$

for other decks of superstructures and deckhouses of the lower tier:

$$s_{min} = 5 + 0{,}01\,L; \qquad (2.12.4.2\text{-}2)$$

for the superstructure and deckhouse decks of other tiers:

$$s_{min} = 4 + 0{,}01\,L. \qquad (2.12.4.2\text{-}3)$$

For the craft of design categories **A** and **A1**, if the spacing assumed is less than the standard one (refer to 2.1.1.1), the minimum thickness may be reduced in proportion to the ratio of the assumed spacing to the standard one, but no more than by 10 per cent.

For the craft of less than 20 m in length, the minimum thickness may be reduced down to 3 mm subject to agreement with the Register.

2.12.4.3 The plate thickness for the end bulkheads of superstructures, for the side and end bulkheads of deckhouses shall not be less than the determined by Formula (1.6.4.4). In this case:

m = 15,8;

k_σ = 0,6;

Δs = 0;

p = as defined in 2.12..3.2.

The thickness of the side plating of deckhouses may be not more than that of superstructures according to 2.12.4.1 provided they are similarly arranged lengthwise of the craft and throughout its depth.

The thickness of a bottom plate of end bulkheads for the superstructures (deckhouses) of the 1st tier shall be increased by 1 mm as compared with the design thickness. The width of the bottom plate shall be at least 0,5 m.

Where the deckhouse front is of the convex form in plan across the entire width of the deckhouse, its plating thickness may be reduced by 0,5 mm as compared with the design value.

2.12.4.4 In any case the plate thickness s_{min}, in mm, for the end bulkheads of superstructures, for the side and end bulkheads of deckhouses shall not be less than the determined by the formulae:

for the lower tier:

$$s_{min} = 5 + 0,01\,L; \qquad (2.12.4.4\text{-}1)$$

for other tiers:

$$s_{min} = 4 + 0,01\,L. \qquad (2.12.4.4\text{-}2)$$

For the craft of less than 20 m in length the minimum thickness may be reduced down to 3 mm subject to agreement with the Register.

2.12.4.5 Framing of the sides, decks and end bulkheads of a forecastle, poop, bridge, quarter deck and deckhouses shall meet the following requirements:

.1 the side framing of superstructures shall meet the requirements for the side framing in tweendecks according to 2.5.4.2 to 2.5.4.5 at the design loads in 2.12.3.1.1. For longitudinals and side stringers of the bridge, forecastle and poop, k_σ = 0,65;

.2 the underdeck framing of superstructures and deckhouses shall meet the requirements in 2.6.4.2 to 2.6.4.7 at the design loads in 2.12.3.1.2. For longitudinals and carlings of the bridge, forecastle and poop,

k_σ = 0,65;

.3 the section modulus of vertical stiffeners of the end bulkheads of superstructures and of the side and end bulkheads of deckhouses shall not be less than the determined according to 2.1.6.4.1. In this case:

k_σ = 0,6;

ω_c = 1;

p = as defined in 2.12.3.2;

m = 12, if the lower end of the stiffener is attached to the deck with a bracket;

m = 10, if the lower end of the stiffener is welded to the deck;

m = 8, if the lower end of the stiffener is sniped.

The section modulus of stiffeners of deckhouse sides need not be greater than that of frames of superstructures as stated in 2.12.4.5.1, where arranged similarly over craft's length and depth.

2.12.4.6 The member scantlings for bulkheads and partial bulkheads inside superstructures and deckhouses shall meet the requirements in 2.7.4.5 unless otherwise specified.

2.12.5 Special requirements.

2.12.5.1 In way of end bulkheads the following requirements shall be met:

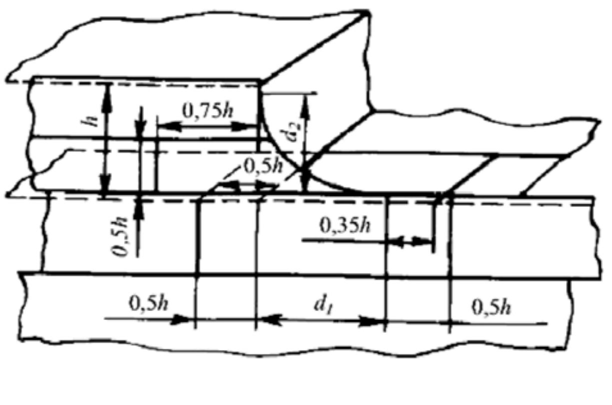
.1 where the superstructure end bulkhead is not in line with the transverse bulkhead of the hull, partial bulkheads or pillars shall be fitted in spaces below the end bulkhead, or frames and beam knees shall be strengthened;

.2 at the section, where the end bulkheads of superstructures and deckhouses abut on the undeck longitudinal structures and the sides of deckhouses – on the transverse underdeck structures fitted below (bulkheads, partial bulkheads, undeck girders, deck transverses, etc.), the webs of these underdeck structures shall be stiffened with brackets.

2.12.5.2 The structure in way of the superstructure ends shall meet the following requirements:

.1 in way of the bridge, forecastle and poop ends, the side plating shall be extended beyond the end bulkhead and gradually curved towards the craft's side on the length d_1, in m (refer to Fig. 2.12.5.2.1), determined by the formula

$$d_1 \geq 0,1\,(B_2\,/2 + h). \qquad (2.12.5.2.1)$$



$0,5 \leq d_2 = 0,65\,d_1 \leq 0,75\,h$

Fig. 2.12.5.2.1

On agreement with the Register, the value of d_1 may be reduced provided the thickness of the bottom strake of the superstructure side plating, of the sheerstrake and deck stringer plate in the region shown in Fig. 2.12.5.2.1 is increased;

.2 the blunted ends of the projecting side plates of the superstructure shall be machined flush with the deck.

The curved edge shall be stiffened with a flat bar offset by 50 mm downward from the edge. The ends of that bar shall be sniped.

Openings in side plating projecting beyond the ends of a superstructure are normally not permitted. The projecting plates shall be attached to the bulwark by means of flexible joints;

.3 at the ends of bridge not extending from side to side of ship the attachment of the side to the deck shall be made as a smooth transition from the side to a short deck girder strengthening the deck under that side with simultaneous strengthening of the deck stringer plate within the region shown in Fig. 2.12.5.2.1.

2.12.5.3 The structures of the break in way of connecting the upper deck to the quarter deck shall meet the following requirements:

.1 the upper deck plating need not extend abaft the break;

.2 the upper deck stringer plate shall be extended beyond the upper deck plating for two frame spaces.

The upper deck stringer plate shall therewith get narrower from its full width to the depth of the frame to which it is to be welded;

.3 the stringer plate of quarter deck shall extend forward in the form of a bracket gradually tapered to ship's side on a length of three frame spaces. The quarter deck stringer plate projecting beyond the break shall be adequately stiffened and its free edge shall have a face plate or flange;

.4 the sheerstrake of quarter deck shall extend forward of the deck stringer plate projecting beyond the break bulkhead for at least 1,5 times the height of break and shall be smoothly tapered into the upper edge of craft's side sheerstrake. For other structural requirements, refer to 2.12.5.2.3;

.5 diaphragm plates spaced not more than 1,5 m apart shall be fitted over the ship's breadth between the overlapping decks in way of the break. The thickness of diaphragms shall not be less than the thickness of the break bulkhead plating.

The diaphragm plates shall be strengthened with vertical stiffeners.

Continuous welds shall be used to attach the horizontal edges of diaphragm plates to the decks, and the vertical edges to break bulkhead on one side, and on the other side to an extra supporting bulkhead made of continuous plate welded to the decks over the craft breadth. The plate thickness of that bulkhead shall be not less than the thickness of break bulkhead plating and may have openings between diaphragms;

.6 where the supporting bulkhead is fitted, the diaphragm plates shall be stiffened with brackets at their ends (refer to Fig. 2.12.5.3.6);

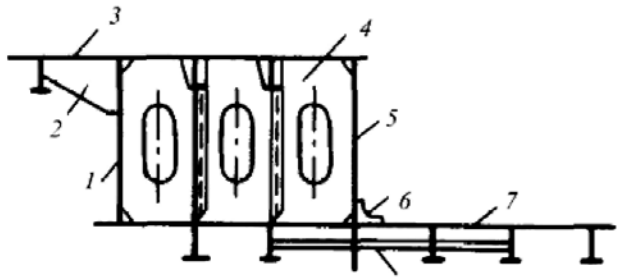


Fig. 2.12.5.3.6:
1 – supporting bulkhead; *2*, *6* – brackets; *3* – quarter deck;
4 – diaphragm; *5* – break bulkhead; *7* – upper deck;
8 – stiffener in line with bracket

.7 where the quarter deck adjoins the bridge, the former shall be extended into the bridge for two frame spaces beyond the break, but no less than the elevation of the bridge above the quarter deck.

The quarter deck stringer plate shall be extended farther forward for two frame spaces with the width gradually reduced as required in 2.12.5.3.2.

Strengthening of the overlapping decks in way of the break shall meet the requirements in 2.12.5.3.5 and 2.12.5.3.6 depending on the position of the break lengthwise of the craft.

The bridge side plates extended aft of the bridge shall be gradually tapered in a curve to the sheerstrake within a length of at least 1,5 times the break height (refer also to 2.12.5.2.1);

.8 where the break is located within 0,25L from the aft perpendicular, strengthenings shall meet the following requirements:

the upper deck plating need not extend aft of the break across the craft's entire breadth, but the upper deck stringer, as well as the quarter deck stringer and sheerstrake shall be extended forward and aft as specified in 2.12.5.3.3 and 2.12.5.3.4.

2.12.5.4 The use of aluminium alloys for the construction of deckhouses is permitted. Decks of accommodation and service spaces situated above the machinery and cargo spaces shall be made of steel.

2.12.5.5 The helideck members and supporting structures shall meet the following requirements:

.1 the helideck members, depending on its location over the ship's length and depth, shall satisfy the requirements for members of weather deck as specified in 2.6 or superstructure (deckhouse) decks, as specified in 2.12.4.2 and 2.12.4.5.2. In any case, the design pressure shall not be less than

$$p_{min} = 2 \text{ kPa};$$

.2 helideck members shall satisfy the requirements for the members of decks intended for the carriage of cargo, as specified in 2.6. The design loads are determined on the basis of the greatest mass of helicopters and equipment stowed on the helideck during operation of the ship and the additional pressure of 0,5 kPa from snow cover or ice.

.3 the helideck members shall satisfy the requirements for deck members of ro-ro ships, as specified in 3.2, Part II "Hull" of the Rules for the Classification and Construction of Sea-Going Ships. The design loads under the helicopter landing conditions are determined on the basis of the following:

Q_0 = conditional axle load to be assumed equal to the maximum take-off weight of the helicopter, in kN;

n_0 = conditional number of wheels on the axle;

n = 1 – number of wheels forming a group;

$u \cdot v = 0,3 \cdot 0,3$ m^2 – size of the tyre print;

k_d = 1,5 – dynamic amplification factor;

.4 where the helideck is not a superstructure or deckhouse deck, its supporting structures shall meet the requirements for pillars according to 2.9 and (or) partial bulkheads according to 2.7.4.4 at the design loads according to 2.12.5.5.1 and 2.12.5.5.3;

.5 where the helicopter deck has the structures protruding beyond the craft's side line, the requirements thereto are subject to special consideration by the Register.

2.13 MACHINERY CASINGS

2.13.1 General.

Openings in decks and platforms over engine rooms shall be protected by strong casings.

The casings may be omitted only in cases where the space on the deck or platform is a part of the engine room.

2.13.2 Construction.

2.13.2.1 Where there are large openings in the deck in way of engine room, additional pillars and deck transverses shall be fitted for strengthening of the deck in way of machinery casing.

2.13.2.2 Where the opening for machinery casing is arranged in the strength deck, the requirements of 2.6.5.1 regarding the design of corners and compensation for openings shall be complied with.

2.13.3 Scantlings of machinery casing structures.

2.13.3.1 The part of machinery casing located inside the enclosed spaces ('tween deck spaces, fore castle, poop, bridge, deckhouse) shall comply with the requirements of 2.7.4.5 for partial bulkheads. The spacing of stiffeners shall not exceed 0,9 m.

The thickness of plating of the part of machinery casing located inside the poop, bridge or deckhouse may be 0,5 mm less than specified.

2.13.3.2 The part of machinery casing located below the bulkhead deck shall comply with the requirements of 2.7.2.3, 2.7.4.1 to 2.7.4.3 for watertight bulkheads where it is included in subdivision calculation as watertight construction.

2.13.3.3 The part of machinery casing located above weather deck shall comply with the requirements of 2.12 for deckhouses situated in the same region of the ship. In calculating the design loads by Formula (2.12.3.2) c_2 shall be taken equal to 1.

2.14 BULWARK

2.14.1 General.

Bulwarks of strong construction shall be provided in places specified in 8.6, Part III "Equipment, Arrangements and Outfit"of the Rules for the Classification and Construction of Sea-Going Ships.

2.14.2 Construction.

2.14.2.1 The height of the bulwark as measured from the upper edge of the deck plating or from that of planking, if any, to the upper edge of the rail section shall comply with the requirements of 8.6.2, Part III "Equipment, Arrangements and Outfit" of the Rules for the Classification and Construction of Sea-Going Ships.

2.14.2.2 The bulwark openings cut in bulwarks shall be so designed as to ensure a smooth transition (with a radius not less than 100 mm) from the bulwark plate to the sheerstrake.

Within 0,07L from the fore perpendicular the welding of bulwark plating to the sheerstrake is necessary.

2.14.2.3 The bulwark shall be supported by stays spaced not more than 1,8 m apart. In the craft with large flare of sides and in craft with minimum assigned freeboard, stays may be required to be fitted at very frame within the region considered.

2.14.2.4 The stays shall be fitted in line with deck beams, brackets and other structures and shall be welded to the rail section, bulwark plate and deck. The attachment of stays to bulwark shall be ensured on a length not less than half the height of the bulwark.

In welding the stays to the deck, holes sufficient in size to allow free passage of water to the scuppers shall be provided in the stays. The welded connection of the beam (bracket) to deck plating under the stay shall not be weaker than the attachment of stay to deck.

Directly under the lower ends of stays no cut-outs in the deck beams and no gaps between frame ends and deck are permitted.

The dimensions of lightening holes in stays shall not exceed half the stay width in any section of the stay.

The free edges of stays shall be stiffened with face plates or flanges.

In general, the flanges (face plates) of stays shall not be welded to deck plating and rail section.

The flanges (face plates) on the outer edge of the stay shall not be welded to horizontal stiffener (flange) of lower edge of the bulwark in way of continuous cutout.

2.14.3 Loads on bulwarks.

The external pressure determined by Formula (2.1.4.6.2) is assumed as the design pressure p, in kPa, acting on the bulwark. In this case the design pressure shall not be less than

$$p_{\min} = 0{,}02\,L + 14 \qquad (2.14.3)$$

but not less than 15 kPa.

For the craft's design categories of an restricted area of navigation the value of $p_{\min}$ may be reduced by multiplying by the factor φ_r obtained from Table 2.1.4.5.

2.14.4 Scantlings of bulwark components.

2.14.4.1 The thickness s, in mm, of the bulwark plating is determined by the formula

$$s = 0{,}065\,L + 1{,}75 \qquad (2.14.4.1)$$

but not less than 3,0 mm.

The thickness of bulwark plating of a superstructure located beyond 1/4 of the craft's length from the fore perpendicular, as well as that of bulwark plating of 2nd tier deckhouses or superstructures may be reduced by 1 mm.

For 3rd and above tiers of the deckhouses the thickness of the bulwark plating need not exceed the thickness required for the plating of sides of 3rd tier deckhouse.

2.14.4.2 The section modulus of a bulwark stay adjoining the deck plating shall not be less than the determined in 2.1.6.4.1. In this case:

p as defined in 2.14.3;

$m = 2$;

$k_\sigma = 0{,}65$.

Where the bulwark has cutouts for passage or expansion joints, the section modulus of stays at the ends of those cutouts or expansion joints shall be increased by 25 per cent.

The width of a stay at its top end shall be equal to that of a rail.

3 ALUMINIUM ALLOY HULL

3.1 GENERAL

3.1.1 An aluminium alloy hull is subject to all the provisions and requirements applicable to a steel hull specified in Section 2 of this Part of the Rules.

3.1.2 The scantlings of the structural members of the aliminium alloy hull shall be determined by recalculating (refer to 3.2.1) the corresponding scantlings of steel hull structures.

3.1.3 The materials used for manufacturing the structural members of the hull regulated by this Section of the Rules shall meet the requuirements of Section 3, Part XII "Materials".

3.2 GENERAL PROVISIONS ON SCANTLING OF HULL STRUCTURAL MEMBERS

3.2.1 A recalculation shall be made with the use of the formulae specifeid in Table 3.2.1 ignoring the restrictions on the minimum scantlings of steel structure members.

3.3 SPECIAL REQUIREMENTS

3.3.1 If continuous (fillet and butt) welds are located in the areas of the maximum stresses, the reduced strength in way of the weld shall be taken into account depending on the aluminium alloy used and the welding method.

3.3.2 For the aluminium alloy structures specified in Table 2.1.7.5.1-1 and used in joints it is not allowed:

.1 to use intermittent welds (excepting scalloped construction);

.2 to use scalloped construction in way of violent vibrations (refer to 2.1.7.1.6);

The weld throat thickness shall be at least 3 mm, but not more than $0{,}5\,s$ (for s, refer to 2.1.7.5.1).

3.3.3 The scantlings of the cross-sections of the stern frame, stem, bar keel and shaft struts shall be 1,3 times greater than those when steel is used.

3.3.4 The structural components of an aluminium alloy deckhouse are dimensioned by recalculating according to 3.2.1. The minimum scantlings of structures are assumed the same as those for a steel deckhouse.

3.3.5 If agreed with the Register, bimetallic (steel – aluminium) pressed elements for joining structures made of steel and aluminium alloys may be used.

3.3.6 The aluminium alloy deckhouse share in the overall longitudinal bending of the hull and the stresses in the craft's hull and the deckhouse shall be determined using the procedure agreed with the Register.

Table 3.2.1

Parameter	Requirement
The thickness of plating for the shell, decks (without covering), bulkhead and inner enclosure plating, and of other details made of platess	For superstructures: $s_1 = S\sqrt{(R_{eH}/R_{p0,2})}$ for main hull: $s_1 = 0{,}9\,S\sqrt{(R_{eH}/R_{p0,2})}$
Section modulus of primary support members	$W_1 = W R_{eH}/R_{p0,2}$
Cross-section area of pillars	$f_1 = f R_{eH}/R_{p0,2}$
Moment of inertia of pillars and primary support members	$I_1 = 3\,I$
Notes: 1. $R_{p0,2}$ = proof stress of aliminium alloy, in MPa. 2. S, W, f and I, the values as stipulated by the Rules, may be adopted without corrosion allowance.	

4 HULL OF GLASS-REINFORCED PLASTIC

4.1 GENERAL

4.1.1 Application.

The requirements of this Section of the Rules apply to the craft of glass-reinforced plastic with the main dimension ratios ranged as folows:

craft's length to depth ratio L/D = 6 to 10;

craft's breadth to depth B/D = 2 to 2,5;

craft's length to breadth L/B = 3 to 5.

Where the main dimension ratios are outside the above limits, the design and scantlings of hull members are subject to special consideration by the Register.

The scantlings of the hull structure components of planing craft and catamarans shall additionally meet the requirements of the Rules for the Classification and Construction of High-Speed Craft.

4.1.2 Definitions and explanations.

Single-skin construction is a construction comprising a single-skin laminate stiffened by primary support members.

Double-skin construction is a construction comprising two single-skin laminates interconnected by primary support members.

Sandwich construction is a construction comprising two single-skin laminates interconnected by a core of plastic foam, a honeycomb structure, etc.with the core being load-carrying and taking up the load together with the laminates.

4.1.3 General requirements.

4.1.3.1 The requirements of this Section apply to:

.1 the hulls moulded either as a whole or in two halves (starboard and portside) to be joined along the keel, stem and sternframe;

.2 the craft with the following connections of hull sections:

shell skin along the centre line;

deck to craft's side;

superstructures and deckhouses to deck;

.3 the craft with the shell, deck plating and strength bulkheads of single-skin construction;

.4 the craft with superstructure and deckhouse sides of single-skin and sandwich construction.

4.1.3.2 The scantlings of double-skin and sandwich construction members, as well as the use of composite structures are subject to special consideration by the Register in each case unless special requirements are given in this Part of the Rules.

4.1.3.3 The drawings of glass-reinforced plastic structures shall specify the thickness of laminates, in mm, and also the number of reinforcing material layers and the total mass of reinforcement, in kg per 1 m^2 of the laminate area.

4.1.3.4 The hull moulding technique shall be approved by the Register in each case.

4.1.3.5 The Register may approve the alternative structural designs which are unlike those given in this Part provided the requirements of 1.3.4.1 of General Regulations for the Classification and Other Activity are met.

4.1.4 Scope of surveys.

4.1.4.1 The general provisions on hull are set forth in the General Regulations for the Classification and Other Activity.

4.1.4.2 Following the consideration and approval of the craft's technical design as a whole, the following shall be surveyed by the Register during the hull construction:

.1 basic materials for moulding hull structures;

.2 condition and microclimate of working shops;

.3 production accessories to be used in moulding hull structures;

.4 moulding of shell plating panels with framing;

.5 moulding of deck assemblies;

.6 moulding of bulkheads;

.7 moulding of tanks;

.8 moulding of superstructures and deckhouses;

.9 moulding of seatings for main machinery, and also for other machinery and arrangements being subject to the Register's survey;

.10 moulding of coamings, companions and similar guards for hull openings;

.11 stems, stern frames and shaft struts.

4.1.4.3 Prior to manufacturing the structures listed in 4.1.4.2, the technical documentation on the hull to the extent specified in Part I "Classification" shall be submitted to the Register for approval.

4.1.4.4 During construction the hull structures listed in 4.1.4.2 shall be surveyed to verify that the requirements of Part XIII "Materials" of the Rules for the Classification and Construction of Sea-Going Ships are met and the Register-approved technical documentation is complied with.

4.1.4.5 The procedure and results of testing the rigidity and strength of completed structures are subject to special consideration by the Register in each case.

4.1.5 Materials.

4.1.5.1 This Part of the Rules provides for the use of glass-reinforced plastics of the types listed in Appendix 1.

4.1.5.2 In addition to the plastics listed in Appendix 1, glass-reinforced plastics with other combinations of reinforcing materials and binders, as well as with other reinforcement patterns may be used after submitting the comprehensive information on their mechanical properties to the Register and their approval by the latter.

4.1.6 Primary support members system and spacing.

4.1.6.1 This Part of the Rules provides for the use of the transverse system of framing of the craft's hull. The design and scantlings of hull members are subject to special consideration by the Register if the longitudinal or combined system of framing is used.

4.1.6.2 The standard spacing of transverse framing is given in Table 4.1.6.2.

Table 4.1.6.2

Length of craft, in m	Spacing, in mm
≤ 15 > 15	350 400

If the spacing assumed is different from that in Table 4.1.6.2, the thickness and scantlings of primary support members are recalculated according to the requirements in 4.2.2, 4.2.3 and 4.2.5.

4.1.6.3 The spacing in the forepeak shall not be more than:

300 mm, if $L \le 15$ m;

350 mm, if $L > 15$ m.

4.1.6.4 The spacing of the transverse watertight bulkhead stiffeners is assumed equal to the spacing of the hull framing.

For the forepeak bulkhead the spacing of stiffeners is assumed equal to the spacing at the fore end.

The spacing of superstructure or deckhouse stiffeners is assumed equal to that of the single-skin construction hull.

4.1.7 Matting-in connections and fastenings.

4.1.7.1 The connection of longitudual and transverse framing primary support members is made by means of matting-in angles (wet angles), which are formed in situ and in which glass mats are used as reinforcement. By way of exception glass fabric of satin or plain weave may be used. The use of glass roving cloth is not permitted. The surfaces to be jointed shall be thoroughly cleaned prior to laying-up the matting-in connections.

On agreement with the Register, the matting-in angles may be moulded by spraying.

4.1.7.2 The thickness of the matting-in angle shall be equal to half the thickness of the stiffener web in the case of tee-shaped sections and to a full thickness of the stiffener web in the case of closed box sections. The width of the matting-in angle flange and the diagram of laying-up the reinforcement shall be in accordance with Figs. 4.1.7.2-1 and 4.1.7.2-2. In any case, the width of the matting-in angle flanges shall not be less than 30 mm for stiffeners and 50 mm for transverse watertight bulkheads.

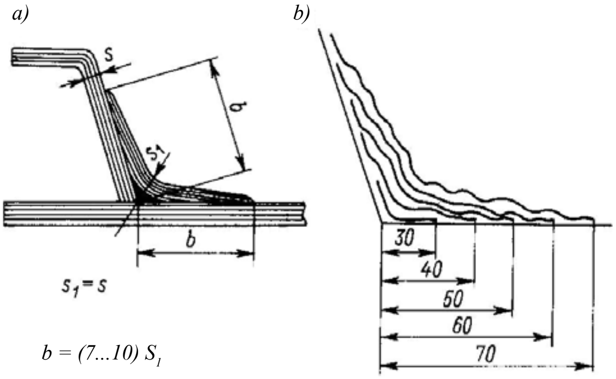


Fig. 4.1.7.2-1:
a – scantlings of matting-in connection;
b – diagram of laying-up layers of glass mats or glass fabric strips

s_1, mm	3	4	5	6	8	10
b_1, mm	30	30	40	50	60	70

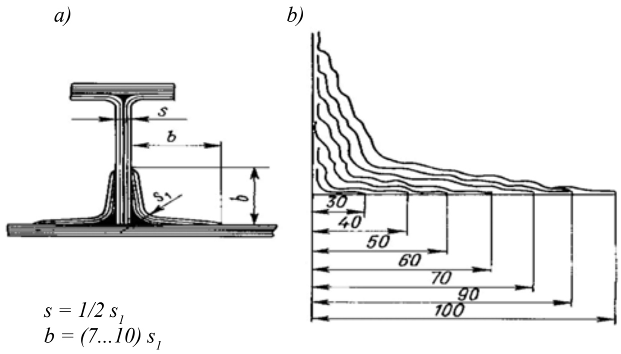


Fig. 4.1.7.2-2:
a – scantlings of matting-in connections;
b – diagram of laying-up layers of glass mats or glass fabric strips

s_1, mm	3	4	5	6	8	10	12	14
b_1, mm	30	30	40	50	60	70	90	100

4.1.7.3 The thickness of matting-in angles of bulkheads, platforms, superstructures and deckhouse sides and ends shall be equal to that of the bulkhead sheathing, platform planking, superstructure or deckhouse side and end, respectively.

4.1.7.4 For bolted connections the following conditions shall be met:

.1 bolting shall not be less than three bolt diameters away from the edge of the laminate;

.2 the bolt diameter shall be equal to the thickness of the thickest laminate to be connected;

.3 bolts shall not be closer spaced than four diameters apart;

.4 parts of the bolted connections shall be protected with anticorrosive coating or made of corrosion-resistant materials;

.5 washers of not less than 2,5 times the bolt diameter shall be fitted under the bolt head and nut, the washer thickness being 0,1 times the bolt diameter, but not less than 1,5 mm.

4.1.7.5 Connections made with the use of riveting shall be specially considered by the Register.

4.1.7.6 Non-essential or low-stresses connections are permitted to be made by means of matting-in butts (refer to Fig. 4.1.7.6). The contact surfaces shall be thoroughly cleaned prior to the laying-up of strap layers.

4.1.7.7 Where the hull is moulded in two (starboard and port) halves, they shall be connected along the centre line with matted-on straps (refer to Fig. 4.1.7.7). The straps shall be moulded with use of the type III or IV glass fabric for any length of the hull. The thickness s of each strap shall be 0,7 times the thickness s_k of the plate keel (refer to Table 4.2.2.1). The full width of the strap shall not be less than 200 mm + 15 s_k.

4.1.7.8 The thickness of matted-on straps shall reduce towards the edges down to the thickness of one layer of

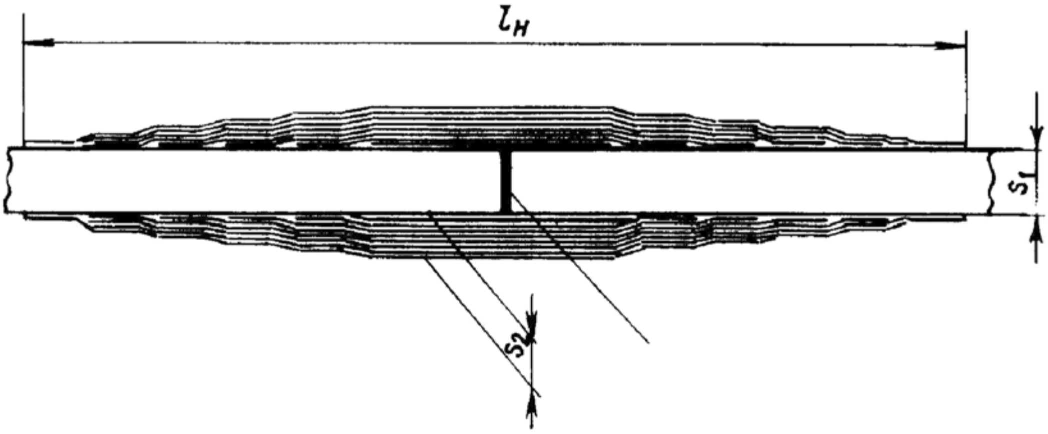


Fig. 4.1.7.6:
l_s – width of the matted-on strap (l_s = 200 + 15s_1, mm); s_1 – thickness of the laminates to be connected; s_2 – thickness of the matted-on strap (s_2 = 0,5s_1)

s_1, mm	s_2, mm	Numbers of glass fabric layers													
		Width of the matted-on strap													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
6	3	100	150	150	200	200	250	300							
8	4	100	100	150	150	150	200	250	250	300					
10	3	100	100	150	150	200	200	250	250	300	300				
14	7	100	100	150	150	200	200	250	250	300	300	330	350	400	400

N o t e s : 1. The glass fabric warp shall be oriented perpendicularly to the laminate butt.
2. The gap is 1 – 2 mm.
3. The strap material is a laminate on the basis of glass fabric of satin or plain weave. Glass mats are not allowed.

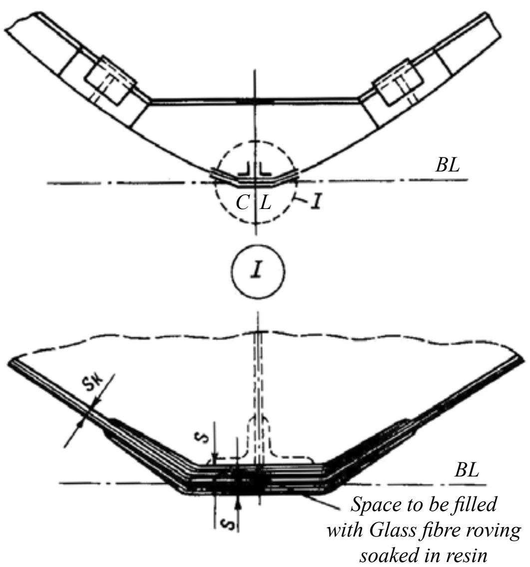


Fig. 4.1.7.7

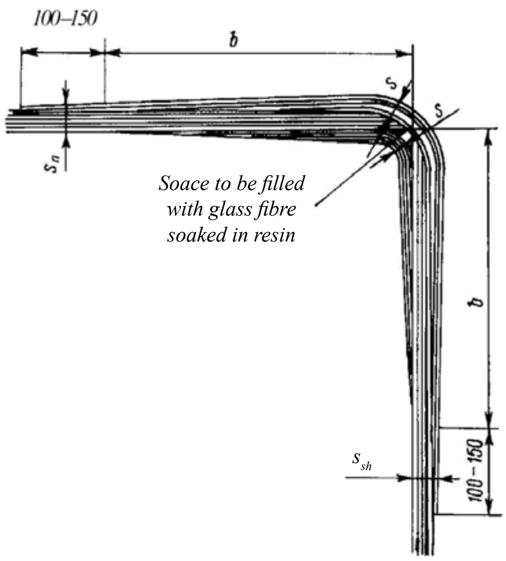


Fig. 4.1.7.9:
s_{sh} – sheerstrake thickness; s_d – deck laminate thickness;
s – thickness of a matting – in single angle;
b – half width of flangers of the matting-in single angle

glass fabric. The reduced thickness is achieved by gradual increase in the width of the tapes laid up: the first layer is formed by a tape of 100 mm wide (50 mm on each side) and the subsequent layers, by tapes (one or two to three at a time) of 140 mm, 180 mm, etc. wide.

N o t e . An additional fabric layer shall be laid onto the outer surface of the deck and side shell laminate to overlap the matting-in a angle by 100 to 150 mm on each side, the direction of fabric warp being along the craft's hull.

4.1.7.9 Deck-to-side connection shall be made by means of inner and outer matting-in angles (straps) in accordance with to Fig. 4.1.7.9. The angles shall be moulded of the type III or IV glass fabric. The width of both flanges of matting-in angles 2 b shall not be less than 200 mm + 15 s_{sh} (where s_{sh} = sheerstrake thickness). The matting-in angle thickness shall be taken equal to 0,7 s_{sh}.

The layers in the matting-in angles shall be distributed as specified in 4.1.7.2.

4.2 GENERAL PROVISIONS ON SCANTLING OF HULL STRUCTURAL MEMBERS

4.2.1 General requirements.

4.2.1.1 The thickness of the shell, deck, bulkhead, etc. laminates shall be determined from Figs. 4.2.1.1-1, 4.2.1.1-2 and 4.2.1.1-3 depending on the permissible bending moment m_{perm} acting on a strip of 1 cm wide which is given in Table 4.2.2.1.

The thickness of glass-reinforced plastic laminates with the glass content specified in line 1 of Tables 1 to 6 in Appendix 2 shall be determined from Fig. 4.2.1.1-1.

The thickness of glass-reinforced plastic laminates with the glass content specified in lines 2 and 3 of the above Tables shall be determined from Figs. 4.2.1.1-2 and 4.2.1.1-3.

The reinforcement schemes specified in lines 1 and 2 of Tables 1, 2, 5 and 6 in Appendix 2 are used for moulding sides and bottom shell, decks, divisions, etc. The reinforcement scheme specified in line 3 of Tables 3 and 6 and in line 2 of Table 1 is used for primary support members which shall be moulded and squeezed in special devices during manufacture.

4.2.1.2 The present Rules provide for hull primary support members to be made of closed box sections of glassreinforced plastics, type I_2, and of T-shaped sections with a face plate of glass-reinforced plastics, type III_3, and the web of glass-reinforced plastics, type I_2 .

4.2.1.3 The scantlings of primary support members shall be determined from Figs. 4.2.1.3-1, 4.2.1.3-2 and 4.2.1.3-3 depending on their section modulus of stiffeners with the associated face plate.

The scantlings of stiffeners of closed box section are determined from Fig. 4.2.1.3-1.

The scantlings of T-shaped stiffeners are determined from Figs. 4.2.1.3-2 and 4.2.1.3-3, Fig. 4.2.1.3-3 being the scaled-up original of Fig. 4.2.1.3-2.

The scantlings of bottom stiffeners (centre girder and side girders) shall be determined in accordance with 4.2.3.5.

The recommended structural types of closed-box and T-shaped sections are shown in Figs. 4.2.1.3-4 and 4.2.1.3-5.

4.2.1.4 The scantlings of primary support members are permitted to be determined according to Appendix 3.

4.2.1.5 The width of the associated plate is taken to be 1/6 of the stiffener span, provided that the panel is of glass-reinforced plastics, types I, V, VI, VII and VIII, or 1/10 of the stiffener span, provided that the panel is of glass-reinforced plastics, type II, but it shall not be more than the distance between adjacent parallel stiffeners.

4.2.2 Side and bottom shell.

4.2.2.1 The thickness of the side and bottom shell shall be determined from Figs. 4.2.1.1-1 and 4.2.1.1-2 depending on the permissible bending moment given in Table 4.2.2.1.

4.2.2.2 The minimum side and bottom shell thickness shall not be less than:

.1 4 mm for the craft's sides and 5 mm for the bottom for the single-skin construction with any type of reinforcement;

.2 3 mm for the craft's side and 4 mm for the bottom for the double-skin or sandwich construction.

4.2.2.3 The following types of glass-reinforced plastics may be used for the side and bottom shell:

I – for hulls having a length of 15 m and less;
II – for hulls having a length within 5 to 10 m;
V – for hulls having a length within 5 to 24 m;
VII – for hulls having a length within 10 to 24 m.

4.2.2.4 Where the shell thickness is 3 mm and more, but less than 6 mm, the reinforcement butts shall be overlapped by 40 mm. Seams are formed without overlapping.

Where the shell thickness is 6 mm and over, the reinforcement butts and seams need not be overlapped, the number of reinforcing material layers being not less than 8.

Table 4.2.2.1

Length of craft, m	Spacing, mm	m_{perm}, Nm		Width, mm	
		Bottom shell	Side shell	Plate keel	Sheer-strake
5	350	1,4	0,8	400	300
7,5	350	2,0	1,3	475	400
10	350	3,1	2,0	550	475
12	350	4,2	2,8	600	575
15	350/400	5,2/6,7	3,5/4,5	675	650
17,5	400	8,0	5,2	750	750
20	400	9,0	6,0	825	825
22,5	400	10,2	6,7	875	925
24	400/450	11,4/13,6	7,5/9,5	950	1000

Notes: 1. If the design spacing assumed is other than given in column 2, the value m_{perm} is to be modified as the square of the assumed spacing-Table spacing ratio.

2. Fot the craft's intermediate lengths, the value m_{perm} is determined by linear interpolation.

3. The thickness of the plate keel and sheerstrake is assumed equal to 1,5 times the bottom shell thickness.

4. The width of the plate keel in column 5 applies to both craft's sides.

5. Reduction in thickness shall be made across the width of 50 mm per each 5 mm difference in thickness.

6. For the craft of 15 m and 25 m long the values in the numerator refer to the smaller spacing and in the denominator, to the greater spacing.

7. The following areas are considered as the bottom shell:
in hard-chine craft – from the keel line up to the bilge;
in round-bilge craft – from the keel line up to 1/3 D.

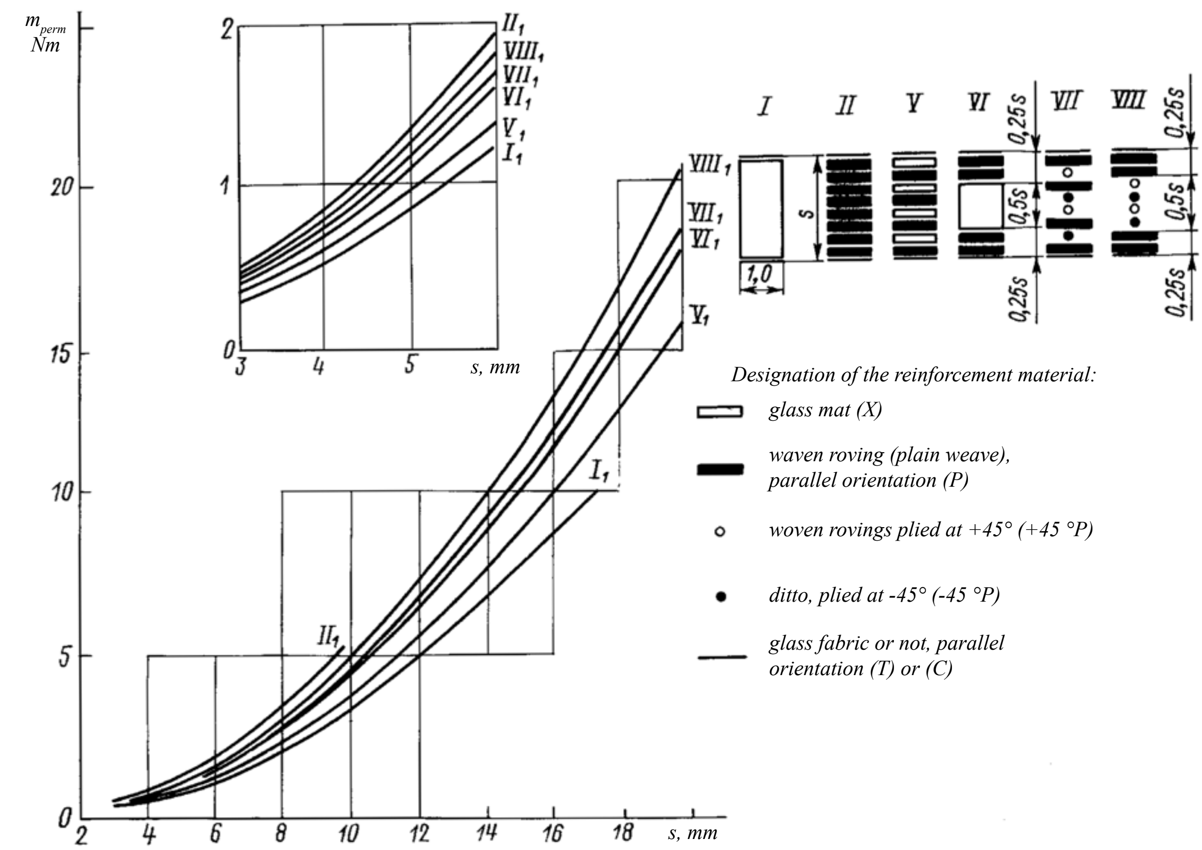


Fig. 4.2.1.1-1

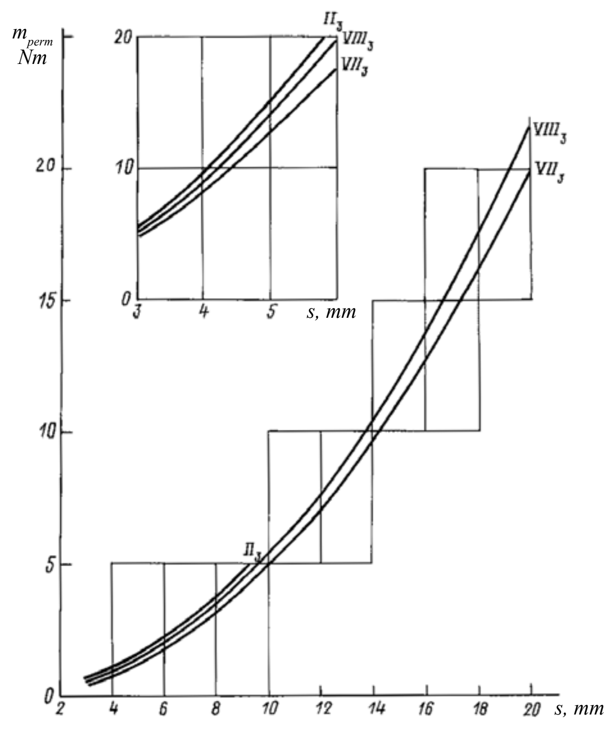


Fig. 4.2.1.1-2

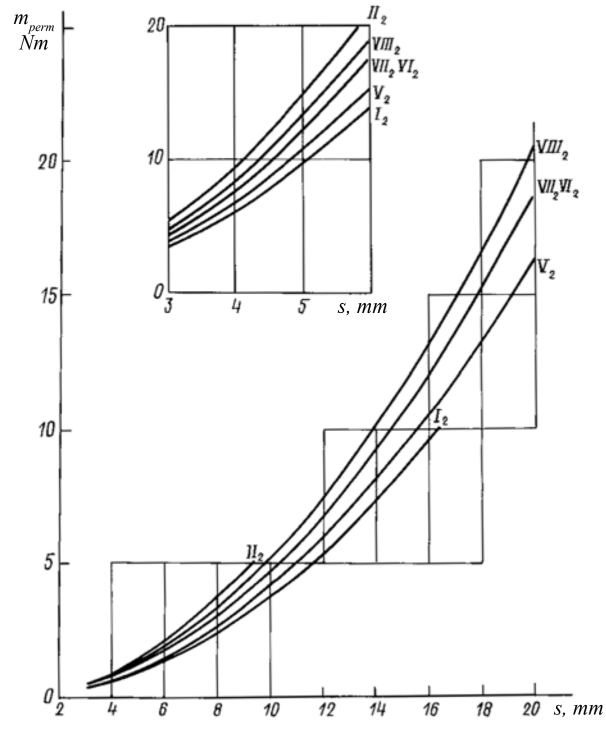


Fig. 4.2.1.1-3

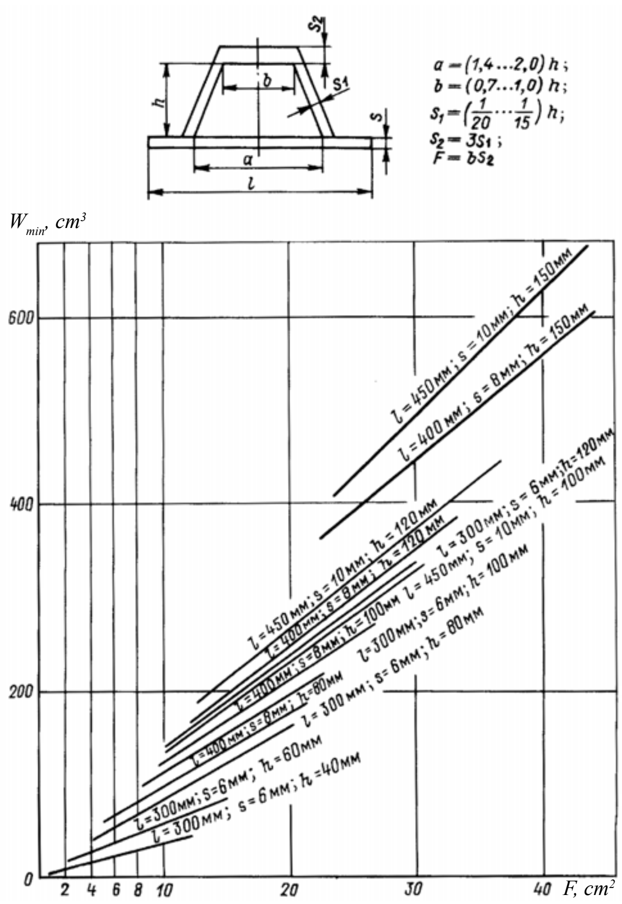


Fig. 4.2.1.3-1

N o t e . Stiffener with associated plate of glass plastic type I_2

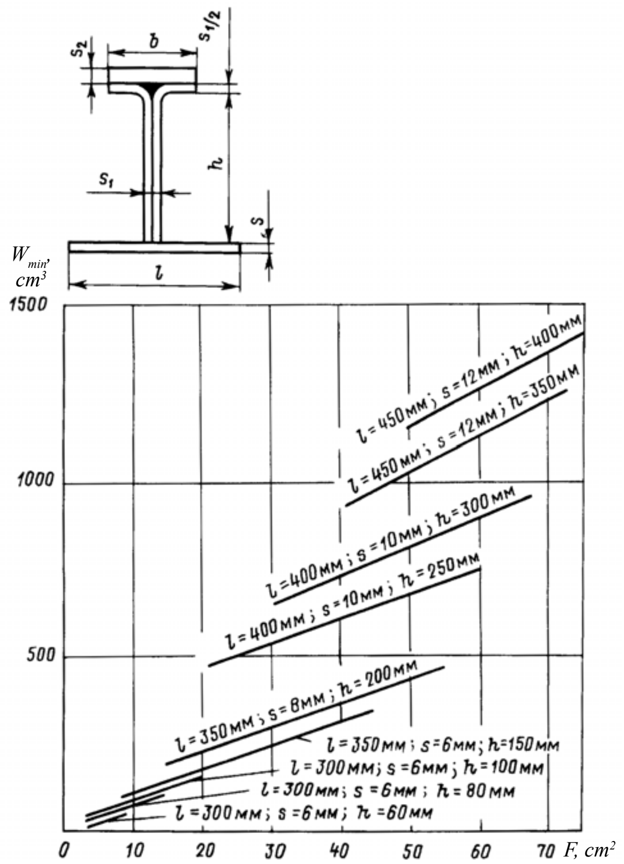


Fig. 4.2.1.3-2

b	s_1	s_2
$(1/1,5 \ldots 1/1,3)\,h$	$(1/10 \ldots 1/20)\,h$	$(2 \ldots 3)\,s_1$
$F = bs_2$		

N o t e s : 1. Face plate of glass plastic type III_3, the associated plate of glass plastic type VII_2, with $E_{VII} - 0,7\,E_{III}$ (where E is the modulus of elasticity.

2. Web of glass plastic type I_2.

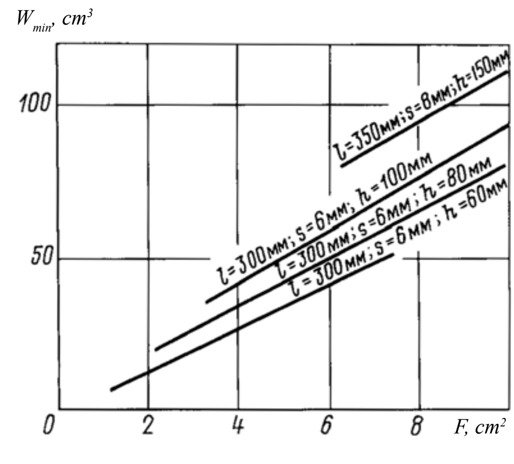


Fig. 4.2.1.3-3

4.2.2.5 The butts and seams of the reinforcing material in each adjacent layer shall be spaced at least 100 mm apart.

The butts and seams may coincide at one section in no less than six layers.

4.2.2.6 Woven rovings in layers of the diagonal layup shall not have butts.

4.2.2.7 The thickness and width of the plate keel and sheerstrake are determined according to Table 4.2.2.1 (refer to Note 3).

4.2.2.8 The thickness of the stern laminates (transom included) shall not be less than that of the bottom laminates.

4.2.2.9 The thickness of the shell and sheerstrake laminates in way of the fore peak shall be taken equal to that of the midship portion.

4.2.2.10 The plate keel and sheerstrake shall be moulded by addition of reinforcing material layers,

which shall be uniformly distributed between the shell basic layers and alternate with the latter.

The change in thickness shall be made in accordance with Table 4.2.2.1 (refer to Note 5).

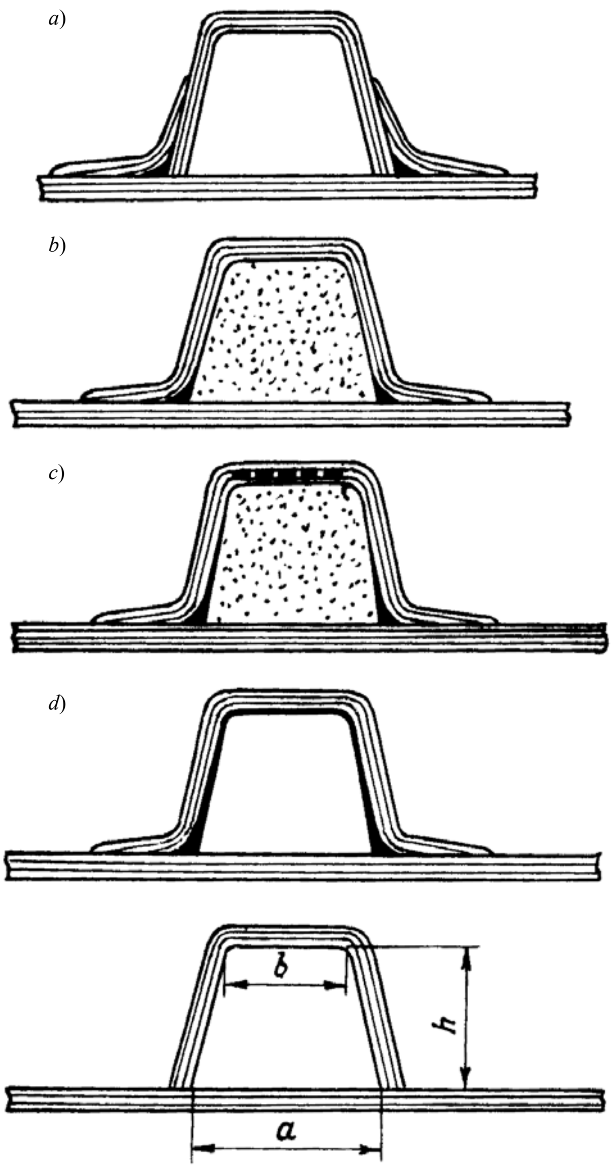


Fig. 4.2.1.3-4:
a – pre-moulded stiffener; *b* – stiffiner moulded in situ with a foamed plastic core; *c* – ditto, with the face plate reinforced; *d* – stiffiner moulded in situ over a former of sheet aluminium

Notes: 1. Reinforcement in face on the basis of glass fabric or glass rovings.
2. These sketches do not regulate a ratio of dimensions for longitudinal primary support members.

4.2.3 Bottom framing.

4.2.3.1 Floors shall be fitted at each frame.

4.2.3.2 Floors of increased section modulus shall be fitted at all web frames. The depth of floors of increased section modulus shall be taken equal to that of the centre girder and side girders, whichever is greater.

4.2.3.3 The scantlings of floors are taken in accordance with 4.2.1.2 depending on the section modulus given in Table 4.2.3.3.

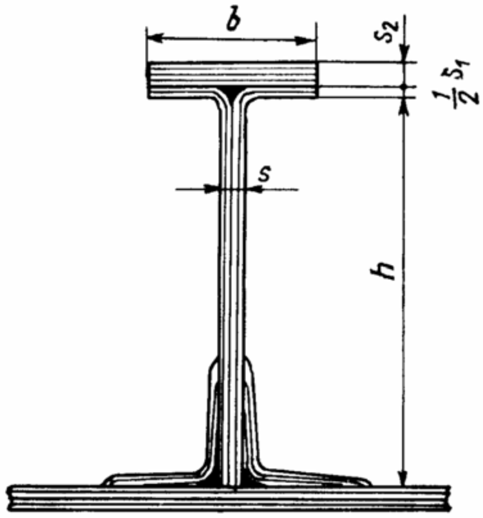


Fig. 4.2.1.3-5

b	s_1	s_2
(1/1,5 ... 1/3,0) h	(1/10 ... 1/20) h	(2 ... 3) s_1

Note. The warp of glass fabric in a face plate shall be directed along the stiffener.

Table 4.2.3.3

Length of craft, m	Design load, kPa	Section modulus of closed-box section, in cm^3, for 400 mm spacing and with the span, in m					
		0,50	0,75	1,00	1,50	2,00	2,50
5,0	20,0	15	25	50	100	–	–
7,5	30,0	20	40	70	150	260	–
10,0	40,0	30	50	90	200	350	–
12,0	25,0	15	30	60	130	220	350
15,0	30,0	20	40	70	150	270	420
17,5	35,0	25	50	80	180	310	490
20,0	38,0	30	60	90	200	350	560
22,5	43,0	35	70	100	230	400	630
25,0	47,0	–	80	110	250	440	690
27,5	51,0	–	–	120	280	490	760
30,0	55,0	–	–	–	300	530	830

Notes: 1. The section modulus in the Table refers to the spacing of 400 mm and varies with the ratio of “spacing, mm/400” for other spacings.
2. Where a T-section is used, the section modulus may be reduced by a factor of three.
3. The span is measured between the floor ends where the keel is omitted; from the keel to the floor end where the keel is fitted and the side girder is omitted; from the keel to the side girder or from the side girder to the floor end, whichever is greater.
4. For the craft of 5 to 10 m in length, the design load is assumed considering the potential water impact against the bottom when the craft is dropped into water.
5. For the craft over 10 m in length, the design load is equal to the craft’s maximum depth at L/D = 6 + 0,5 m.
6. Where the design load considerably differs from that given in the Table, the section modulus may be reduced proportionally with the ratio: actual design load/tabular design load.

4.2.3.4 The minimum thickness of floors shall be 2 mm in the case of closed-box sections and 4 mm in the case of T-shaped sections.

4.2.3.5 Where the half-breadth measured along the top edge of the floor is in excess of 0,75 m, a centre girder is required to be fitted. Where this value is in excess of 2,5 m, the fitting of one side girder on each side is required in addition to the centre girder. The scantlings of the centre girder and side girders are given in Table 4.2.3.5.

Table 4.2.3.5

Length of craft, m	Spacing, mm	Centre girder			Side stringer		
		depth, mm	thickness, mm	section of of face plate, mm²	depth, mm	thickness, mm	section of of face plate, mm²
5,0	350	150	8	60 × 12	–	–	–
7,5	350	180	9	70 × 14	–	–	–
10,0	350	210	10	80 × 15	–	–	–
12,0	350	240	11	90 × 15	–	–	–
15,0	350	270	12	100 × 15	200	10	80 × 15
17,5	400	300	13	110 × 16	225	11	90 × 15
20,0	400	330	14	120 × 18	250	12	100 × 15
22,5	400	370	15	130 × 20	275	13	110 × 16
25,0	400	410	16	140 × 22	300	14	110 × 16
27,5	450	440	17	150 × 24	325	15	120 × 18
30,0	450	470	18	160 × 26	350	16	130 × 20

Notes: 1. The scantlings shown in the Table are given for a T-shaped section with the face plate of glass-reinforced plastic, type III_3, and the web of glass-reinforced plastic, types I_2, V_2, VII_2.

2. Where closed-box sections of glass-reinforced plastic, type I_2, are used, the section moduli shall be increased by the factor of three.

3. The scantlings of longitudinal primary support members refer to the compartments having a length of 30 per cent of the craft's length for the craft between 5 m and 20 m long, and of 20 per cent for the craft between 20 m and 24 m long. In the case of compartments of greater lengths the scantlings of the longitudinal primary support members shall be considered specially

4. Where the actual spacing differs from that shown in the Table, the scantlings of the centre girder and side girders shall not be modified.

5. For the craft's intermediate length the section modulus is determined by linear interpolation.

4.2.3.6 The intersection of the side girders with floor shall be effected in accordance with Figs. 4.2.3.6-1 and 4.2.3.6-2 without cutting the floors. The intersection of side girders with floors of increased section modulus shall be made by means of an edge cross-lap joint (refer to Fig. 4.2.4.6).

4.2.3.7 The depths of non-continuous longitudinals shall be reduced to the floor depth within at least three spacings at each longitudinal end.

4.2.3.8 In floors and side girders water courses shall be provided. The recommended structural design of a water course is shown in Fig. 4.2.3.8.

4.2.3.9 The connection of the bottom framing to the side framing may be effected by means of matting-in or matting-on connections.

4.2.4 Side framing.

4.2.4.1 The scantlings of frames shall be taken in accordance with 4.2.1.2 depending on the section modulus given in Table 4.2.4.1.

4.2.4.2 The distance between adjacent bulkheads and web frames shall not exceed 6 spacings.

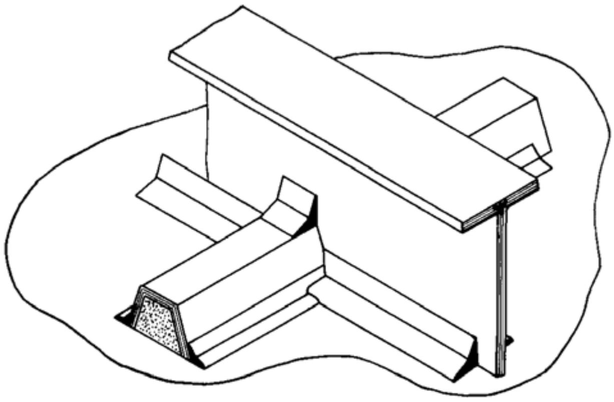


Fig. 4.2.3.6-1

Note. The primary support member shall be formed first and not be cut at a deep member.

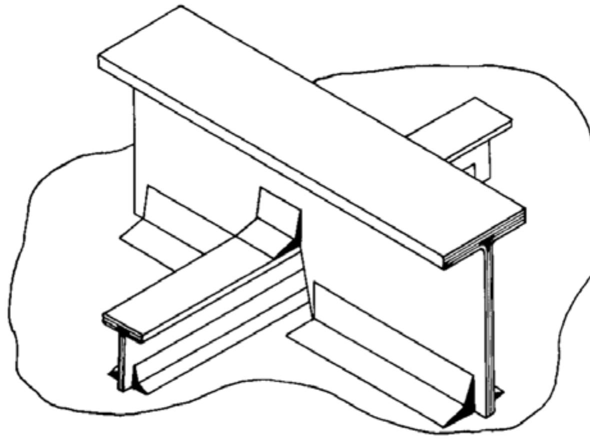


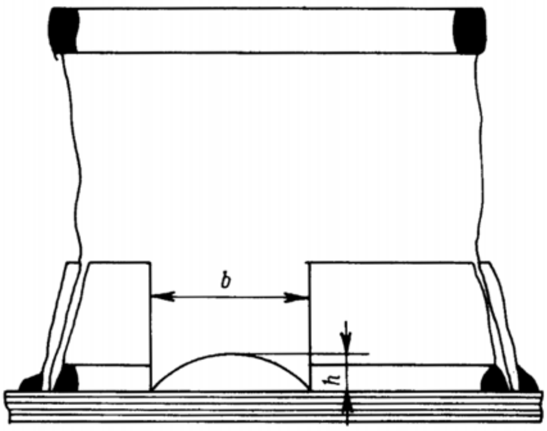
Fig. 4.2.3.6-2

Note. The primary support member shall be formed first and not be cut at a deep member.

Table 4.2.4.1

Span, m	Section modulus, cm³					
	Closed-box section, with spacing, mm			T-shaped section, with spacing, mm		
	350	400	450	350	400	450
1,0	47	54	61	12	18	20
1,2	76	87	98	29	29	33
1,4	107	128	138	35	41	46
1,6	147	159	180	47	53	59
1,8	200	228	256	70	76	85
2,0	290	330	370	93	110	123
2,2	369	420	470	123	140	157
2,4	500	570	640	150	189	210

Note. Where a side stringer is fitted, the section modulus of the frame shall be taken equal to 1,5 times the section modulus determined from the Table for a span measured from the deck to the side stringer or from the side stringer to the floor, whichever is greater.



h = 10 ... 25 mm; b = 4 h

Fig. 4.2.3.8

N o t e s : 1. The hole is cut at 1/4 of the spacing distance from the intersection with a floor.

2. The edge of the hole shall be covered with resin.

4.2.4.3 The section modulus of a web frame shall not be less than 5 times the frame section modulus.

4.2.4.4 Where the frame span is in excess of 2,4 m, a side stringer shall be fitted.

4.2.4.5 The section modulus of a side stringer shall be equal to that of a web frame.

4.2.4.6 The intersection of a web frame and a side stringer shall be effected by means of an edge cross lap joint only (refer to Fig. 4.2.4.6).

4.2.4.7 The intersection of a side stringer and a frame shall be made as shown in Figs. 4.2.3.6-1 and 4.2.3.6-2 without cutting the frame.

4.2.5 Decks.

4.2.5.1 The upper deck laminate thickness shall be determined from Figs. 4.2.1.1-1 and 4.2.1.1-2 depending on the permissible bending moment value given in Table 4.2.5.1.

T a b l e 4.2.5.1

Length of craft, m	Spacing, mm	m_{perm}, Nm	Width of deck stringer, mm
5	350	0,8	300
7,5	350	1,3	400
10	350	2,0	475
12	350	2,8	575
15	350/400	3,5/4,5	650
17,5	400	5,2	750
20	400	6,0	825
22,5	400	6,7	925
24	400/450	7,5/9,5	1000

N o t e s : 1. If the spacing differs from the Table value, m_{perm} shall be modified as the square of the assumed spacing-Table spacing ratio.

2. The thickness of a deck stringer is assumed equal to the sheerstrake thickness (refer to Table 4.2.2.1).

3. For the craft's intermediate lengths, the value m_{perm} is determined by linear interpolation.

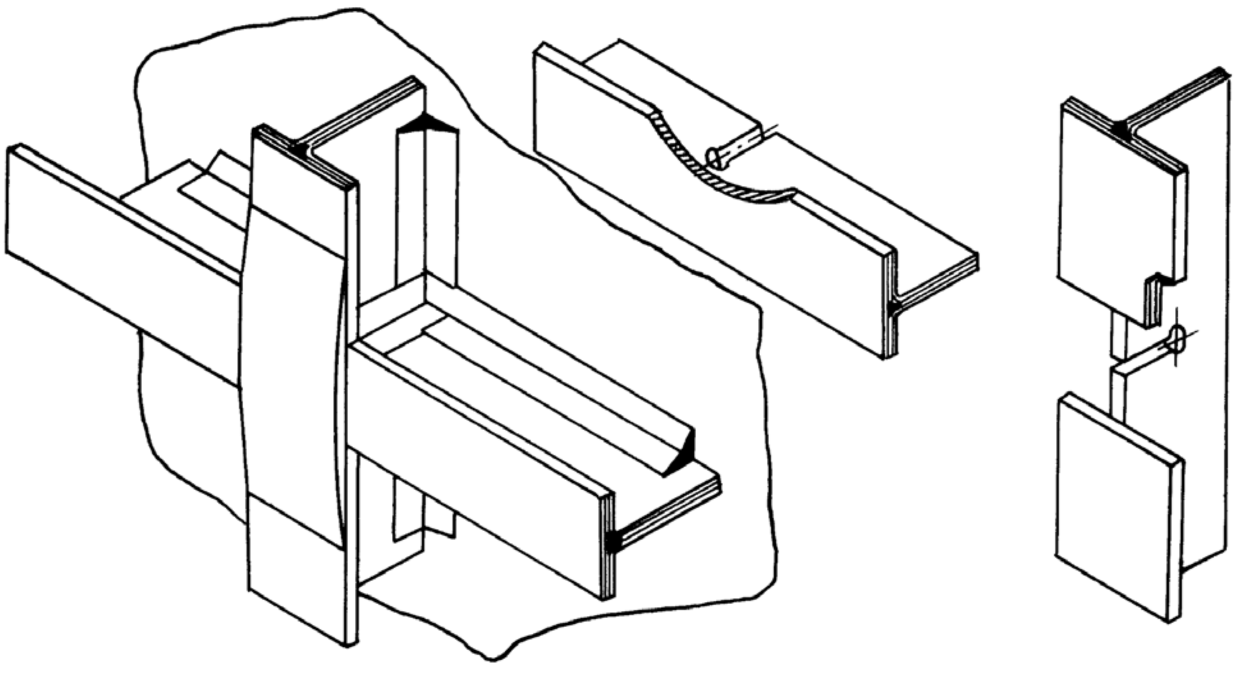


Fig. 4.2.4.6

N o t e s : 1. Primary support members are joined with the use of an edge cross-lap.

2. The length of the outer strap shall not be more than three widths of the flange of a longitudinal primary support member. A 20 mm overlap in adjacent layers shall be provided. The strap thickness shall be equal to that of the flange of transverse primary support member.

4.2.5.2 The minimum deck laminate thickness shall be 4 mm.

4.2.5.3 The thickness and width of a deck stringer are determined according to Table 4.2.5.1.

4.2.5.4 The deck is permitted to be constructed of glass-reinforced plastics of the following types:

I – for hulls of not more than 15 m long;

VI – for hulls from 5 m to 30 m long;

VIII – for hulls from 10 m to 30 m long.

The deck laminate of the craft between 5 m and 10 m in length may be constructed of the type II glass-reinforced plastic.

4.2.5.5 The reinforcing material shall be laid up in compliance with the requirements of 4.2.2.4.

4.2.5.6 Provisions shall be made for thickening like straps of at least 3 mm thick in the areas exposed to intense wear unless the deck therein has a special protective coating.

4.2.5.7 Beams shall be dimensioned according to the requirements of 4.2.1.2 depending on the section modulus given in Table 4.2.5.7.

Table 4.2.5.7

Span of beam, m	Section modulus, cm^3					
	Closed-box section, with spacing, mm			T-section, with spacing, mm		
	350	400	450	350	400	450
1,0	16	18	20	–	–	–
1,2	24	27	30	–	–	–
1,4	33	38	43	–	–	–
1,6	43	49	55	15	17	19
1,8	52	59	66	18	20	22
2,0	65	74	83	23	25	27
2,2	80	90	100	26	30	34
2,4	98	110	124	32	37	42

Note. The design span of the beam is measured between the ends of the beam brackets, from the bracket end to the deck girder or between the deck girders, whichever is greater.

4.2.5.8 A deep beam having the section modulus equal to at least five times that of the main beam shall be fitted in the plane of every web frame.

4.2.5.9 Carlings shall be dimensioned according to the requirements of 4.2.1.2 depending on the section modulus given in Table 4.2.5.9.

Table 4.2.5.9

Span of carling, m	Section modulus, in cm^3, at the width of the deck supported, in m				
	1,0	1,25	1,50	1,75	2,0
1,8	95	120	140	165	190
2,0	120	150	180	210	240
2,2	140	175	210	250	280
2,4	170	210	250	300	340
2,6	200	250	300	350	400
2,8	230	290	345	400	460

Notes: 1. The section moduli are given for a T-shaped section. Where closed-box section is used, the Table section modulus shall be increased by the factor of three.

2. Deck girder span is the greatest of the deck girder spans measured between two supports (centres of pillars, bulkheads, end hatch beams).

4.2.5.10 The intersection of deck primary support members shall be arranged in compliance with Figs. 4.2.3.6-1, 4.2.3.6-2 and 4.2.4.6.

4.2.6 Pillars.

4.2.6.1 This Section of the Rules provides for the fitting of tubular pillars of aluminium alloys.

Alternative materials may be used for construction of pillars on agreement with the Register.

In any case, the pillar material shall be in compliance with the requirements of Part XIII "Materials" of the Rules for the Classification and Construction of Sea-Going Ships.

4.2.6.2 The scantlings of aliminium alloy pillars shall be taken according to Table 4.2.6.2.

Table 4.2.6.2

Supported area $l \times b$, m^2	Height of pillar, m						
	1,8	2,0	2,2	2,4	2,6	2,8	3,0
1,8	85/70	85/70	85/70	85/70	85/70	85/70	95/80
2,5	85/70	85/70	85/70	85/70	95/80	95/80	105/90
3,0	85/70	95/80	95/80	95/80	95/80	105/90	105/90
4,0	85/70	95/80	95/80	105/90	105/90	110/90	110/90
5,0	95/80	95/80	105/90	105/90	110/90	110/90	120/90
6,0	95/80	105/90	105/90	105/90	110/90	120/90	120/90

Notes: 1. Shown in the numerator and denominator are an outer and inner diameter, in mm, respectively.

2. l = distance between the centres of the adjacent spans of a deck girder, in m;

b = width of the deck supported by a deck girder, in m.

4.2.6.3 The pillars shall be connected to the framing by pillar heels made of aluminium alloys or steel and fastened to the framing by bolts.

4.2.7 Bulkheads.

4.2.7.1 The thickness of bulkhead laminates shall be determined from from Figs. 4.2.1.1-1, 4.2.1.1-2 and 4.2.1.1-3 depending on the permissible bending moment values given in Table 4.2.7.1.

Table 4.2.7.1

Overall height of bulkhead, m	m_{perm}, Nm, with spacing, mm			
	300	350	400	450
1,25	0,9	–	–	–
1,50	1,1	1,5	–	–
1,75	1,3	1,8	2,3	–
2,00	1,5	2,0	2,7	3,4
2,25	1,7	2,3	3,0	3,8
2,50	1,9	2,6	3,3	4,2
2,75	2,1	2,8	3,7	4,6
3,00	2,2	3,1	4,0	5,1
3,25	2,4	3,3	4,3	5,5
3,50	2,6	3,6	4,7	5,9
3,75	2,8	3,8	5,0	6,3
4,00	3,0	4,1	5,3	6,8
4,25	3,2	4,3	5,7	7,2
4,50	–	4,6	6,0	7,6
4,75	–	–	6,3	8,0
5,00	–	–	–	8,4

Notes: 1. m_{perm} refers to the bottom strake of the bulkhead panels.

2. The bulkhead thickness may be reduced throughout the height with the thickness at the upper deck not less than half the bottom strake thickness.

Table 4.2.7.1 – continued

3. Each strake shall be 0,7 m ... 1,0 m wide.
4. m_{perm} for the bulkhead of an intermediate height is determined by linear interpolation.

4.2.7.2 The minimum plate thickness of watertight bulkhead laminates shall be 4 mm.

4.2.7.3 Bulkhead panels may be manufactured of type I_2, V_2 or VII_3 glass-reinforced plastics.

4.2.7.4 The scantlings of bulkhead stiffeners are taken according to 4.2.1.2 depending on the section modulus given in Table 4.2.7.4.

Table 4.2.7.4

Span of stiffener, in m	Section modulus of bulkhead stiffener, in cm^3							
	Stiffener span from deck to bottom or horizontal girder at spacing, in mm				Stiffener span from horizontal girder to bottom at spacing, in mm			
	300	350	400	450	300	350	400	450
1,25	15	18	20	23	24	29	33	37
1,50	25	29	33	37	30	35	40	45
1,75	40	47	54	60	50	59	67	76
2,00	55	64	73	92	80	92	105	105
2,25	80	93	105	105	95	110	125	140
2,50	95	110	125	140	130	150	170	190
2,75	130	150	170	90	170	200	225	260
3,00	160	187	210	240	225	260	300	335
Notes: 1. The section moduli refer to T-section stiffeners. 2. For П-shaped section stiffeners with a face plate reinforced with glass mats the tabular section modulus shall be increased by a factor of three.								

4.2.7.5 The maximum span of a stiffener shall be within 3 m. Where the bulkhead height exceeds 3 m, a horizontal girder with a section modulus of not less than 5 times the section modulus of the stiffener shall be fitted.

4.2.7.6 Where a horizontal girder is provided, a stiffener of the same section modulus as the horizontal girder shall be fitted at the centre line.

4.2.7.7 The design of openings in bulkheads shall meet the requirements of 4.2.10.

4.2.7.8 The longitudinals shall not be cut at bulkheads. The slots in the bulkheads for the longitudinals shall be 3 to 4 mm higher and wider than the longitudinals proper and after the installation of bulkheads shall be filled with glass rovings and covered with not less than 3 layers of glass fabric.

4.2.7.9 The horizontal girders of bulkheads shall be fitted in one plane with side stringers and interconnected therewith by brackets of an arm length equal to the web depth of the side stringer.

4.2.7.10 The bulkhead stiffeners supported by longitudinal framing members shall be connected thereto by means of straps and mattings-in.

4.2.7.11 The bulkhead stiffeners receiving support from the bottom or deck shall be interconnected with the nearest transverse member by means of short longitudinals, which depth shall be equal to the stiffener depth. The connection of these short longitudinals to stiffeners shall be effected in accordance with 4.2.7.9.

4.2.8 Tanks.

4.2.8.1 The thickness of the laminates of the structures bounding tanks is determined from Figs. 4.2.1.1-1, 4.2.1.1-2 and 4.2.1.1-3 depending on the permissible bending moment m_{perm} given in Table 4.2.7.1. In this case a distance up to the top of an air pipe is assumed in lieu of the overall height of the bulkhead given in Table 4.2.7.1 (refer also to 4.2.7.2).

4.2.8.2 Primary support members shall be dimensioned according to Table 4.2.8.2.

Table 4.2.8.2

Head of water, m	Section modulus of closed-box section, in cm^3, with a 400 mm spacing and a span, in m:			
	0,50	0,75	1,00	1,25
2,00	10	25	50	70
2,50	15	30	60	85
3,00	20	40	70	100
3,50	25	45	80	120
4,00	30	50	90	140
4,50	35	55	100	160
5,00	40	65	110	175
Notes: 1. In the Table scantlings for a closed-box section are given. Material used is glass-reinforced plastic on the basis of glass mats (type I_2). Where T-shaped section with a flange of glassreinforced plastic, type III_3, is used, the section modulus may be reduced by the factor of three. 2. The section moduli in the Table refer to a spacing of 400 mm. For other spacings the section modulus varies proportionally to a ratio of spacing, mm/400. 3. The design head of water is measured from the midlength of a stiffener or from a crown to the top of an air pipe. 4. The stiffener span is measured from the bottom to the crown of a tank. The beam span is measured between the sides or between the side and swash bulkhead.				

4.2.8.3 The thickness of a margin plate in way of double bottom tanks shall be equal to that of shell laminates in this area.

4.2.8.4 The sides and tops of tanks may be constructed of type I_2, II_2 or V_2 glass-reinforced plastics.

4.2.8.5 Fuel oil tanks of glass-reinforced plastic shall be provided with Register-approved earthing arrangements for discharging static electricity.

4.2.8.6 The construction of tank manholes and covers shall ensure the watertightness of the tanks.

The recommended design of a manhole fitted in the crown of tank is shown in Fig. 4.2.8.6.

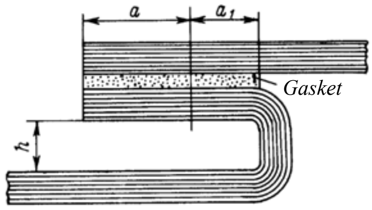


Fig. 4.2.8.6:
a – minimum distance from the edge to the bolts. $a \geq 3d$ (where d = bolt diameter); h – height to suit bolt or nut fitting; $a_1 \geq 1{,}5$ mm

Note. Bolts shall be spaced not more than $4d$ apart.

4.2.8.7 Primary support members inside tanks shall be provided with water courses and air holes.

4.2.9 Superstructures and deckhouses.

4.2.9.1 The outer shell of supestructures extended as the craft's side plating shall be integral to the latter. The thickness of the superstructure laminate shall be equal to that of the hull sides. The thickness reduction from the sheerstrake to the superstructure side shall be according to Table 4.2.2.1.

4.2.9.2 The sides of superstructures not extending to the hull sides and deckhouses may be of single-skin or sandwich construction. The material to be used for superstructure and deckhouse sides is glass-reinforced plastic on the basis of glass mats or woven rovings (type I_2 or II_2). The primary support members shall be of glass reinforced plastic, type I_2.

4.2.9.3 The double-skin construction of superstructures and deckhouses is subject to special consideration by the Register.

4.2.9.4 The thickness of a foam plastic core in sandwich construction shall be within 30 to 50 mm. The average density of foam plastic for superstructure sides shall not be less than 100 kg/m^3 and not more than 200 kg/m^3.

4.2.9.5 The laminate thickness for the end bulkheads of superstructures, as well as for all outer ends and sides of deckhouses shall be taken according to Table 4.2.9.5-1 for single-skin construction and Table 4.2.9.5-2 for sandwich construction.

Table 4.2.9.5-1

Single-skin construction ends and sides of superstructures and deckhouses, spacing 400 mm

Length of craft, in m	Plate thickness, in mm
5	4
10	6
15	8
20	10
24	10

Notes: 1. For other spacings the thickness varies proportionally to a ratio of spacing, mm/400, but it shall not be less than 4 mm.

2. The material used is glass-reinforced plastic on the basis of glass mat (type I_2).

3. For intermediate craft length the thickness is determined by linear interpolation.

Table 4.2.9.5-2

Ends and sides of superstructures and deckhouses of sandwich construction with core thickness of 30 to 50 mm, spacing 800 mm

Length of craft, in m	Laminate thickness, in mm	
	outer	inner
5	3	2,5
10	4	3
15	7	3,5
20	8	4
24	8	4

Note. For other spacings the thickness of the outer laminate varies proportionally to a ratio of spacing, mm/800, but it shall not be less than 3 mm.

4.2.9.6 The stiffeners of the superstructure and deckhouse ends and sides shall be dimensioned according to Table 4.2.9.6-1 for single-skin construction and Table 4.2.9.6-2 for sandwich construction.

Table 4.2.9.6-1

Stiffeners of single-skin construction superstructures and deckhouses, spacing 400 mm

Span of stiffener, in m	Section modulus of closed-box section, in cm^3	Span of stiffener, in m	Section modulus of closed-box section, in cm^3
1,0	18	1,8	53
1,2	25	2,0	74
1,4	38	2,2	90
1,6	49	2,4	105

Notes: 1. For other spacings the section modulus varies proportionally to a ratio of spacing, mm/400.

2. For the intermediate value of a stiffener span the section modulus is determined by linear interpolation.

Table 4.2.9.6-2

Stiffeners of sandwich construction superstructures and deckhouses, spacing 800 mm

Span of stiffener, in m	Section modulus of closed-box section, in cm^3	Span of stiffener, in m	Section modulus of closed-box section, in cm^3
1,0	37	1,8	120
1,2	52	2,0	150
1,4	75	2,2	14
1,6	98	2,4	215

Notes: 1. For other spacings the section modulus varies proportionally to a ratio of spacing, mm/800.

2. The spacing of superstructure side stiffeners shall be adjusted with that of superstructure deck beams.

3. For the intermediate value of a stiffener span the section modulus is determined by linear interpolation.

4.2.9.7 The deck laminate thickness and the scantlings of the deck framing of superstructures and deckhouses are taken in accordance with the requirements of 4.2.5 and 4.2.6.

4.2.10 Openings in structures.

4.2.10.1 Round openings cut in the shell, deck and watertight bulkheads with a diameter less than 150 mm are permitted not to be reinforced.

4.2.10.2 Round openings cut in the shell with a diameter of 150 mm and over shall be reinforced with glass fabric of satin weave or woven rovings in accordance with Fig. 4.2.10.2.

The reinforcements of openings having other shapes are subject to special consideration by the Register.

4.2.10.3 Round openings cut in decks with a diameter of 150 mm and over as well as rectangular openings of any diameter shall be reinforced with glass fabric of satin weave or woven rovings.

The recommended reinforcement of openings is shown in Figs. 4.2.10.3-1 and 4.2.10.3-2.

4.2.10.4 Lightening holes are not permitted in the webs of primary support members.

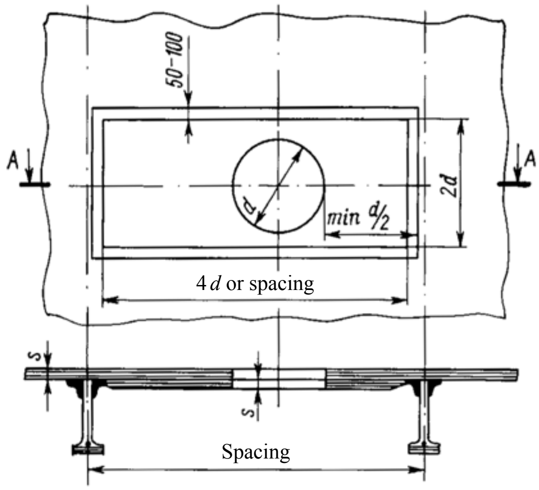


Fig. 4.2.10.2

Notes: 1. Reinforcing shall be made only with glass fabric whose warp is oriented along the hull.

2. The thickness of the strap shall be equal to that of the structure. If the position of the openings is specified beforehand, the strap is moulded into the basic layers of the laminate, otherwise it shall be matted onto the inner face of the laminate between the frames, within one spacing as shown in the Figure.

3. Openings are not permitted to be positioned closer than $d/2$ to the frame.

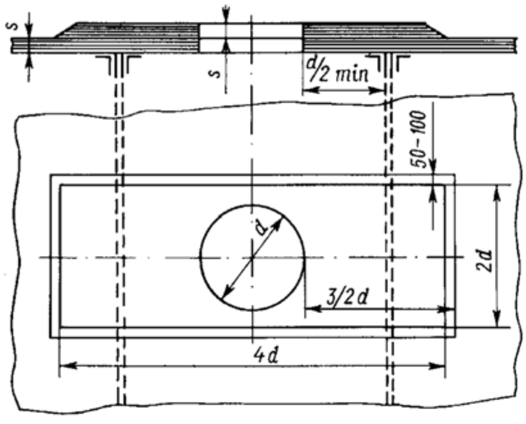


Fig. 4.2.10.3-1

Notes: 1. Reinforcing shall be made only with glass fabric, which warp is oriented along the hull.

2. The thickness of the strap shall be equal to that of the structure. The strap is matted into the basic layers of the laminate of the position of the openings is known beforehand or moulded onto the upper surface of the deck.

4.2.10.5 Openings cut in the primary support member webs for the passage of cables, pipes, etc. having a diameter of more than 1/3 of the web depth shall be reinforced with straps.

4.2.10.6 Dimensions of openings and the structure of closures in the outer shell and watertight bulkheads of

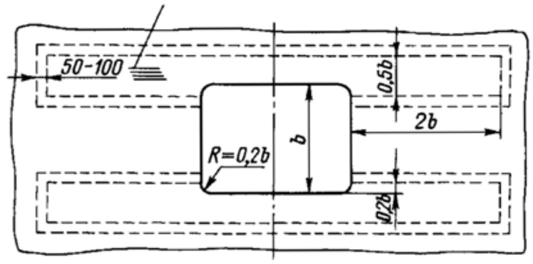


Fig. 4.2.10.3-2

Notes: 1. Reinforcing shall be made only with glass fabric of which a warp is parallel to the craft's centre line.

2. The fabric layers forming the strap shall be laid between the reinforcement layers of the deck laminate.

3. The total thickness of reinforcing fabric layers shall be equal to that of the deck laminate thickness.

craft, which subdivision is regulated by the requirements in Part V "Subdivision" of the Rules for the Classification and Construction of Sea-Going Ships are subject to special consideration by the Register in each case.

4.2.11 Bulwark.

4.2.11.1 The bulwark thickness shall be equal to half the thickness of the side laminate, but not less than 4 mm.

4.2.11.2 The bulwark stays shall be fitted at alternate beams.

4.2.11.3 In craft over 15 m in length the bulwark laminate shall not be integral to the side laminate and its sectional area shall be ignored in determining the craft's hull section modulus.

4.2.11.4 The structure of bulwarks in craft, which can moor at sea, shall be specially considered by the Register.

4.2.12 Engine seatings.

4.2.12.1 Side stringers shall be used as the bearers of main engine seatings, wherever possible. Where this is impracticable, additional bottom longitudinals with the web as thickness equal to that shall be fitted.

4.2.12.2 The engine seating girders shall extend forward and aft beyond the machinery space bulkheads for at least three spacings and be tapered at the end of the third spacing to floor depth.

4.2.12.3 The seating girders shall be reliably connected with transverse brackets fitted at every frame.

4.2.12.4 Seatings are permitted to be built of steel and aluminium alloys on special agreement with the Register.

4.2.12.5 The fastening of the engine bed flanges may be made by metal flats moulded into the flanges of the girders by fitting of metal angle sections bolted to the girder top edge or by other means approved by the Register.

4.2.13 Stems, sternframes, propeller shaft brackets and bilge keels.

4.2.13.1 Stems may be moulded of glass-reinforced plastic or may be of composite structure with the use of metal.

4.2.13.2 For the reinforcing of the stem laminate glass fabrics, woven rovings and glass-fibre bundless (rovings) are used. The use of glass mats is not permitted.

4.2.13.3 Metal parts of the stem may be of aluminium alloys or of steel reliably protected by corrosion-resistant coating. As a rule, they shall be moulded into the stem.

4.2.13.4 The section of glass-reinforced stem shall be shaped as a rectangule with the width *b* and length *l*, mm, determined by the formulae:

$$b = 1{,}5\,L + 30; \qquad (4.2.13.4)$$
$$l = 2{,}5\,b$$

where L = craft's length, in m.

The thickness of the stem laminate reinforced with type II, III or IV glass fabric shall be 1,5 times the sheer-strake thickness. The space inside the stem shall be filled with plastic reinforced with glass-fibre bundles, which shall be directed along the stem.

4.2.13.5 In case of a composite stem the width b_1 of the alluminium alloy core, length l_1 and total width b_2 of the sterm are determined by the formulae:

$$b_1 = 0{,}4\,L + 10;$$
$$b_2 = b_1 + 2\,s; \qquad (4.2.13.5)$$
$$l_1 = 2{,}5\,b_2$$

where L = craft's length, in m;
s = thickness of the stem laminate determined according to 4.2.13.4.

4.2.13.6 The width of a steel core may be equal to 3/4 of the aluminium one (refer to 4.2.13.5). The core length is determined according to 4.2.13.5.

4.2.13.7 The sternframe (if any) may be metal or composite (glass-reinforced plastic with metal core). The sternframe scantlings and structure are subject to special consideration by the Register in each case.

4.2.13.8 The shaft brackets shall be as required in 2.10.4.5, Part II "Hull" of the Rules for the Classification and Construction of Sea-Going Ships. The strut arms shall be attached to the hull with bolts. Straps of glass-reinforced plastic having a thickness equal to twice the shell thickness and fitted on the reverse side in way of bracket attachment as well as stiffening for primary support members, which shall be agreed with the Register, shall be provided in this area.

4.2.13.9 Bilge keels, if fitted, shall be of glassreinforced plastic of type II. The attachment of bilge keels to the hull shall be effected by means of matting-in double angles (without using bolts), which shall be fitted on both sides of the keel laminate. The thickness of the matting-in double angles shall be equal to that of the keel laminate. The structural design of bilge keels shall be such that no damage would be caused to the shell in case of bilge keel loss.

4.2.14 Casings of engine and boiler rooms, hatch and fan coamings.

4.2.14.1 The structure and scantlings of engine and boiler room casings, hatch and fan coamings are subject to special consideration by the Register.

APPENDIX 1

RECOMMENDED TYPES OF GLASS-REINFORCED PLASTICS

1. The following eight types of glass-reinforced plastics are recommended for use in craft and lifeboat strucrures:

type I: plastic reinforced with glass mats, which may be coated on the outer face or on both faces with one or two layers of glass net or glass fabric to impart better surface smoothness to it (designation *X*);

type II: plastic reinforced with woven rovings of plain weave and parallel orientation, i.e. all layers are laid with their warp in one direction (designation *P*);

type III: plastic reinforced with glass fabric of satin weave with parallel orientation (designation *T*);

type IV: plastic reinforced with glass fabric or glass net of plain weave with parallel orientation (designation *T* or *C*);

type V: plastic reinforced both with glass mats and woven rovings of parallel orientation, each amounting to 50 per cent in thickness, the layers of mats and woven rovings being alternately laid through the entire thickness of the laminate;

type VI: plastic with the same reinforcement thickness ratio as for type V, but with mats concentrated in the middle and woven rovings laid on the outer and inner faces and amounting to 1/4 of the thickness on each side;

type VII: plastic with parallel and diagonal reinforcement of woven rovings at angles + 45° and – 45° , which layers, laid parallel to the warp, shall amount to half the laminate thickness, while the diagonal parts plied at + 45° and – 45° to the layers of parallel orientation shall amount to 1/4 of the laminate thickness each, the layers of parallel reinforcement being alternately laid throughout the entire thickness;

type VIII: layers arranged diagonally shall occupy the middle portion of the laminate thickness while those of parallel reinforcement shall form the outer and inner faces of the laminate (packet arrangement).

Glass-reinforced plastics, types II, V, VI, VII and VIII shall be overlaid on both faces with one or two layers of glass fabric or glass net.

.2 The schemes of reinforcement for the above plastics types are shown in Fig. 1.

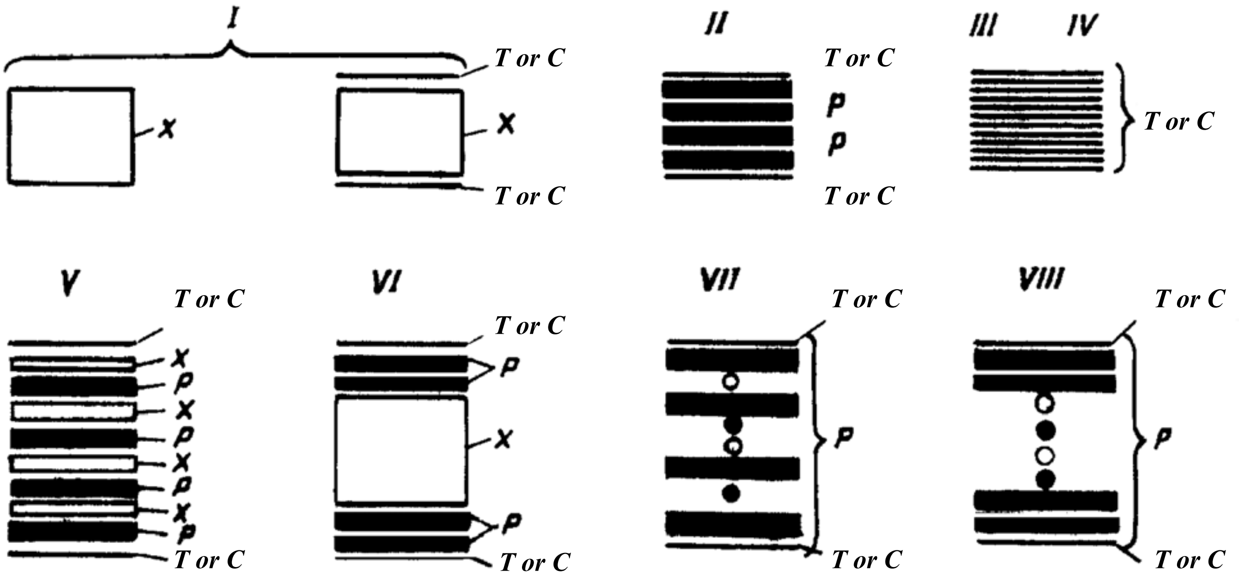


Fig. 1
Schemes of reinforcement. Reinforcing material:
X – glass mat; *P* – woven rovings (plain weave), parallel orientation of layers: woven rovings,
plied at + 45° or – 45°; *T* or *C* – glass fabric or glass net, parallel orientation of layers. Types of glass-reinforced plastics
(shown in per cent is the fraction of thickness falling on the layers of the given reinforcement): type I – *X* 100 %; type II – *P* 100 %;
types III and IV – *T* 100 % (or *C* 100 %); types V and VI – *X* 50 %, *P* 50 %; types VII and VIII – 0° *P* 50 %, + 45° *P* 25 %, – 45° *P* 25 %

APPENDIX 2

PHYSICAL AND MECHANICAL PROPERTIES OF GLASS-REINFORCED PLASTICS

Physical and mechanical properties of glassreinforced plastics depending on the reinforcement schemes included in Appendix 1 shall be in accordance with the values stated in Tables 1 to 6.

For each type of plastic depending on the fibre glass content in per cent by mass the tables contain respective values of physical and mechanical properties.

The values of physical and mechanical properties such as glass content by volume, average density, shear modulus, Poisson's ratio and shear strength in the laminate plane are determined only during approval tests of a particular type of plastic.

Table 1

Physical and mechanical properties of glass-reinforced plastics with glass mats as reinforcement and a polyester binder (type I). Tested in dry condition at 20 °C

Nos.	Type	Glass content, %		Average density, in kg/m³	Young's modulus, in MPa	Shear modulus in laminate plane, in MPa	Poisson's ratio	Tensile strength, in MPa	Compression strength, in MPa	Shear strength in laminate plane, in MPa
		by mass	by volume							
1	I_1	25	15	1,45	$0{,}60 \times 10^4$	$0{,}22 \times 10^4$	0,35	80,0	110,0	40,0
2	I_2	30	18	1,50	$0{,}70 \times 10^4$	$0{,}26 \times 10^4$	0,35	90,0	120,0	50,0

N o t e s : 1. The glass content by volume and the average density of glass-reinforced plastic refer to the average density of glass equal to 2550 to 2600 kg/m³ and to the average density of binder as cured of 1200 to 1250 kg/m³.

2. Young's modulus refers to tension-and-compression.

3. For a thickness of 4 mm and less the tensile strength is reduced by 20 per cent against the Table value.

Table 2

Physical and mechanical properties of glass-reinforced plastics with woven roving of parallel orientation and a polyester binder (type II). Tested in dry condition at 20 °C

Nos.	Type	Glass content, %		Average density, in kg/m³	Young's modulus, in MPa	Shear modulus in laminate plane, in MPa	Poisson's ratio	Tensile strength, in MPa	Compression strength, in MPa	Shear strength in laminate plane, in MPa
		by mass	by volume							
1	II_1	45	28	1600	$\frac{1{,}30 \times 10^4}{1{,}30 \times 10^4}$	$0{,}21 \times 10^4$	$\frac{0{,}12}{0{,}12}$	$\frac{170{,}0}{170{,}0}$	$\frac{105{,}0}{105{,}0}$	60,0
2	II_2	50	32	1640	$\frac{1{,}50 \times 10^4}{1{,}50 \times 10^4}$	$0{,}25 \times 10^4$	$\frac{0{,}12}{0{,}12}$	$\frac{200{,}0}{200{,}0}$	$\frac{110{,}0}{110{,}0}$	70,0
3	II_3	55	37	1700	$\frac{1{,}70 \times 10^4}{1{,}70 \times 10^4}$	$0{,}29 \times 10^4$	$\frac{0{,}12}{0{,}12}$	$\frac{230{,}0}{230{,}0}$	$\frac{115{,}0}{115{,}0}$	80,0

N o t e s : 1. The glass content by volume and the average density of glass-reinforced plastic refer to the average density of glass equal to 2550 to 2600 kg/m³ and to the average density of binder as cured of 1200 to 1250 kg/m³.

2. Young's modulus refers to tension-and-compression.

3. Shown in the numerator are the values for the warp direction, in the denominator – for the weft direction.

4. For woven rovings the ratio of breaking strength in the warp and weft direction is 1:1.

Table 3

Physical and mechanical properties of glass-reinforced plastics with glass fabric of satin weave and parallel orientation, and a polyester binder (type III). Tested in dry condition at 20 °C

Nos.	Type	Glass content, %		Average density, in kg/m³	Modulus, in MPa	Shear modulus in laminate plane, in MPa	Poisson's ratio	Tensile strength, in MPa	Compression strength, in MPa	Shear strength in laminate plane, in MPa
		by mass	by volume							
1	III_1	45	28	1600	$\frac{1{,}70 \times 10^4}{1{,}10 \times 10^4}$	$0{,}28 \times 10^4$	$\frac{0{,}15}{0{,}10}$	$\frac{270{,}0}{170{,}0}$	$\frac{200{,}0}{150{,}0}$	80,0
2	III_2	49	31	1640	$\frac{1{,}80 \times 10^4}{1{,}20 \times 10^4}$	$0{,}10 \times 10^4$	$\frac{0{,}15}{0{,}10}$	$\frac{290{,}0}{180{,}0}$	$\frac{210{,}0}{160{,}0}$	85,0
3	III_3	52	34	1670	$\frac{1{,}90 \times 10^4}{1{,}30 \times 10^4}$	$0{,}32 \times 10^4$	$\frac{0{,}15}{0{,}10}$	$\frac{300{,}0}{190{,}0}$	$\frac{220{,}0}{170{,}0}$	90,0

Notes: 1. The glass content by volume and the average density of glass-reinforced plastic refer to the average density of glass equal to 2550 kg/m³ to 2600 kg/m³ and to the average density of binder as cured of 1200 to 1250 kg/m³.

2. The modulus of elongation refers to tension-and-compression.

3. Shown in the numerator are the values for the warp direction, in the denominator – for the weft direction.

4. Glass fabric features the ratio of breaking strength in the warp and weft direction equal to 2:1.

Table 4

Physical and mechanical properties of glass-reinforced plastics with glass net or glass fabric of plain weave and parallel orientation, and a polyester binder (type IV). Tested in dry condition at 20 °C

Nos.	Type	Glass content, %		Average density, in kg/m³	Young's modulus, in MPa	Shear modulus in laminate plane, in MPa	Poisson's ratio	Tensile strength, in MPa	Compression strength, in MPa	Shear strength in laminate plane, in MPa
		by mass	by volume							
1	IV_1	45	28	1600	$\frac{1{,}30 \times 10^4}{1{,}30 \times 10^4}$	$0{,}28 \times 10^4$	$\frac{0{,}13}{0{,}13}$	$\frac{220{,}0}{220{,}0}$	$\frac{160{,}0}{160{,}0}$	80,0
2	IV_2	49	31	1640	$\frac{1{,}40 \times 10^4}{1{,}40 \times 10^4}$	$0{,}30 \times 10^4$	$\frac{0{,}13}{0{,}13}$	$\frac{230{,}0}{230{,}0}$	$\frac{170{,}0}{170{,}0}$	85,0
3	IV_3	52	34	1670	$\frac{150 \times 10^4}{1{,}50 \times 10^4}$	$0{,}32 \times 10^4$	$\frac{0{,}13}{0{,}13}$	$\frac{240{,}0}{240{,}0}$	$\frac{180{,}0}{180{,}0}$	90,0

Notes: 1. The glass content by volume and the average density of glass-reinforced plastic refer to the average density of glass equal to 2550 to 2600 kg/m³ and to the average density of binder as cured of 1200 to 1250 kg/m³.

2. Young's modulus refers to tension–and-compression.

3. Shown in the numerator are the values for the warp direction, in the denominator – for the weft direction.

4. For the glass fabric the ratio of the breaking strength in the warp and weft direction is 1:1.

Table 5

Physical and mechanical properties of glass-reinforced plastics of composite reinforcement with 1/2 of the thickness by glass mats and 1/2 of the thickness by roving glass fabric of parallel orientation on the basis of a polyester binder (types V and VI). Tested in dry condition at 20 °C

Nos.	Type	Content by mass, %			Average density, in kg/m³	Young's modulus, in MPa	Shear modulus in laminate plane, in MPa	Poisson's ratio	Tensile strength, in MPa	Compression strength, in MPa	Shear strength in laminate plane, in MPa
		glass mat	roving glass fabric	glass							
1	V_1 VI_1	25	50	37,5	1550	$\frac{1{,}05 \times 10^4}{1{,}05 \times 10^4}$	$0{,}24 \times 10^4$	$\frac{0{,}21}{0{,}21}$	$\frac{135{,}0}{135{,}0}$	$\frac{77{,}0}{77{,}0}$	55,0
2	V_2 VI_2	30	55	42,5	1600	$\frac{1{,}20 \times 10^4}{1{,}20 \times 10^4}$	$0{,}28 \times 10^4$	$\frac{0{,}21}{0{,}21}$	$\frac{160{,}0}{160{,}0}$	$\frac{80{,}0}{80{,}0}$	65,0

Notes: 1. The average density of glass-reinforced plastic refers to the average density of glass equal to 2550 to 2600 kg/m³.

2. Young's modulus refers to tension-and-compression.

3. Shown in the numerator are the values for the warp direction, in the denominator – for the weft direction.

Table 6

Physical and mechanical properties of glass-reinforced plastics with parallel-and-diagonal reinforcement by roving glass fabric, of which 1/2 the layers is of parallel orientation and in 1/4 of the layers, of diagonal orientation at angles of + 45° and – 45°, and a polyester binder (types VII and VIII). Tested in dry condition at 20 °C

Nos.	Type	Glass content, %	Average density, in kg/m^3	Modulus of elongation, in MPa	Shear modulus in laminate plane, in MPa	Poisson's ratio	Tensile strength, in MPa	Compression strength, in MPa	Shear strength in laminate plane, in MPa
1	VII_1 $VIII_1$	45	1600	$\frac{1,10 \times 10^4}{1,10 \times 10^4}$	$0,37 \times 10^4$	$\frac{0,30}{0,30}$	$\frac{140,0}{140,0}$	$\frac{80,0}{80,0}$	56,0
2	VII_2 $VIII_2$	50	1650	$\frac{1,30 \times 10^4}{1,30 \times 10^4}$	$0,45 \times 10^4$	$\frac{0,30}{0,30}$	$\frac{170,0}{170,0}$	$\frac{95,0}{95,0}$	68,0
3	VII_3 $VIII_3$	55	1700	$\frac{150 \times 10^4}{1,50 \times 10^4}$	$0,52 \times 10^4$	$\frac{0,30}{0,30}$	$\frac{200,0}{200,0}$	$\frac{110,0}{110,0}$	79,0

N o t e s : 1. The average density of glass-reinforced plastic refers to the average density of glass equal to 2550 to 2600 kg/m^3 and to the average density of binder as cured of 1,20 to 1,25 g/cm^3.

2. Young's modulus refers to tension-and-compression.

3. Shown in the numerator are the values for the warp direction, in the denominator – for the weft direction.

4. For the glass fabric the ratio of the breaking strength in the warp and weft direction is 1:1.

APPENDIX 3

CALCULATION OF CRAFT'S HULL MEMBER SCANTLINGS

1 In addition to the table method of the hull scantlings determination as given in this Part of the Rules, this may be done by a calculation method approved by the Register.

2 The basic data for recalculating separate hull members and for calculating the hull strength (longitudinal and local) are given in Tables 1, 2 and 3.

Table 1

Craft's length[1], m	Maximum bending moment at longitudinal bending, kNm
5 – 10 15 – 24	1,66 ΔL ΔL (ΔL = full-load displacement)

[1] Bending moment for craft from 10 m to 15 m in length is determined by linear interpolation.

Table 2

Type of load	Design formula or value, kPa
Local load on bottom and side shell	$h_p = 10\,(h_1 + \Delta)$
Local load on the upper deck in way of:	
forward of the forepeak bulkhead	15
elsewhere	5
Ditto, for craft of design categories **C2**, **C3** and **D**:	
forward of the forepeak bulkhead	10
elsewhere	4

N o t e s : 1. h_1 = distance from the member under consideration to the upper deck; Δ = 0,5 m for any region excepting the forepeak shell; Δ = 1,5 m for the region forward of the forepeak bulkhead.
2. The load for the craft of an intermediate length is determined by linear interpolation.

3 Permissible stresses is taken as a part of design tensile, compression or shear strength. For permissible stress in the case of alternating tension-andcompression and bending, either tensile or compressive stresses shall be taken, whichever are less.

4 Design values for Young's modulus and the shear modulus are assumed equal to

$$E_d = 0{,}6\,E \text{ and } G_d = 0{,}6\,G$$

where E and G = Young's modulus and the shear modulus determined for dry material at 20 °C (refer to Appendix 2).

.5 For hull structural members the factor of safety against buckling shall be taken not lower than that given in Table 4.

Table 4

Structural member to be calculated	Safety factor
Centre girder, side and deck girders r	3
Plate keel, sheerstrake and deck stringer	1,5

6 Permissible deflection values calculated with due regard for shear are assumed equal to:

1/400 of length for the hull as a whole;

1/50 of spacing for the shell;

1/100 of a span for primary support members.

7 For the shell and upper deck the reduction coefficient may be used. The moment of inertia with consideration of the reduction coefficient shall then not be less than 95 per cent of the moment of inertia calculated in the first approximation without regard to the reduction coefficient.

Table 3

Type of load	Permissible stress
Stresses due to general and local bending:	
at instantaneous load:	$\sigma = 0{,}25\,R_m$
for type I glass-reinforced plastics	$\tau = 0{,}25\,\tau_m$
for type II to VIII glass-reinforced plastics	$\sigma = 0{,}30\,R_m$
at permanent load for all types of	$\tau = 0{,}30\,\tau_m$
glass-reinforced plastics	$\sigma = 010\,R_m$
at shear in the laminate plane for all types of	$\tau = 0{,}10\,\tau_m$
glass-reinforced plastics	$\tau = 0{,}30\,\tau_m$
at shear in matting-in connections and at interlaminar shear	$\tau = 0{,}60\,\tau_m$
Stresses at the matting-in connections subject to pull;	
at instantaneous load	σ = 2 MPa
at permanent load	σ = 1 MPa

N o t e s : σ = permissible normal stress;
τ = permissible shear stress;
R_m and τ_m = tensile strength and shear strength respectively obtained on dry specimens at t = 20 °C (refer to Appendix 2).

PART III. EQUIPMENT, ARRANGEMENTS AND OUTFIT

1 GENERAL

1.1 APPLICATION

1.1.1 The requirements of the present part of the Rules 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 the present 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 the present part of the Rules:

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 an arrangement necessary for moving various cargoes by craft means.

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 aquisition 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.

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 a 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 craft cargo derricks, cranes and hoists with the carrying capacity of 1t and more;

.2 craft electric traction elevators which are intended for lifting and lowering of people and/or cargoes in a cage moved by the ropes at a speed of not more than 1,0 m/s;

.3 craft elevating platforms which are lifted and lowered at a speed of not more than 0,1 m/s.

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, 1.3.1.3.5, 1.3.1.3.2, 1.3.1.4.2, 1.3.1.5.3, 1.3.1.5.4 and 1.3.1.9 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, 1.3.1.3.1, 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 the 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 and Construction of Sea-Going Ships.

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". The necessity for evaluation of acceleration at motions in waves is a matter of the special consideration by the Register in each case.

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 upon agreement with the Register. 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 is a matter of the special consideration by the Register in each case.

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 the present 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 to nozzled steering gears and rudders which design differ from those given in Fig. 2.1.6.

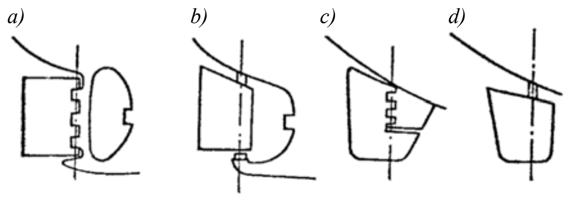


Fig. 2.1.6
Types of rudders:
a – ordinary unbalanced multipintle rudder;
b – ordinary balanced rudder;
c – semi-spade balanced rudder;
d – suspended balanced rudder

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., in each case are a matter of the special consideration by the Register.

Considering the purpose, special features of a craft and intended regimes of its operation it may be allowed upon approval by the Register 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 special agreement with the Register	–
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 2.9.8.

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 is to 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 motor-sailing craft: $L_{wl}/\sqrt[3]{\Delta} \le 6$ $L_{wl}/\sqrt[3]{\Delta} > 6$	 1,6 $0{,}11 + 0{,}25\,L_{wl}/\sqrt[3]{\Delta}$

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

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

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 is to be calculated by the formula

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

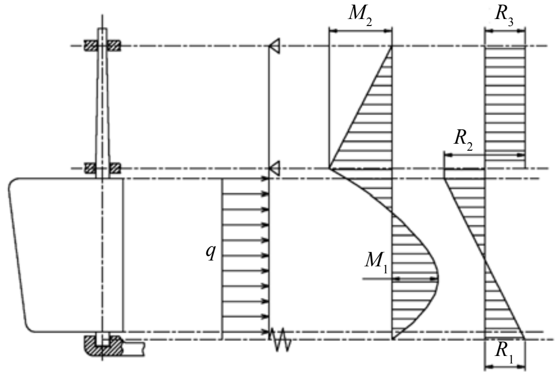


Fig. 2.2.3.1
Load, bending moments and transverse forces in the balanced rudder with rudder heel

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.

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 is to be calculated by the formula

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

where F = design hydrodynamic load, in N, according to 2.2.2.1;
A_b = square, in m^2, of the part of rudder blade below the section in question;
h_1 = 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 m^2, 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 is to 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.

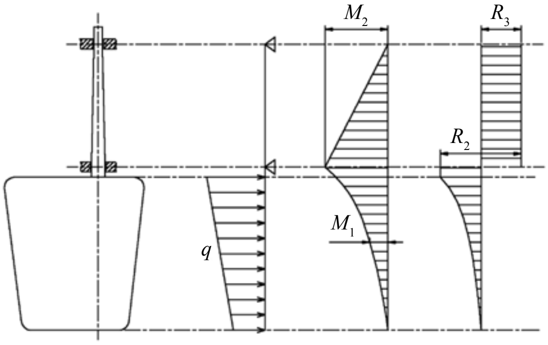


Fig. 2.2.3.2
Load, bending moments and shear forces of the balanced suspended rudder

2.2.3.3 Balanced semi-spade rudder.

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

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

where F = design hydrodynamic load, in N, according to 2.2.2.1;
A_b = square, in m^2, 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 m^2, 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:

$$M_2 = F h / 17 \qquad (2.2.3.3\text{-}2)$$

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.

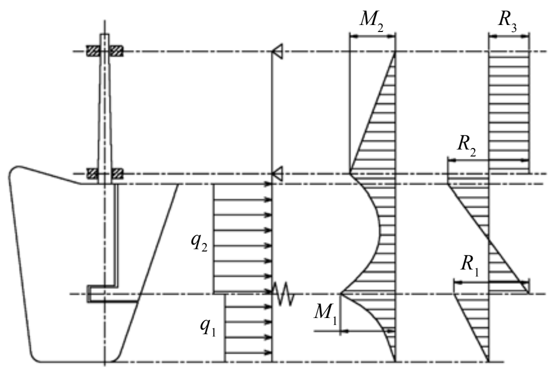


Fig. 2.2.3.3
Load, bending moments and shear forces of the balanced semi-spade rudder

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.

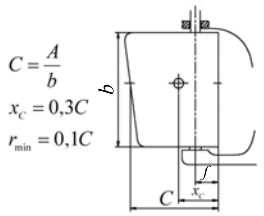


Fig. 2.2.4-1
Rudder with heel without skeg

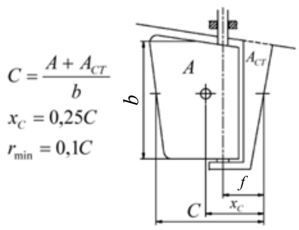


Fig. 2.2.4-2
Rudder with heel and narrow skeg

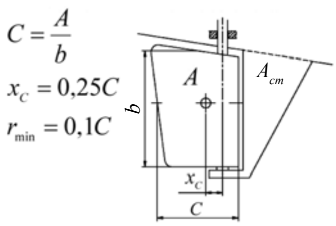


Fig. 2.2.4-3
Rudder with heel and large skeg

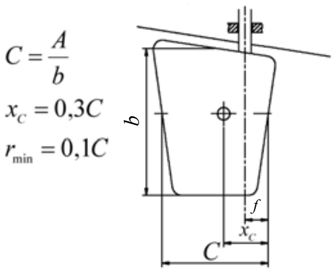


Fig. 2.2.4-4
Balanced suspended rudder

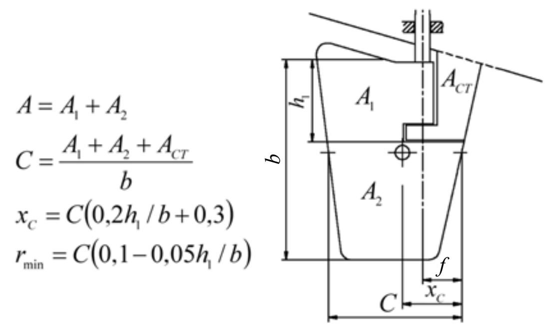


Fig. 2.2.4-5
Balanced semi-spade rudder

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 requirements 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} (see Fig. 2.4.3), mm, shall not be less than those calculated by the following formula:

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

$$d_{t2} = 33\sqrt[3]{\frac{\sqrt{0,75\,M_2^2 + M_s^2}}{R_m + R_e}}; \qquad (2.4.3\text{-}2)$$

for supported and semi-spade rudders:

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

for suspended rudders:

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

for supported and semi-spade rudders:

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

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

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

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

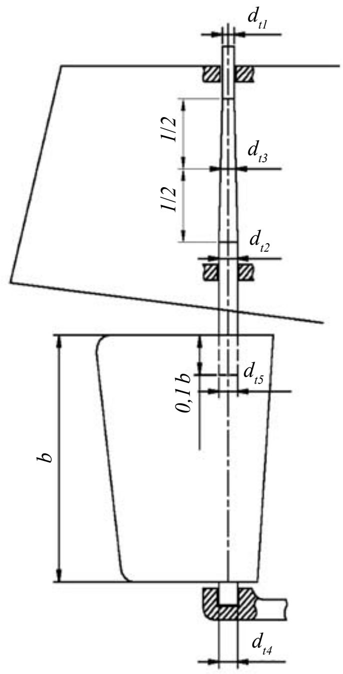


Fig. 2.4.3
Rudder stock

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:

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

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_s = 12 mm – for stainless steel.

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 12m 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:

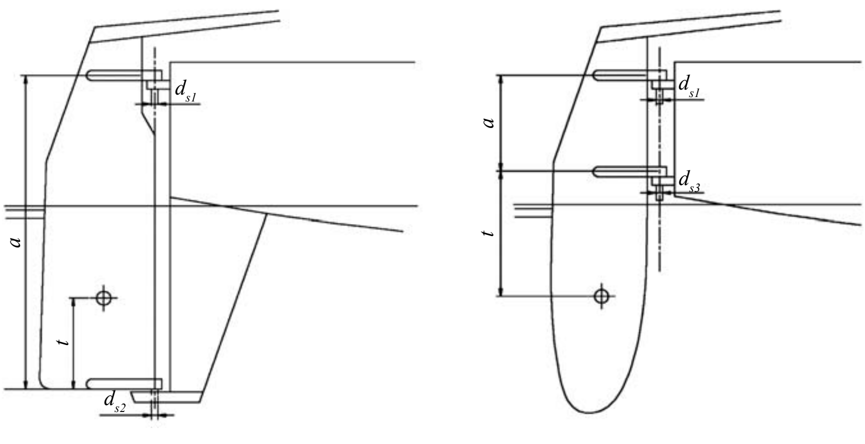


Fig. 2.5.3
Transom rudders

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

$$l \le 1{,}5\, d_1 \quad (2.6.9\text{-}2)$$

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 is to be fitted with relevant key.

2.6.11 The size of nut shall not be less than the following ones:

inner thread diameter $d_3 \ge 0{,}65\, d_1$,

height of nut $h_n \ge 0{,}60\, d_3$;

outer thread diameter $d_n \ge 1{,}20\, d_2$ or $d_n \ge 1{,}50\, d_3$, whichever is greater.

The nut is to be firmly fixed to prevent unscrewing.

2.6.12 Other types of rudder stock couplings are the matter of the special consideration by the Register.

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 mm^2, (height multiplied by diameter) shall not be less than

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

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), is to 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 $0{,}25R_m$ (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 mm^3, tiller or rudder quadrant arm (arms) in the place of connection with the boss shall not be less than

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

Modulus of resistance, in mm^3, in the end of tiller shall not be less than

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

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 are to be connected by at least four bolts, two on each side of the rudder stock.

Total square of the section of these bolts, in mm^2, shall not be less than

$$A = 12 M_s / f \tag{2.9.6}$$

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 is to 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 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 H;

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 thae 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 nort 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 and Construction of Sea-Going Ships.

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:

$$(\alpha° + 1°) \le \beta° \le (\alpha + 1{,}5°) \tag{2.10.7-1}$$

where α° = maximum angle of putting the rudder to which the end switches of the steering gear are adjusted is usually taken as α° ≤ 35°.

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_{ult}, in kN·cm, calculated by the formulae:

$$M_{ult} = 2{,}7\, d^3. \tag{2.10.7-2}$$

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 is to 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 is to 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 is to comply with the requirements of EN 28848:1993 or EN 29775:1993 at power of the outboard motor from 15 to 40 кW.

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

$$R = 9{,}5\, M_s / r_s \tag{2.10.11}$$

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

Ropes of steering rods are to be made of stainless steel.

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 are to 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 is to 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 –

$$k = 635/R_{p\,0,2} + R_m \qquad (2.11.1\text{-}3)$$

where $R_{p\,0,2}$ = 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 are to 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 is to 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 outwhales;

Table 3.2.1-1

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

Outfit characteristic *Nc*, in m^3	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		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	$5L_{\text{H}}$	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
						8		
70	17,00	25,0	21,0	36,0	9,0	24		22
90	23,00	29,0	25,0	40,0	10,0	26	$4{,}75L_{\text{H}}$	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	–		24
155	44,00	46,5	40,0	52,5	13,0	–	$4{,}5L_{\text{H}}$	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	–		26
280	84,00	84,0	71,0	74,0	16,0	–	$4{,}25L_{\text{H}}$	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 *Nc*, in m^3	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]		
1	2	3	4	5	6	7	8	9
≤ 10	≤ 0,15	2,5	–	–	–	8		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	$55L_{\text{H}}$	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		22
90	23,00	25,0	21,0	36,0	9,0	24	$4{,}75L_{\text{H}}$	22
110	29,00	29,0	25,0	38,5	10,0	26		24

Table 3.2.1.2 – continued

1	2	3	4	5	6	7	8	9
130	36,00	34,5	29,0	42,0	10,0	28		24
155	44,00	40,0	34,0	47,0	11,0	–	44,5 L_H	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	–		26
280	84,00	70,5	60,0	66,5	14,0	–	44,25 L_H	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.

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 m^3, meanwhile superstructures and deckhouses which width is less than B/4 may be disregarded.

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 *Nc* 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 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, Outfit" 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. On the basis of satisfactory results of anchor survey the marking of an anchor is checked, the Register stamp is put and the Certificate is issued.

Anchors of the following types are permitted to be used on craft:

Hall's;

Gruson's;

admiralty anchor.

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", Rules for the Classification and Construction of Sea-Going Ships. 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 l,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 and Construction of Sea-Going Ships.

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 are to 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 is to 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 are to 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 is to 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 are to 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 are to 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 is to 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) is to 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 is not to 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 the present chapter apply to the anchor machinery (windlasses, capstans and winches) which are installed on a craft in accordance with the requirements in 3.4.10 and 3.4.11.

3.7.2 Type of drive.

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

Hand drive levers are to 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 is to have a disengaging clutch between a sprocket and drive shaft.

3.7.5 Breaks.

Anchor machinery is to 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 is to 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 is to be cable to withstand a short term overload during detachment of an anchor from soil.

3.7.7.3 Strength dimensions of drive elements are to 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 is to be provided on each craft.

4.2 MOORING APPLIANCES

4.2.1 Each craft is to be completed with mooring cables of the following quantity:

1 – for craft, which length is $L_H \le 6$ 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, 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 are to 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 are to 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 0,75 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), is to 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 is to 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 is to 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 carft 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 кN, 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:
$5 \le K \le 7$ – for synthetic lines;
$K > 2$ – fozr steel ropes;
N_e = effective power of the craft propulsion plant, in kW.

4.4.3.2 The length of tow line L_{tl} 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 is to 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 Terylene	Poly Polyprop Hostalen
Density, kg/dm^3 Breaking elongation, % Melting point, °C Light stability	1,14 35 – 50 225 – 250 good	1,38 20 – 40 260 very good	0,19 20 – 40 163 – 174 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 Construction of Sea-Going Ships 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 are to 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 the present section refer to rig of sailing craft, saling-motor craft and motor-sailing craft.

5.1.1.2 The requirements of the present 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 the present section are applicable to crafts with the Bermuda rig which is most extensively used on the pleasure craft.

Application of the requirements of the present part to the craft with the square or gaff rig or rig of another type is a matter of the special consideration by the Register unless otherwise is not specified.

5.1.2 Definitions and explanations.

5.1.2.1 The following definitions and explanations are used in this section of the Rules:

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.

5.1.2.2 Main types of pleasure craft.

Yawl I 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.

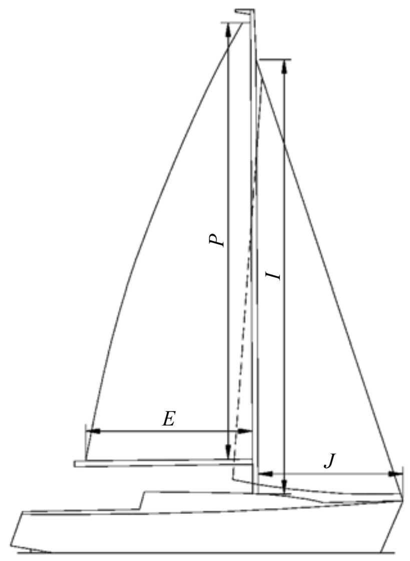


Fig. 5.1.2.1
Main dimensions of sails

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 (staysails 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 кN;
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 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_i = 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 $k_{rm} M_{30}$ 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:

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

for reduced and storm square of sails:

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

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_{st}, 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

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

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:

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

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 β between the shrouds and the mast (see Table 5.3.3.1-1) on the plane perpendicular to the centreline plane shall not be less than 10°. Use of the rigging with angles β < 10° is subject to special consideration by the Register.

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 α between the lower shrouds and the mast (see 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*” (see 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 (see Table 5.3.3.1-1, rig type "*c*3"), 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 α (between the upper shrouds inclined aft and the mast) on the centreline plane is not less than 5° and the projection of angle β (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 (Table 5.3.3.1-1), the angle of deviation of the spreaders from the midcraft plane is subject to the Register special consideration.

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 (see Fig. 5.3.2.1.1);

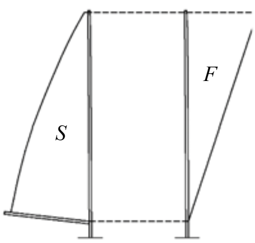


Fig. 5.3.2.1.1

.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 (see Fig. 5.3.2.1.2) consists of the following:

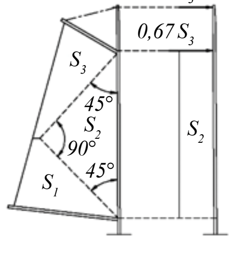


Fig. 5.3.2.1.2

area S_2 in the form of the right triangle;

area 0,67 S_3 concentrated at the place of a gant-line block;

area 0,33 S_1 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:

$$F = Sb / (a + b) \tag{5.3.2.1.3}$$

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

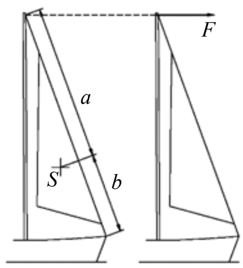


Fig. 5.3.2.1.3

.4 for a square sail, equivalent area of sail F is concentrated at the place of hanging the yard (see Fig. 5.3.2.1.4) and F = 0,675 S.

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

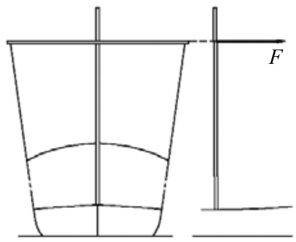


Fig. 5.3.2.1.4

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:

$$P_i = F_i\, p + Q_i; \tag{5.3.2.2-1}$$

for multihulls:

$$P_i = F_i\, p \tag{5.3.2.2-2}$$

where F_i = equivalent area of the sails, in m^2, 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, occuring 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 m^2;
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 $1{,}3J$, 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/m^2 for the main sail area;

p = 0,572 кН/м^2 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

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

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.

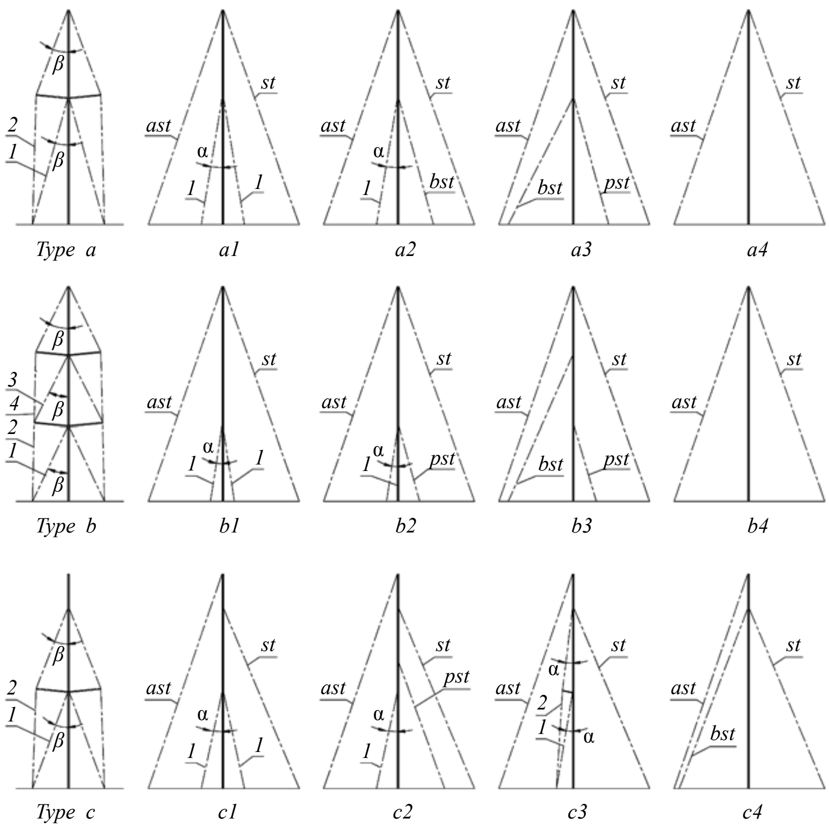
5.3.3.2 If the lower shrouds are located in the mast plane (shroud stay; rigging types “a3” and “b3”), the backstays shall be installed to ensure enough tension of the post stay.

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:

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

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 forestay (*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

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

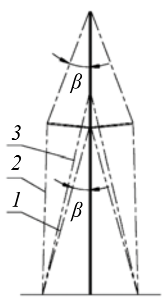


Fig. 5.3.4.2
Standard rigging of Bermudian yawls and ketches

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_o, in kN, shall be determined by the formula depending on the breaking load of the relevant rope:

$$R_o = k_o R \qquad (5.3.6)$$

where k_o = coefficient of the rigging screw and fittings:
k_o = 1,20 for the shroud rigging screw;
k_o = 1,35 for the stay rigging screw;
k_o = 1,35 for the shroud foot points;
k_o = 1,50 for the stays;
k_o = 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, сплетения и обжатые концы на тросах 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 cm^4, 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 cm^4, 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	2,5 k_3	–
One cross-tree (pair of spreaders)	2,5 (2,4) k_3	3,5 (3,6)
Two cross-tree and more	2,7 k_3	3,8
Values in the brackets refer to the rigging of "*c*" type.		

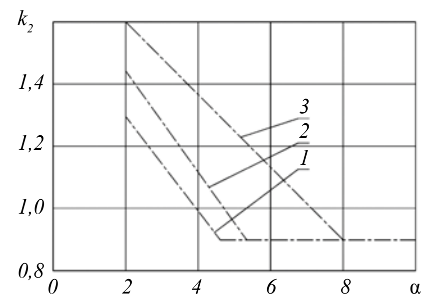


Fig. 5.4.1.1-1
Stay coefficient k_2 for rigging types *a*1, *a*2, c1 and *c*2

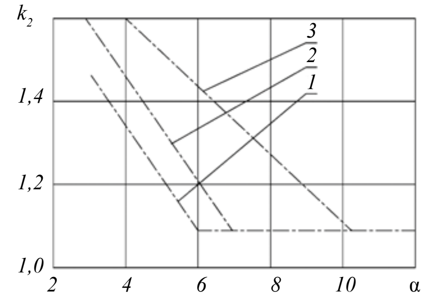


Fig. 5.4.1.1-2
Stay coefficient k_2 for rigging types *b*1 and *b*2

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;
β_1 = angle between shroud 1and the mast (see Table 5.3.3.1-1);
β_2 = angle between shroud 2 and the mast (see 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 (α = 0°), if the inner forestay and check stays are available, the stay coefficient k_2 = 1,65 for the rigging type "*a*3" or k_2 = 1,85 – for the rigging type "*b*3" 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 "*a*4", "*b*4" or "*c*4"), the stay coefficient k_2 = 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 "*a*3".

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, see Fig. 5.4.1.3-1.

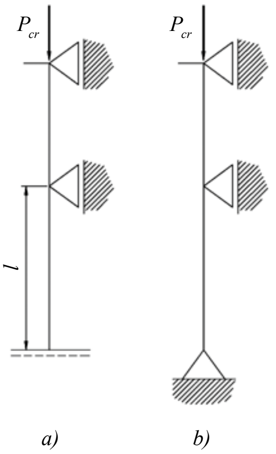


Fig. 5.4.1.3-1

if bending in the craft centreline plane – a girder elastically fixed at one end and simply supported at the other end, with an additional elastic support at the lower shroud fixing point, see Fig. 5.4.1.3-2.

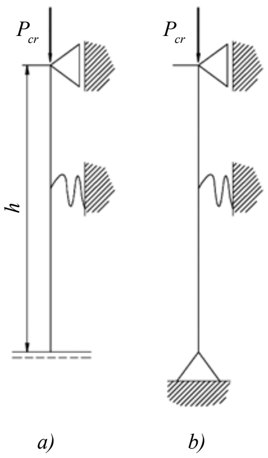


Fig. 5.4.1.3-2

Elastic fixing in a mast hole section is taken into account by the mast housing influence (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 (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 cm^4, 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)

$I = 1/8\ (I_1 + 3\,I_2 + 3\,I_3 + I_4)$, 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 cm^3, at the intersection of the stay or shroud fixing point are not less than determined by the formulae:

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

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

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, see Fig. 5.4.1.6;
β_{st} = 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

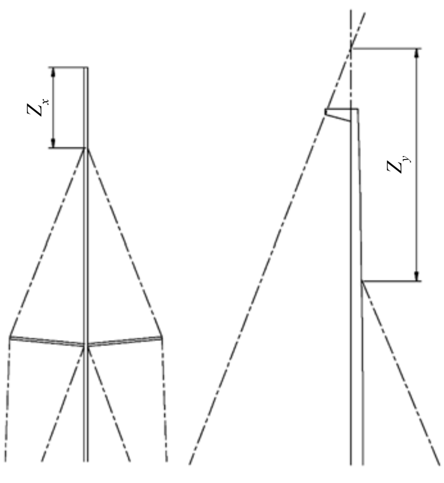


Fig. 5.4.1.6
Masthead sizes

strength of the mast is used, calculation according to Formula (5.4.1.6-2) is not required.

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 cm^4, related to the x and y axes shall not be less than calculated by the formula

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

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 cm^3, related to horizontal W_y and vertical W_z axes shall not be less than determined by the formulae:

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

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

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.

Choice of the gaffs is subject to Register special consideration.

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 "*a*3" or "*b*3", 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 "*a*3" or "*b*3", 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 of sails	Design category of boat						
	A, **A1** and **A2**	**B**	**C**	**C1**	**C2**	**C3**	**D**
Trysail	+	+	–	–	–	–	–
Storm staysail	+	+	–	–	–	–	–
Reduced staysail	+	+	+	+	–	–	–
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 trysail 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 $P E$, 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 I^2, 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 the present 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 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

$$d = 22\,l; \tag{6.2.1-1}$$

$$t = 0{,}2\,l + 3 \tag{6.2.1-2}$$

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

$$a = 0{,}15\,h \tag{6.2.1.1}$$

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

$$b = 0{,}30\,h; \tag{6.2.1.2}$$

.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

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

In other respects, the ropes for shroud shall comply with the requirements of 3.15, Part XIII "Materials" of the Rules for the Classification and Construction of Sea-Going Ships.

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

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

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

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_i, 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 m^2;
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/s^2 – 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 $L_H \geq 8,0$ m [1] [2] [3] [4]
A1, **A2** and **B**	600	For craft with $L_H \geq 8,0$ 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 the 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 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 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 the Table 7.1.10.

Table 7.1.10

Craft hull length, in m	Minimum rope diameter, in mm
$L_H \leq 8,0$	3,0
$8,0 < L_H \leq 13,0$	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 cm^3, 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 areaa) 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 appearering 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 are subject to special consideration of the Register.

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 50N 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 are 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 3m 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 though 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 m^2 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.

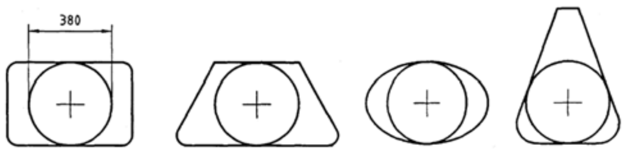


Fig. 8.1.9

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 the present 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 the present Section, the following definitions and explanations have been adopted:

W a t e r t i g h t n e s s is the capacity of an appliance or a device to prevent ingress of water inside the craft.

E n t r y d o o r is a door or another closing appliance closing the passage to crew spaces.

S i d e s c u t t l e o f n o n - o p e n i n g t y p e is a side scuttle provided with a fixed glass of non-opening type.

C l o s i n g a p p l i a n c e is a device used to cover openings in hull or superstructure, including windows, side scuttles, deadlights, hatch covers, doors, sliding appliances, emergency hatches.

E s c a p e h a t c h is an appliance intended to provide an exit and designated means of saving life in the event of accident or inversion.

W i n d o w is a glazed appliance. The term "portlight" is generally used for a small window.

F l u s h d e c k s c u t t l e is a side scuttle of non-opening type installed on the exposed deck plating to ensure access of light into the space.

D e c k h a t c h is a device fitted on decks and inclined sides of superstructures and deckhouses.

A p p l i a n c e l o c a t i o n a r e a is one of the outer hull areas as stated below and shown in Fig. 9.1.1:

A r e a I is a part of hull sides situated below the waterline, including inner sides of multihulls and transom.

A r e a 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 deckhouses 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.

A r e a III are the outer sides of superstructures and deckhouses of the first tier not belonging to area II.

A r e a IV are the decks and outer sides of superstructures and deckhouses of the second tier and upper. Parts of

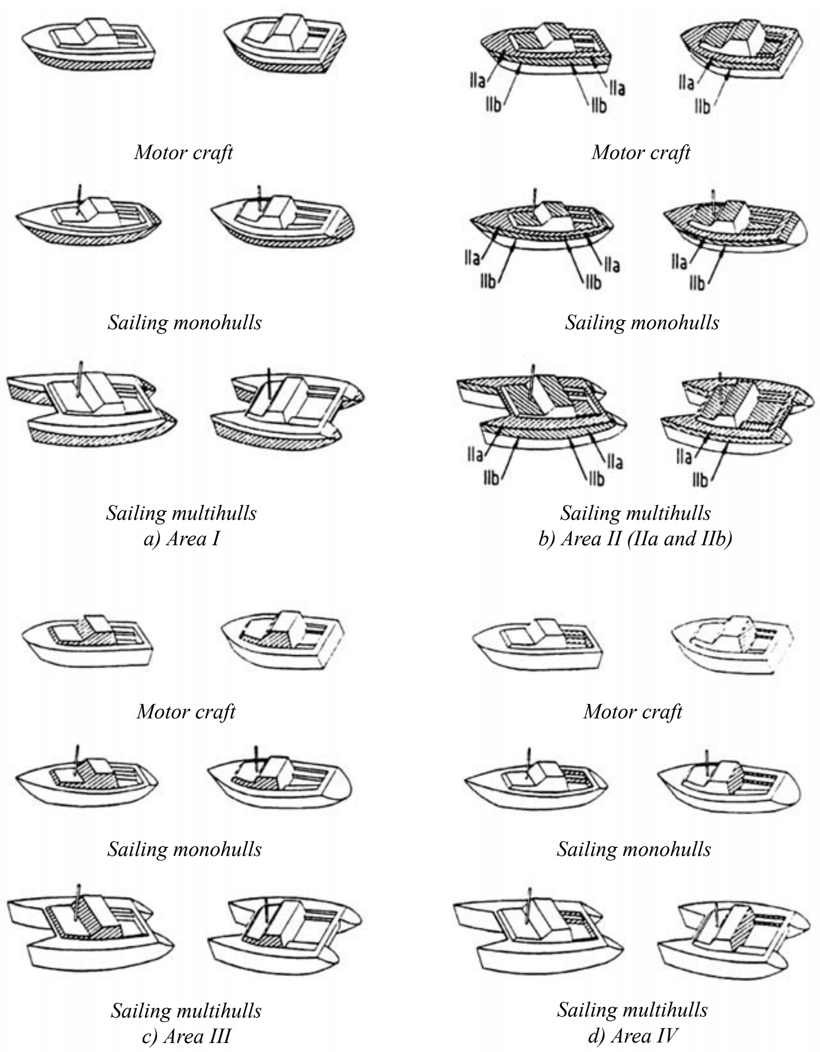


Fig. 9.1.1
Typical appliance location areas on pleasure craft
Areas are schematically shown as hatched spots

area III protected from the direct impact of waves. Cockpit sides, rear faces of superstructures and deckhouses of all tiers.

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.

Pivoted sidescuttle 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;

degree 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 sprayproof, 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 is to 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 should 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.

T a b l e 9.2.2.1

Minimum degree of watertightness

<table>
<tr><th rowspan="2">Type of craft</th><th rowspan="2">Appliance location area</th><th rowspan="2">Type of appliance</th><th colspan="4">Design categoriy</th></tr>
<tr><th>A, A1, A2 and B</th><th>C and C1</th><th>C2 and C3</th><th>D</th></tr>
<tr><td rowspan="4">All craft</td><td>Area I</td><td>Any</td><td>1</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td rowspan="2">Area II</td><td>Any</td><td rowspan="3">2</td><td>2</td><td>3</td><td rowspan="6">4</td></tr>
<tr><td>Sliding companionway hatch</td><td>3</td><td rowspan="5">4</td></tr>
<tr><td>Area III</td><td>Any</td><td>2</td></tr>
<tr><td>Sailing monohulls</td><td rowspan="3">Area IV</td><td>Any</td><td rowspan="3">3</td><td>3</td></tr>
<tr><td>Motor craft</td><td rowspan="2">Any</td><td rowspan="2">4</td></tr>
<tr><td>All multihulls</td></tr>
<tr><td colspan="7">N o t e . 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 the present Rules. Watertightness of closing appliances and component parts fitted in cockpits shall comply with the present requirements.</td></tr>
</table>

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 9.10 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:

T a b l e 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]
Ventilation ducts 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 50mm 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 m^2 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 subject to special consideration by the Register in each particular case.

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 under-deck 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 300mm, 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 6mm.

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 m^2;
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* Design categories A, A1, A2 and B	*n* Design categories C, C1, C2, C3 and D	t_{min}, in mm
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.

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.

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)methacrylate	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.

9.6 DEADLIGHTS

9.6.1 Deadlights shall meet the requirements of Part III "Equipment, Arrangements and Outfit" of the Rules for the Classification and Construction of Sea-Going Ships. 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 9.8.3-2.

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.

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.

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

Note. 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.

9.8.4 Specific requirements.

9.8.4.1 Type of end connection.

The 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.

Note. 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.

Every part of the mechanical elements connecting appliances to the rest of the craft shall be capable of withstanding, without breaking, twice the force induced by the pressure loads defined in 9.10.2.1. This requirement shall be verified for inwards opening appliances, where hinges, locks, or any other part of the link chain between the plate and the support shall be checked by calculation or testing.

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 the present 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 the present 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 $0{,}005 L_H \cdot B_{max}$ and is usually the lowest point of the cockpit coaming.

2. For assessing h_C, 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 the present 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 amidcrafts 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.

C o c k p i t s o l e is essentially horizontal surface(s) of the cockpit on which people normally stand.

S e m i - f i x e d s i l l 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.

C o m p a n i o n w a y o p e n i n g is an opening (hatchway or doorway) giving way to accommodation. There may be several companionway openings.

F i x e d s i l l is a sill being a fixed, integral and permanent part of the cockpit or hull.

R e c e s s 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.

S e l f - d r a i n i n g c o c k p i t 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.

D e g r e e o f w a t e r t i g h t n e s s is ability of a closing appliance, fitting or surface to resist the ingress of water. The degree of water tightness is summarized as follows:

d e g r e e 1 . Degree of tightness providing protection against effects of continuous immersion in water;

d e g r e e 2 . Degree of tightness providing protection against effects of temporary immersion in water;

d e g r e e 3 . Degree of tightness providing protection against splashing water;

d e g r e e 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	m^3	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 the present 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.

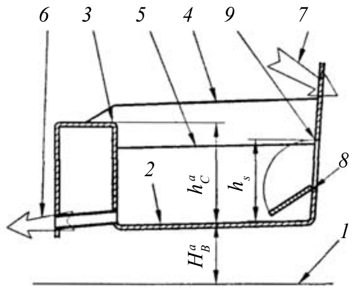


Fig. 10.3.1.1

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.

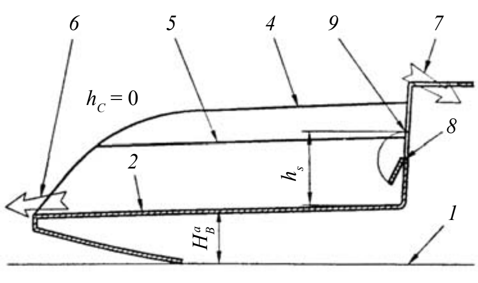


Fig 10.3.1.2

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.

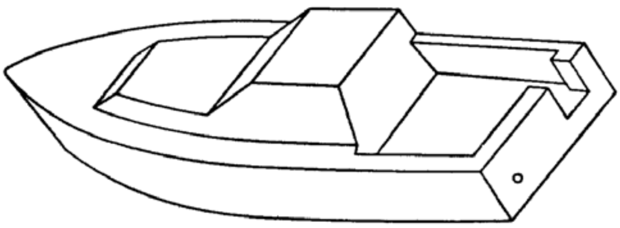


Fig. 10.3.1.3

10.3.1.4 Cockpit having a transom door with a bottom gap.

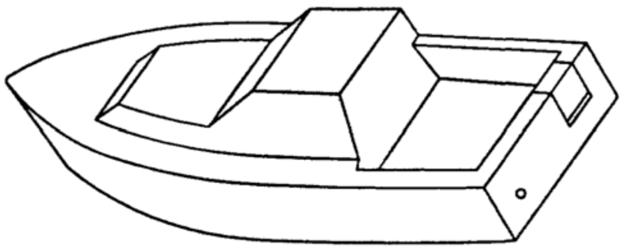


Fig. 10.3.1.4

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.

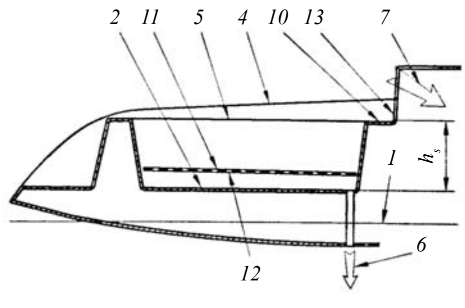


Fig. 10.3.1.5

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.

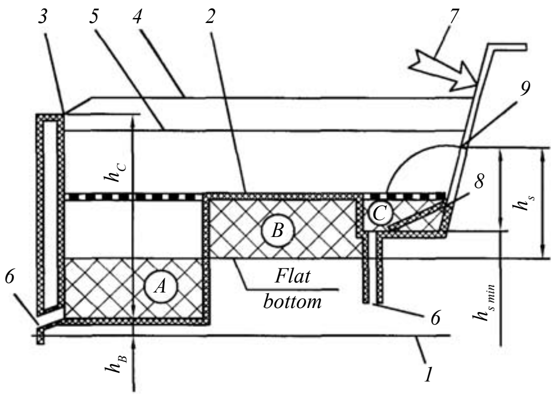


Fig. 10.3.2

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-retension 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, $h_{S\,\min}$, 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 12.3.1.5 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.

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 heignht, $h_{S\,\min}$

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 $2\,h_{S\,\min}$	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 mm^2 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 mm^2 (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.

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 $2h_{S\,\min}$ 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".

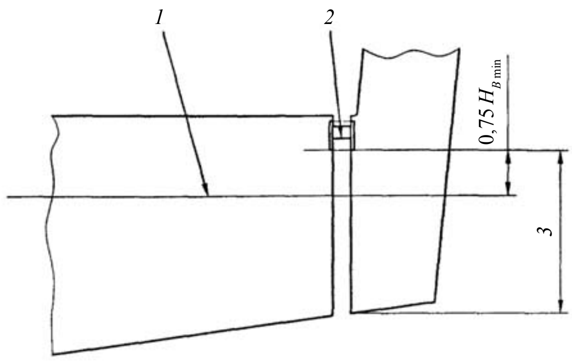


Fig. 10.13.1
Drain integral with the hull shell
1 – waterline;
2 – top of integral penetration above $0{,}75\,H_{B\,\min}$, no seacock required;
3 – in this area, the drain shall be integral with the hull shell

11 SIGNAL MEANS

11.1 GENERAL

11.1.1 The requirements of the present Section of the Rules 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 of the Rules.

White, red, green, yellow and blue lights are lights complying with the requirements of 10.1.4 and 10.2 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 10.1.5, 10.1.6 and 10.2, 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 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.

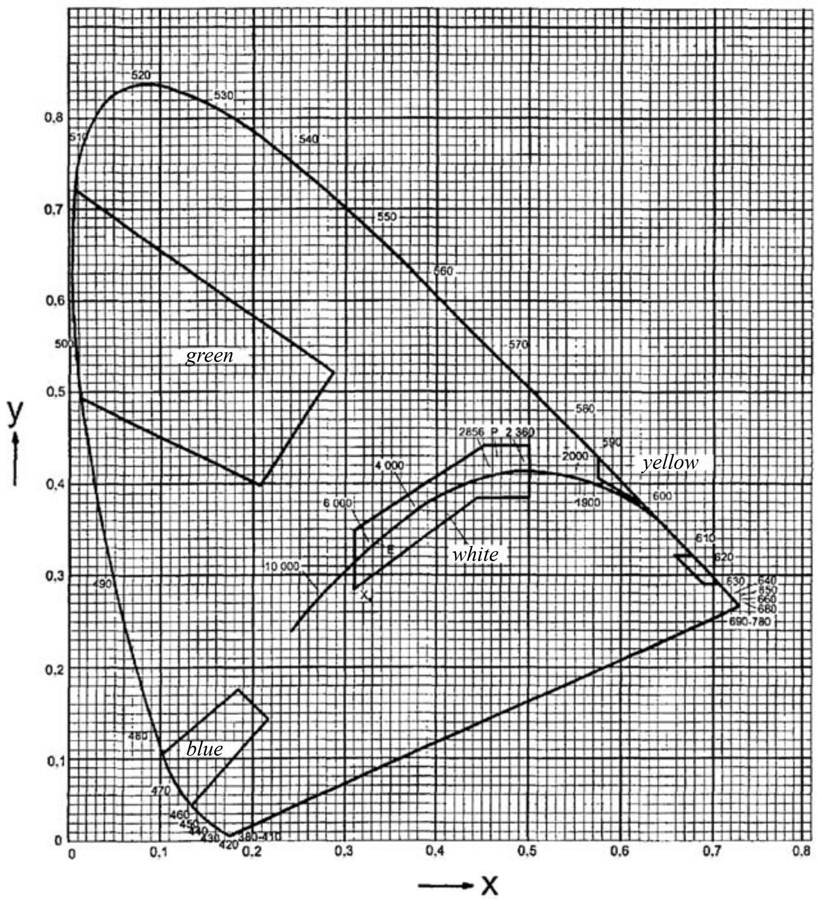


Fig. 11.1.4.2
IEC chromaticity diagram:
2360K corresponds to the light of a vacuum filament lamp; 2848K corresponds to the light of a gas-filled filament lamp

Table 11.1.4.2

Colour of signal light		Coordinates of the intersecting points					
White	X У	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 У	0,690 0,290	0,710 0,290	0,680 0,320	0,660 0,320		
Green	X У	0,009 0,720	0,284 0,520	0,207 0,397	0,013 0,494		
Yellow	X У	0,612 0,382	0,618 0,382	0,575 0,425	0,575 0,406		
Blue	X У	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, $I_в$ and t:

I_0 = photometric luminous intensity, in candelas (cd), measured at normal voltage for electric lights;

$I_в$ = 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, $I_в$ is taken as 25 per cent less than I_0.

Consequently, $I_в = 0.75 \cdot I_0$.

The relation between $I_в$ and t of signal lights is given by the following equation:

$$I_в = 0,2\,t^2 q^{-t}. \qquad (11.1.5.1.2)$$

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, $I_в$ 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, $I_в$ and t

Nature of the 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
	$I_в$	2,0	7,5	0,9	3,5	0,8	2,4	0,7	2,0
	t	2,3	3,7	1,7	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
	$I_в$	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						
	$I_в$	35,0	100,0						
	t	5,9	8,0						

Note. I_0 and $I_в$ 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 the present Section of the Rules 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 the present 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 11.2.1.3-2

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	Sternlight, 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 10.2.1-1.

[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.

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 L_H, in m	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 starboard 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 Green	Any	Bright or ordinary	360 360	All round the horizon 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 from the craft's beam, overlapping the for and aft centerline by a sector of 22,5°
		$L_H > 20$ at night	Bright	+ 112,5	
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.					

11.2.1.4 The required sector of light visibility in a vertical plane of at least 10 degrees 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", of the Rules. Main Regulations for the Danube Navigation.

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.

The use of coloured lenses is subject to special consideration by the Register in each case.

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 the present 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 means	Range of audibility, in km	1/3-octave band level at 1 m in dB referred to 2×10^{-5} N/m^2
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 is not to 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 hours – for craft of Categories **A**, **A1**, **A2** and **B**;

16 hours – 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 Register, separately in each case;

.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 standards specified in Tables 11.5.1-1 and 11.5.1-2.

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 11.5.1-1

Type of the craft and its hull length L_H, in m		Signal lights										Signal cone
		Masthead light	Side lights		Stern light	Light flashing lamp	All-round lights				Anchor	
			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	–	–	–	–	–

[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 waterways

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]	–	–
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.

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		1[10]
1.2	of less than 12 m in length;	1[2, 3]	1[3]	1[3]	1[2]	1[4]	–	1	One for a craft having sails	–
1.3	of less than 7 m in length whose maximum speed does not exceed 7 knots	1[2]	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 the present 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 supplied 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. A sound pressure level of 75 dB (A) can be permitted only after special consideration by the Register.

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

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.

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 shall be provided, 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

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 fitter'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, m^2		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.

12.2.3 It is recommended that the sets of rigging and fitter's tools specified in Table 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	∅18 mm	1	–
10	Tongs	200 mm	1	–
11	Hollow punch	∅18 mm	–	1
12	Hollow punch	∅25 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
Note. 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 litres 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 the present 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 the present 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 manoeuvring 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 ($Fr_\Delta > 3$) 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, m^2; 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 centerboards, bilge boards, brackets and protruding parts, in m^2;

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 $h_R^2/A_R \ge 1{,}5$;

$k_{AR} = (0{,}5 \cdot h_R^2/A_R + 0{,}25)$ 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:

$k_A = (2X_A + L_{WL})/L_{WL}$;

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: $k_C = (2X_C + L_{WL})/L_{WL}$;

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

$$E_R = k_N k_L k_{AR} \frac{l_R A_R}{z_{sc} SA} \cdot 10^3 \qquad (3.1.2)$$

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 $h_R^2/A_R \ge 1{,}5$; $k_{AR} = (0{,}5 \times h_R^2/A_R + 0{,}25)$ 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 m^2; 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 m^2.

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

$$E_{R\min} = (60 / L_{WL}) + 1{,}5. \quad (3.1.3)$$

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.

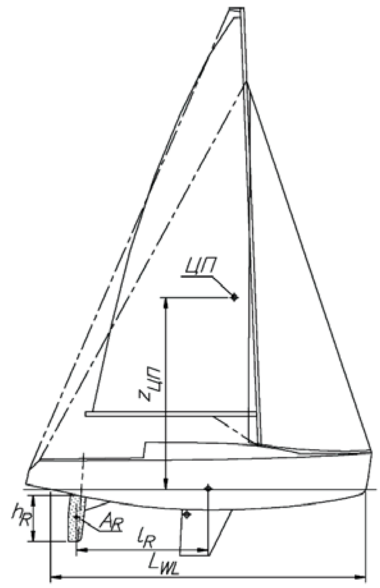


Fig. 3.1.2
Sailing craft elements

PART IV. STABILITY, RESERVE OF BUOYANCY AND FREEBOARD

1 GENERAL

1.1 APPLICATION

1.1.1 The requirements of this Part of the Rules apply to craft being subject to the Register technical supervision in compliance with the requirements of Section 1 of the General Regulations.

1.1.2 The requirements of this Part of the Rules apply to craft in service to the extent which is expedient and feasible. However they are mandatory for craft under construction, and also for craft under conversion or major repair if their stability or freeboard depth are affected.

1.1.3 The Register may allow the deviations from the requirements of this Part of the Rules provided the equivalents in craft's design are ensured or special restrictions on navigation conditions are specified. The deviations, equivalents and specified restrictions shall be entered in an Owner's Manual.

1.2 DEFINITIONS AND EXPLANATIONS

1.2.1 The definitions and explanations relating to the general terminology are given in the General Regulations, in Part I "Classification" and Part II "Hull".

The following definitions and explanations are adopted in this Part of the Rules:

Loaded displacement, Δ_{max} (m_{LDC}) is the mass of a craft in the loaded condition which includes the light craft mass Δ_{min} (m_{LCC}) and the maximum total load DW (m_{MTL}) being defined in Section 3 of the General Regulations.

Air space is an air-tight space of hull structure.

Righting moment, M_R is a moment produced by gravity and buoyancy forces at the given heeling angle.

Load waterline (L_{WL}) is the waterline of a craft when upright at a loaded displacement and design trim.

Actual sail area, A'_S is an actual profile projected area of the specific combination of sails of a sailing craft.

Liquid cargo is all liquids on board including craft's liquid stores, ballast, etc.

Craft's liquid stores are domestic waste waters and drinking water, fuel oil, lubricating oil in permanently fitted tanks.

Reserve of buoyancy is the watertight volume of a craft's hull above a load waterline including the volumes of watertight superstructures and deckhouses.

Design category of craft means operational conditions permitted for a craft in compliance with 4.2 of the General Regulations.

Well is any volume open to the sky that may retain water.

Initial metacentric height, h_0 is the elevation of a metacentre above a craft's centre of gravity with no craft's heel.

Corrected initial metacentric height, h is an initial metacentric height, h_0 corrected for the effect of free surfaces.

Minimum operating load is the sum of the following amounts:

mass representing the minimum crew, positioned on the centreline near the highest main control station, which is assumed equal to:

75 kg where $L_H \le 8$ m;

150 kg where 8 m < $L_H \le 16$ m;

225 kg where 16 m < $L_H \le 24$ m;

life-saving appliances with a mass of not less than $(L_H - 2,5)^2$, in kg;

non-consumable stores and equipment normally carried on the craft;

water ballast in tanks to be filled whenever the craft is afloat;

a liferaft (if any) fitted in the stowage provided;

not more than 10 per cent of the total amount of the stores of fuel oil, fresh water and provisions.

Minimum operating displacement, m_{MOC} is a craft's mass comprising the light craft mass and the minimum service load.

Midship section of craft is the transverse section of the craft's hull in the middle of waterline length L_{WL}.

Heeling moments are the assumed design values of moments statically and dynamically applied to a craft which correspond to a design model of their action on the craft.

Maximum permissible moments are the design values of moments being maximum permissible on condition that the craft's stability parameters required at its static and dynamic inclinations are ensured.

Freeboard, F is a distance measured vertically amidships between the deck line and waterline plane at the maximum draught. For undecked craft, the freeboard is assumed as a distance measured from the maximum draught plane till the upper edge of permanent side plating.

Superstructure is an enclosed secure and weathertight structure on the freeboard deck extended from side to side of the craft or having the sides at a distance of not more than 4 per cent of a breadth B_H inboard from the craft's side.

Inflated bag is a bag made of flexible material which is always to be inflated when the craft is being used.

Capsize is an event when a craft reaches any heel angle from which it is unable to recover to equilibrium near the upright without intervention.

Capsizing moment is an assumed design minimum dynamically-applied heeling moment resulting in a capsize of craft.

Displacement volume of craft, V_D is a volume of displacement of the craft to the approprriate loading condition.

Basic stability criterion is the ratio of the maximum permissible moment to the heeling moment due to wind or wind and waves.

Main sails are sails, which may be set under favourable navigational conditions.

Openings considered as open are openings in the upper deck or hull sides, as well as in decks, sides and bulkheads of superstructures and deckhouses of which closing appliances do not comply with the requirements of Section 9, Part III "Equipment, Arrangements and Outfit" as to their weathertightness, strength and dependability. Small openings like sea openings of craft's systems and pipelines which actually have no effect on stability in craft's dynamic heeling are not considered as open.

Freeboard deck is a continuous deck from which a freeboard is calculated.

Righting lever, l (static stability arm) is an arm of gravity and buoyancy couple at craft's heeling.

Windage area, A_{LV} is the projected lateral area of the above-water portion (hull, superstructures, deckhouses and spars, including awnings and dodgers) of a craft with no sails on the centre line plane with the craft in the upright position.

Correction for free surfaces is a correction to the initial value of a metacentric height allowing for a decrease in the craft's stability due to the effect of free surfaces of liquid cargoes.

Trim of craft is the attitude of a craft in water featured by midship draught d, heel θ and trim ψ. Unless otherwise specified, all dimensions and definitions relate to the craft's trim in calm water at the design displacement and design trim in the upright position.

Crew limit, CL is the maximum number of crew (with a mass of 75 kg each) which does not exceed the number of seats provided for accommodation.

Maximum permissible angle of heel is an angle of heel which is not to be exceeded under the Rules.

Design trim is the longitudinal attitude of a craft when upright with crew, stores and equipment in the positions designated by a designer or builder.

Downflooding height is a vertical distance measured between the deepest permitted draught plane and the lowest point of an opening considered as open or having watertightness degree 2, 3 or 4.

Calculation wind speed, v_W is a wind speed used for calculating stability and bouyancy of pleasure craft.

Loaded displacement condition is the light craft condition with the maximum total load added at the design trim and the distribution of crew.

Watertightness degree of closing appliance is the ability of the appliance or surface to provide protection against an ingress of water.

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 or getting awash.

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.

Light craft is a craft which is fully ready for use as defined in 3.2.26 of the General Regulations.

Type of craft: for the purpose of this Part of the Rules, craft are subdivided into five types arbitrarily designated as A, B, C, D and E.

Type A is fully decked craft. The fully decked craft means a craft in which the horizontal projection of the sheerline area comprises any combination of:

watertight deck and superstructure; and/or

quick-draining well or cockpit complying with the requirements of Section 10, Part III "Equipment, Arrangements and Outfit" and Section 2 to 5 of this Part; and/or

watertight wells or cockpits complying with the requirements of Section 10, Part III "Equipment, Arrangements and Outfit" with a combined volume of less than $L_H \cdot B_H \cdot F_M / 40$;

provided that all craft's closing appliances have the adequate strength, stiffness and watertightness degree complying with the requirements of Section 9, Part III "Equipment, Arrangements and Outfit", as well as:

for craft of design category **A** and **A1** – plan area of all wells shall be less than $0{,}2\,L_H B_H$, at that plan area of all recesses forward of $L_H / 2$ shall be less than $0{,}1\,L_H B_H$;

for craft of design category **A2** and **B** – plan area of all wells shall be less than $0{,}3\,L_H B_H$, at that plan area of all wells forward of $L_H / 2$ shall be less than $0{,}15\,L_H B_H$.

Type B is pontoons and similar craft. These craft shall have a continuous deck with small openings for access to compartments and the openings shall have steel or equivalent watertight closing appliances provided with gaskets. With any one compartment damaged, the watertight deck of such craft shall remain above the water surface around the entire periphery.

Type C is open craft. The open craft are craft of types A and B having hatch covers of the inadequate strength, stiffness or watertightness degree, or hatches without closing appliances.

T y p e D is partially decked craft. These are deemed as the craft of which over two thirds of the craft's length (including one third of the length from the bow) may be considered as type A or B, and which have cockpits meeting the requirements of Section 10, Part III "Equipment, Arrangements and Outfit" within the remaining length of the craft.

T y p e E is undecked craft. These are deemed as the craft of which less than two thirds of the craft's length may be considered as type A or B, and/or which have cockpits with a total coefficient by volume $K_C \geq 1$, and/or the cockpits not meeting the requirements of Section 10, Part III "Equipment, Arrangements and Outfit".

A n g l e o f v a n i s h i n g s t a b i l i t y, θ_V is an angle of heel, in deg, other than zero at which the righting moment is equal to zero; determined assuming that there is no offset load.

D o w n f l o o d i n g a n g l e, θ_D is an angle of heel at which the craft's interior spaces are flooded by water through openings considered as open, or over board or coamings.

A n g l e o f m a x i m u m o f r i g h t i n g l e v e r c u r v e, θ_M is an angle of heel at which the maximum righting lever occurs.

C e n t r e o f l a t e r a l r e s i s t a n c e (C L R) is the geometric center of the projection of the craft's underwater hull onto the centerline including appendages.

W i n d a g e c e n t r e (W C) is the geometric centre of a corresponding windage area.

B e a m b e t w e e n h u l l c e n t r e s, B_{CB} is a transverse distance between the centres of buoyancy of the sidehulls.

F l o t a t i o n e l e m e n t is independent tanks, inflated bags and low density materials providing the necessary reserve of buoyancy to the craft in case of its hull damages.

1.3 GENERAL TECHNICAL REQUIREMENTS

1.3.1 All calculations shall be made by the methods generally accepted in naval architecture.

When using a computer, the methods of computation and programme shall be approved by the Register.

1.3.2 The lines plan shall be made to a scale of at least 1:20; in so doing, the largest ordinate shall be not less than 100 mm. Where computerized design is not used in calculating form-stability arms, the width of the projection "body plan" used for measuring ordinates for calculations shall be not less than 300 mm. Where the lines plan is constructed as the computerized mathematical model of the hull, and buoyancy and stability calculations are also computer-aided with the automatic transformation of the hull shape to a calculation program, the requirement on dimensioning the projection "body plan" may be ignored.

1.3.3 Calculation of cross-curves of stability.

1.3.3.1 The calculation of cross-curves of stability shall be carried out to the waterline which is parallel to the design waterline. If the craft is shaped and arranged so that the effect of trim associated with inclinations essentially affects righting moment values, the calculations of cross-curves of stability shall be carried out with due regard for the trim.

In calculating the cross-curves of stability, the superstructures located above the freeboard deck are ignored.

1.3.3.2 The diagram of stability shall include the small-scaled layout chart of a hold coaming, as well as of a companionway to an engine room, a deckhouse, and the designations of downflooding angles referred to an open hole.

1.3.3.3 The calculation of cross-curves of stability shall be supplemented with a curve of downflooding angles for the lowest open hole at the craft's side, on deck and in superstructure.

1.3.4 Calculation of liquid cargo effect.

1.3.4.1 Tanks for each kind of liquid cargo and ballast, which may simultaneously have free surfaces in craft's operation, shall supplement the tanks considered in computing the free surfaces effect of craft's liquid stores on stability at large angles of inclination. To allow for the free surface effect, one design combination of single tanks or their combinations for each kind of liquid cargo shall be drawn up. Considering the number of tank combinations for the individual kinds of liquid cargo or for single tanks likely to occur in operation, only those producing the greatest total heeling moment ΔM_{30} due to liquid overflow at the craft's heel of 30° should be selected.

In all cases, the correction shall be computed with the tank filled by 50 per cent of its capacity.

The tanks complying with the following condition below can be ignored:

$$l_{30} \cdot \upsilon_t \cdot b_t \cdot \gamma \sqrt{C_b} < 0{,}01 \cdot \Delta_1 \qquad (1.3.4.1)$$

where a_t, b_t, v_t = overall dimensions (along base planes): width, depth and volume of tank;
γ = density;
C_b = block coefficient of tank;
Δ_1 = displacement at the most unfavourable loading condition in magnitude of h and l;
l_{30} = non-dimensional factor according to Table 1.3.4.1.

Table 1.3.4.1

Factor l_{30}

b_t/a_t	l_{30}	b_t/a_t	l_{30}
20	0,111	1	0,049
10	0,113	0,5	0,024
5	0,114	0,2	0,010
2	0,094	0,1	0,005

1.3.4.2 The tanks included in the design combination for considering the free surface effect on initial stability shall be selected in compliance with the instructions of 1.3.4.1 with the difference that proceeding from initial stability the tanks shall be selected in the maximum value of

Δm_h which is equal to the product of the intrinsic moment of inertia of free surface for a craft in the upright position by the density of liquid cargo.

The correction to a metacentric height in the specific loading condition of a craft is calculated for the tanks, which have free surfaces of liquids, for the craft when upright without trim; at that the correction is assumed as the greatest within the tank capacity specified by recommendations on the craft operation.

The tanks complying with the following condition below can be ignored:

$$\Delta m_h = 0{,}0834 \cdot \upsilon_t \cdot b_t \cdot \gamma \cdot \sqrt{C_b} \cdot b_\tau / a_\tau < 0{,}01\,\Delta_{\min} \qquad (1.3.4.2)$$

where Δm_h = correction to stability coefficient to allow for liquid cargo effect;
$\Delta_{\min}$ = displacement corresponding to the craft's minimum loading condition regulated by the Rules.

The residues of liquids which are usual in emptied tanks are ignored in calculations.

The tank filled to more than 98 per cent of its capacity is considered as completely filled.

1.3.5 Calculation of windage area.

1.3.5.1 The windage area shall include the projections of the following items on the centre line plane: all continuous walls and surfaces of the hull, supestructures and deckhouses; rig, ventilators, boats, deck machinery, all awnings which may be set in stormy weather, as well as the projections of side surfaces of the deck cargoes specified.

Where projections of various elements are superimposed one upon the other, the summation for continuous elements does not apply. The projection of discontinued surfaces superimposed onto the projections of continuous elements is not included in the windage area.

The windage area of sailing craft is determined for each sail combination of the set of sails specified, including reefing. The windage area variants for the sailing craft are used in assessing stability with the corresponding values of wind strength or velocity according to the set of sails specified for use taking into account the provisions of 5.7.1, Part III "Equipment, Arrangements and Outfit".

1.3.5.2 The windage of discontinued surfaces of rails, rigging and various small items is recommended to take into account by increasing the total windage area of continuous surfaces, which is determined for the minimum draught, by 5 per cent and the static moment of this area by 10 per cent.

The above approximate methods to allow for the windage of discontinued surfaces and small items are not mandatory. Where needed, those parts of windage may be determined by detailed calculations. In this case, in calculating the windage of discontinued surfaces like the craft's rig, rails, frames of the lattice type, etc., the overall areas taken into account shall be multiplied by the filling factors assumed equal to:

0,6 for netted rails;
0,2 for not netted rails;
0,5 for structures of lattice type;
0,6 for rigging.

The area of the projections of a hull above waterline, as well as of superstructures and deckhouses of the traditional (other than streamlined) type shall be taken into account with a flow coefficient equal to 1,0. The areas of the projections of superstructures and deckhouses of the streamlined type may be assumed with the flow coefficient of at least 0,6 if confirmed by corresponding experimental and design data.

The areas of the projections of detached and sreamlined elements (masts, smoke funnels, ventilators, etc.) of the craft should be assumed with the flow coefficient of 0,6.

1.3.5.3 The position of the centre of windage area is determined by a method generally applied for determining the coordinates of the centre of gravity for a plane figure.

1.3.6 A righting lever curve shall be plotted up to an angle of 80° with a spacing of 10°.

Where righting is ensured by crew's strength, the righting lever curve of the craft shall be plotted up to an angle of 180° with a spacing of 10°.

The craft's righting lever curve shall be plotted, as a minimum, up to a downflooding angle θ_D or an angle of vanishing stability, θ_V, whichever is geater.

Righting lever curves shall be plotted allowing for the potential effect of free surfaces of liquids.

1.3.7 Loading condition.

1.3.7.1 Unless otherwise specified, the craft's stability shall be checked for the following loading conditions:

craft in fully loaded condition at loaded draught;
craft with minimum service load;
craft with minimum sevice load without crew.

1.3.7.2 If the loading conditions anticipated in normal service of a craft as regards stability are less favourable than those listed in 1.3.7.1 or stated in 2.7, stability shall also be checked for these conditions.

1.3.7.3 The mass of solid ballast on board craft shall be included in the light-craft condition.

1.3.8 Curves of stability computed considering the correction for the effect of free surfaces of liquid cargoes according to 1.3.4, including the free surfaces of the accumulated oily mixtures shall be plotted for all the loading conditions under consideration.

1.3.9 Requirements for Information on Stability.

1.3.9.1 To provide adequate stability of craft in service, the Information on Stability approved by the Register and containing the data below shall be issued to the craft:

.1 craft's main characteristics and data resulting the trim and stability calculations, including damaged condition, and also the tests for type design loading conditions specified.

The summary tables of the results of calculating the displacement, the position of centre of gravity, initial stability and trim, as well as the summary tables of the results of stability checking for compliance with the requirements of this Part shall be drawn up;

.2 data on inclining test;

.3 operational, navigational and other restrictions pertinent for craft's safety to prevent downflooding and capsizing;

.4 instructions, diagrams, tables and other data to provide a possibility to assess craft's stability in service under the actual loading;

.5 instructions on mandatory arrangements when forced to tow another craft to render assistance;

.6 recommendations on arrangements to improve stability.

1.3.9.2 It shall be noted in the Information that craft's stability essentially depends on the way of craft's operation.

The Information on Stability shall contain an entry: "Compliance with the requirements of this Information does not relieve the Master, and in his absence, the person in charge of craft's safety from responsibility for stability and the necessary reserve of buoyancy of the craft during operation".

1.3.9.3 In developing instructions for the owner/master, the recommendations on selecting the craft's moving direction and speed relative to sea allowing for potential capsizing due to broaching or getting into (main and parametric) resonance conditions of rolling shall be included.

The Information on Stability for any craft shall include the following entries:

"Under way in following sea with a wave height of 3 per cent probability above 2,0 m (corresponding approximately to sea state IV as per Table 4.3.3 of the General Regulations), at a craft's speed over ... m/s, the craft can capsize.

While running beam to the sea at the sea state close to the one limiting the craft's navigation, the craft can capsize.".

The maximum permissible speed of the craft in a following sea, in m/s, is determined by the formula

$$V_s = 0{,}7\sqrt{L_H}. \qquad (1.3.9.3)$$

The guidance to the Master may include the sections from the IMO document MSC/1/Circ.1228:

cautions;

dangerous phenomena;

operational guidance on avoiding dangerous situations, including useful, in the developer's view, information.

The recommendations shall not be overburdened with well-known provisions of good marine practice.

1.3.9.4 The Information on Stability shall be compiled relying on the calculations carried out in compliance with these Rules.

The Information on Stability for the lead (first) craft in series shall be confirmed by an inclining test of this craft.

The Information on Stability for series-built craft shall be confirmed by the inclining test/light-weight check carried out in compliance with 1.4 of this Part of the Rules.

The Information on Stability compiled for the first craft of one series may be used for the following craft of this series if the inclining test/light-weight check results for the craft compared meet the following conditions:

.1 difference in the light craft displacement is within 2 per cent and in the height of the centre of gravity is within 5 per cent, but comprises not more than 4 cm;

.2 difference in the abscissa of the centre of gravity is within 1 per cent of the length between perpendiculars of the craft;

.3 requirements of this Part of the Rules are met in the worst, with regard to stability, loading conditions recalculated on the basis of the craft's inclining test.

1.3.9.5 The Information on Stability for the craft of design categories **A, A1, A2** and **B** shall contain particulars on damage stability and buoyancy compiled on the basis of calculations.

1.3.9.6 If a capsized craft has a possibility to regain its upright position by crew, the Information on Stability shall include the corresponding recommendations on righting the craft on the basis of calculations which are confirmed by experiments in craft's testing.

1.3.9.7 The Information on Stability shall be approved by the Register.

1.3.9.8 The Information on Stability may be inserted as a separate section in the Owner's Manual of a craft approved by the Register. If the Information on Stability is issued as a separate document, the Owner's Manual shall include entry on the mandatory fulfilment of the Information on Stability requirements.

1.4 INCLINING TEST AND LIGHT-WEIGHT CHECK

1.4.1 To be inclined are:

.1 series-built craft as per 1.4.2;

.2 every craft of non-series construction;

.3 every craft after reconstruction;

.4 craft after major repair, conversion or modernization as per 1.4.3;

.5 craft after installation of permanent solid ballast as per 1.4.4;

.6 craft in service at time intervals within 10 years, if necessary, as per 1.4.5;

.7 craft of which stability is unknown or shall be verified;

.8 craft in initial survey for the assignment of class according to these Rules requirements.

1.4.2 Of the series of craft under construction at each shipyard, to be inclined are:

.1 the first craft, then every fifth craft (i.e. sixth, eleventh, etc.).The rest series-built craft shall be subject to the light-weight check as per 1.4.14.

Depending on the seasonal conditions at craft's delivery and subject to special agreement with the Register, the inclining test of the craft may be reserved for the next craft in the series. Beginning from the twelfth craft in the series, the Register may require to incline the lesser number of craft if it is demonstrated to the satisfaction of the Register that in the process of constructing the craft of the series the stability of their mass and the position of the centre of gravity is ensured within the limits specified in 1.4.4.2.2;

.2 a series-built craft wherein structural modifications, as compared with the first craft of the series, according to the calculation result in:

.2.1 the change of the light craft displacement by more than 2 per cent; or

.2.2 the increase of the height of the light-craft centre of gravity simultaneously exceeding 4 cm and the value determined by the formulae:

$$\delta z_g = 0{,}1\,\Delta_1/\Delta_0\,l_{max}; \qquad (1.4.2.2.2\text{-}1)$$

$$\delta z_g = 0{,}05\,\Delta_1/\Delta_0\,h, \qquad (1.4.2.2.2\text{-}2)$$

whichever is less,

where Δ_0 = light-craft displacement;
Δ_1 = craft's displacement under the most unfavorable loading condition with regard to a value of h or l_{max};
l_{max} = maximum lever of the righing lever curve at the worst, with regard to its value, design loading condition;
h = corrected initial metacentric height under the most unfavorable design loading condition as regards its value;
or

.2.3 violation of the requirements of this Part of the Rules for design loading conditions with:

$$z_g = 1{,}2\,z_{g2} - 0{,}2\,z_{g1} \qquad (1.4.2.2.3)$$

where $z_{g1}(z_{g2})$ = design light-craft vertical centre of gravity prior to (after) structural changes;
z_g = assumed light craft vertical centre of gravity.

Such craft shall be considered the first craft of a new series regarding stability, and the inclining test procedure for the following craft shall meet the requirements of 1.4.2.1.

1.4.3 After reconstruction, major repair, conversion or modernization, to be inclined are the craft wherein structural modifications, as shown by calculation, result in:

.1 change of load (total mass of loads removed or added) by more than 6 per cent of the light-craft displacement; or

.2 change in the light-craft displacement by more than 2 per cent; or

.3 increase in the the light-craft vertical centre of gravity by more than the value computed as per 1.4.2.2.2; or

.4 violation of the requirements of this Part of the Rules for design loading conditions as specifeid in 1.4.2.2.3.

If no inclining test is required according to the calculation results, the light-weight check shall be carried out in compliance with 1.4.14.

Irrespective of the calculations submitted, the Register in compliance with 1.4.1.7 the inclining test of the craft to be performed, proceeding from the craft's technical condition.

1.4.4 After installation of the permanent solid ballast every craft shall be inclined.

The inclining test of the ship may be omitted if the Register is satisfied that when installing the ballast,

efficient control is effected to ensure the design values of mass and centre of gravity position, or these values can be properly confirmed by calculation.

1.4.5 In order to determine a need to incline the craft in accorance with 1.4.1.6, the light-weight check shall periodically be carried out (experimental determination of the light craft displacement and the longitudinal centre of gravity). The light-weight check shall be performed at intervals not exceeding five years.

If a change in the light-ship displacement by more than 2 per cent or in longitudinal centre of gravity by more than 1 per cent of the ship's length as compared to the approved Information on Stability is found out as a result of the light-weight check then the craft shall be inclined.

1.4.6 Where the inclining test results for the craft built show that the light-ship vertical centre of gravity exceeds design value to the extent that involves the violation of the requirements of the present Part, calculations with explanation of the reasons of such differences shall be attached to the Inclining Test Report.

On examining the documents submitted, or in case of their absence, the Register may demand the performance of the repeated (check) inclining test of the craft. In this case, both the Inclining Test Records shall be submitted to the Register for consideration.

1.4.7 Except for the craft engaged on international voyages, the Register may, as an shipowner's wish, dispense a newly-built craft from the inclining test provided that the 20 per cent increase of the light craft centre of gravity, as compared with the design value, does not violate the requirements of this Part of the Rules.

1.4.8 Craft's loading during the inclining test shall be as far as practicable close to the light-craft

displacement. The mass of missing loads shall be not more than 2 per cent of the light-ship displacement, and the mass of surplus loads less inclining ballast and ballast according to 1.4.9 – 4 per cent.

1.4.9 The metacentric height of the craft in the process of the inclining test shall be at least 0,20 m.

For this purpose necessary ballast may be taken. When water ballast is taken, the tanks shall be carefully pressed up.

1.4.10 To determine the angles of heel during the inclining test, at least two pendulums of at least 2 m and over long, or at least two Register-approved devices shall be fitted, or a special Register-approved arrangement for use in the inclining test shall be applied.

1.4.11 If the inclining test is accurately carried out, the value of a metacentric height obtained may be used in calculations with no deduction for a probable error of the test.

The inclining test results are acceptable if:

.1 for each measurement the following condition is fulfilled:

$$|h_i - h_k| \le 2\sqrt{\frac{\sum (h_i - h_k)^2}{n-1}} \qquad (1.4.11.1)$$

where h_i = metacentric height obtained in a single measurement;
$h_k = \sum h_i / n$ – metacentric height obtained in inclining the craft;
n = number of measurements.

The measurements, which do not meet the above condition, are ignored in processing the test results with the corresponding correction of the total number n and the repeated calculation of the metacentric height h_k.

No more than one measurement may be ignored (greater number of measurements may be excluded only if justified and agreed with the Register);

.2 probable error of the test

$$t_{\alpha n}\sqrt{\frac{\sum (h_i - h_k)^2}{n(n-1)}}$$

fulfils the condition:

$$t_{\alpha n}\sqrt{\frac{\sum (h_i - h_k)^2}{n(n-1)}} \le 0{,}02\,(1 + h_k) \quad \text{if } h_k \le 2 \text{ m}; \qquad (1.4.11.2\text{-}1)$$

$$t_{\alpha n}\sqrt{\frac{\sum (h_i - h_k)^2}{n(n-1)}} \le 0{,}01\,(4 + h_k) \quad \text{if } h_k > 2 \text{ m}. \qquad (1.4.11.2\text{-}2)$$

Factor $t_{\alpha n}$ is taken from Table 1.4.11.2;

Table 1.4.11.2

Factor $t_{\alpha n}$

n	8	9	10	11	12	13	14	15	16
$t_{\alpha n}$	5,4	5,0	4,8	4,6	4,5	4,3	4,2	4,1	4,0

.3 considering the values of h and l_{max} and the worst loading conditions corresponding thereto, the following condition is met

$$t_{\alpha n}\sqrt{\frac{\sum (h_i - h_k)^2}{n(n-1)}} \cdot \Delta_0/\Delta_1 \le \varepsilon \qquad (1.4.11.3)$$

where $\varepsilon = 0{,}05\,h$ or $0{,}10\,l_{max}$,

whichever is less, but at least 4 cm;

.4 total number of satisfactory measurements is not less than 8.

1.4.12 Where the requirements of 1.4.11 are not met, it is allowed, if agreed with the Register, to use for calculations the value of the metacentric height obtained in the inclining test less the probable error of the test computed according to 1.4.11.2.

1.4.13 The inclining test shall be carried out in compliance with the instructions on the inclining Test (refer to 2.17, Part V “Technical Supervision during Construction of Ships” of the Rules for Technical Supervision during Construction of Ships and Manufacture of Materials and Products for Ships) and shall be witnessed by the Register’s Surveyor.

Other methods of experimental determining the light craft weight and the position of its centre of gravity may also be used, provided that it will be demonstrated to the satisfaction of the Register that the accuracy of the inclining test results meets the present requirements.

1.4.14 The light-weight check of a craft shall be performed in compliance with the Instructions on Light-Weight Check (refer to 2.17, Part V “Technical Supervision During Construction of Ships” of the Rules for Technical Supervision during Construction of Ships and Manufacture of Materials and Products for Ships) and shall be witnessed by the surveyor to the Register. The light-weight check is carried out for determining:

.1 a need to conduct the inclining test in compliance with 1.4.5;

.2 the possibility of applying the values of the light craft displacement and the coordinates of its centre of gravity in stability documents which were obtained:

in the inclining test of the previous series-built craft – for series-built craft constructed at the same shipyard, by the same drawings and not being subject to the inclining test in compliance with 1.4.2.1;

by calculation – for any series-built craft with certain distinctions in the light craft displacement from the previously inclined craft, which do not exceed the values specified in 1.4.2.2, or for the craft in service subjected to modifications and for which the light craft displacement changes may be calculated and do not exceed the values specified in 1.4.3.

In each of the above cases, no corrections of the stability documents are needed if the light craft data resulting the light-weight check differ from those in the stability information by not more than 2 per cent for the light craft displacement and by not more than 1 per cent of the craft’s length between perpendiculars for the longitudinal position of the light craft’s centre of gravity. Otherwise, the craft shall be subject to the inclining test with the follow-up correction of the stability documents.

.3 the parameters of the craft in a light condition not subjected to the inclining test in compliance with 1.4.7.

1.5 DEVIATIONS FROM THE RULES

1.5.1 If doubts arise with regard to stability of any craft when the requirements of the present Part are formally complied with, the Register may require checking of the craft's stability against additional criteria.

In case where the requirements set forth in the present Part are considered to be too severe, the Register may permit, on a well-grounded statement of design and service bodies, appropriate departures from these requirements for the craft concerned.

1.5.2 When a ship navigating in a particular area does not comply with the requirements of the present Part, the Register may, in each particular case, either restrict the craft's area of navigation or place other limitations depending upon the craft's stability characteristics, service conditions and purpose the craft is intended for.

2 STABILITY

2.1 BASIC STABILITY CRITERIA

2.1.1 The requirements on meeting the basic stability criteria apply to all the displacement craft.

2.1.2 Craft's stability is assumed to be adequate if the craft meets the criteria, specified according to its design category and type, in the worst, with regard to stability, loading condition, while navigating within the specified navigational area and following to the place of refuge.

2.1.3 The craft's stability is assessed for the following basic criteria:

Weather criterion considering breaking waves is used to assess the craft's stability under breaking wave conditions. The criterion applies to monohull craft of design categories **A**, **A1**, **A2**, **B** and **C**. A weather criterion below applies to multihulls of those design categories.

Weather criterion is used to assess the craft's stability for navigating in the specified service area. The criterion applies to assessing the stability of all the craft of categories **C1** and **C2**.

Weather criterion on a following wave top is used to assess the monohull craft's stability for design categories **A**, **A1**, **A2** and **B.**

Wind stiffness criterion is used to assess the craft's stability for design categories **C3** and **D.**

Stability criteria specified in 2.1.8 and 2.1.9 to fit craft's specific design categories.

2.1.4 Weather criterion.

The weather criterion is defined by the moment ratio

$$M_{per}/M_w \geq 1{,}0$$

where M_{per} = maximum permissible moment, in kNm, determined according to 2.3.2 considering craft's motions in the seas according to 2.2.2;
M_w = heeling moment, in kNm, due to the wind pressure determined according to 2.2.1.

2.1.5 Weather criterion considering breaking waves.

The weather criterion considering breaking waves is defined by the moment ratio

$$M_{per}/M_w^d \geq 1{,}0$$

where M_{per} = maximum permissible moment, in kNm, specified in 2.1.4 considering craft's motions in the seas according to 2.2.2; however, the design amplitude of rolling for the design category C craft may be determined only according to 2.2.2.2;
M_w^d = dynamic heeling moment, in kNm;
$M_w^d = M_w + M_v$;
M_w = heeling moment, in kNm, due to the wind pressure determined according to 2.2.1;
M_v = heeling moment, in kNm, due to an impact of breaking waves determined according to 2.2.3.

Where this criteria is impracticable to meet, the parameters of a righting lever curve are subject to special consideration by the Register with due regard for the opportunities of righting the craft from a bottom up position as specified in a design.

2.1.6 Weather criterion on a following wave top.

The criterion defines the adequacy of craft's initial stability allowing for the effective waterline area lost:

$$h + \Delta l_{10} > 0 \quad (2.1.6)$$

where h = initial metacentric height, in m;
Δl_{10} = increase of the static stability arm, in m, determined according to 2.2.4.

2.1.7 Wind stiffness criterion.

The wind resistance criterion is defined by the moment ratio

$$M_{per}/M_w \geq K_w \quad (2.1.7)$$

where M_{per} = maximum permissible moment, in kNm, determined according to 2.3.3;
M_w = heeling moment, in kNm, due to the wind pressure determined according to 2.2.1;
K_w = wind stiffness criterion assumed equal to:
1,0 for type A or B craft;
1,15 for type D or C craft;
1,50 for type E craft.

2.1.8 Stability in turning.

2.1.8.1 The stability of a motor craft, which power output of the propulsion engines meets the requirement in 1.2.3.2, Part I "Classification", shall be verified for the effect of a heeling moment acting on the craft during the turning at the worst, regarding stability, loading condition.

An angle of stable heel in turn shall not exceed:

12° or 80 per cent of the value of a downflooding angle; or

the angle at which the freeboard deck immerses; or

the angle at which the bilge emerges at its middle; or

15° considering the joint action of the simulated heeling moment due to the crowding of passengers to one side defined in 2.5 of this Part of the Rules, and the heeling moment in steady turning;

whichever is less.

2.1.8.2 The heeling moment acting on the craft during turning, M_R, in kNm, is computed by the procedure agreed with the Register or is determined by the formula

$$M_R = c\Delta v^2 (z_g - d/2)/L \qquad (2.1.8.2)$$

where L and d = craft's length and draught up to the effective waterline, respectively, in m;
Δ = displacement at the draught up to the effective waterline, in t;
z_g = elevation of craft's centre of gravity above the base line, in m;
v = full speed in calm water on straight course, in m/s;
c = factor determined by maneuverability tests of a prototype craft, but at least 0,2.

2.1.9 Additional criteria.

Depending on the craft's purpose, its structural details and operational conditions, the additional requirements set forth in 2.7 shall be met.

2.2 CALCULATION OF EXTERNAL ACTION PARAMETERS

2.2.1 The heeling moment M_w, in kNm, due to wind pressure on the above-water portion of a craft is determined by the formula

$$M_w = A_{LV}(z_{WC} + a_1 a_2 d_A)\, p_W \cdot 10^{-3} \qquad (2.2.1\text{-}1)$$

where A_{LV} = craft's windage area, in m², to be assumed equal to $A_{LV} = 0{,}55\, L_H B_H$ for the craft of design categories **A**, **A1**, **A2** and **B** if $A_{LV} < 0{,}55\, L_H B_H$;
p_W = design wind pressure, in Pa.
The design wind pressure p_W for all types of craft, in Pa, is determined by the formula

$$p_W = W_{ST} + W_D \qquad (2.2.1\text{-}2)$$

where W_{ST} and W_D = static and dynamic components of wind loading, respectively, to be determined according to 4.3.4 in the General Regulations.
In calculating the static and dynamic components of wind loading, the wind pressure is assumed at the the height equal to the sum of the height of a windage centre above waterline and half the wave height with 3 per cent probability of exceeding a certain level, $h_{3\%}$, in accordamce with the craft's opeational area;
z_{WC} = elevation of the windage centre above the waterline plane, in m;
d_A = draught determined as the doubled distance from a design waterline to the parallel thereto neutral axis of inertia of the area of the craft's centre plane underwater part (A_{CL}), allowed for hull keels excepting centreboards/leeboards and appendages. It is allowed to assume d_A equal to a midlength draught for the craft with a simply-shaped underwater area;
a_1 = factor allowing for the effect of water resistance-to-craft's lateral drift forces on a heeling arm assumed according to Table 2.2.1-1 depending on the ratio B_H/d_A.

Table 2.2.1-1

B_H/d_A	< 2,5	3,0	4,0	5,0	6,0	7,0	8,0	9,0	> 10,0
a_1	0,40	0,41	0,46	0,60	0,81	1,00	1,20	1,28	1,30

a_2 = factor allowing for the effect of inertia forces on a heeling arm z to be determined according to Table 2.2.1-2 depending on the ratio z_g/B_H (z_g = elevation of a centre of mass above the craft's base plane, in m).

Table 2.2.1-2

z_g/B_H	≤ 0,15	0,20	0,25	0,30	0,35	0,40	≥ 0,45
a_2	0,66	0,58	0,46	0,34	0,22	0,10	0

2.2.2 Design roll amplitude θ_r, in deg, is assumed for monohulls as the greatest of the values defined by the requirements in 2.2.2.1 to 2.2.2.3 correspondingly to the craft's type and the characteristics of the navigational area in question, or by other procedures recognized by the Register for small pleasure craft.

For the craft with waterline length above 24 m, on agreement with the Register, design roll amplitude may be determined according to 2.1.5, Part IV "Stability" of the Rules for the Classification and Construction of Sea-Going Ships.

The design roll amplitude for catamarans is determined in compliance with 2.2.2.3 and 2.7.5 of this Part of the Rules. Roll calculations for other multihulls are subject to special consideration by the Register.

The design roll amplitude for sailing craft carrying the sails of a total area over 25 per cent of the standard one is defined by the requirements in 2.2.2.3 only.

2.2.2.1 The design roll amplitude of 3 per cent probability, $\theta_{3\%}$, in rad, is determined by the formula

$$\theta_{3\%} = 2{,}64\,\sqrt{D_\vartheta}. \qquad (2.2.2.1)$$

2.2.2.1.1 The dispersion of heeling angles D_ϑ, in rad², is determined by the formula

$$D_\vartheta = \frac{h_0 - 3\,h_1\,\theta_V^2}{6\,h_1}\sqrt{\left(\frac{h_0 - 3\,h_1\,\theta_V^2}{6\,h_1}\right)^2 - \frac{D_\vartheta^1 (J_x + \mu_{44})}{3\,\Delta h_1}} \qquad (2.2.2.1.1)$$

where h_0 = initial metacentric height, in m;
θ_V = static heeling angle, rad: $\theta_V = M_W/g\Delta h_0$;

M_w = heeling moment, in kNm, due to the design wind pressure determined according to 2.2.1;
Δ = craft's weight displacement at the loading condition in question, in tons;
D^1_ϑ = dispersion of angular velocities of rolling, in rad/s², determined by Formula (2.2.2.1.2);
J_x = moment of inertia of craft's masses about the central longitudinal axis going through the craft's centre of gravity, in kg·m·s²;
μ_{44} = moment of inertia of added water mass about the central longitudinal axis going through the craft's centre of gravity, in kg·m·s²;
h_1 = coefficient computed by the formula
$h_1 = 4\,h_0^3/27\,l_m^2$;
l_m = maximum righting lever, in m.

2.2.2.1.2 The dispersion of angular velocities of rolling D^1_ϑ, in rad/s², is determined by the formula

$$D^1_\vartheta = \left[(G_1 + G_2)/W\right]^{2/3} \qquad (2.2.2.1.2)$$

where G_1 = dimensionless factor of disturbing wave moment intensity to be determined by Formula (2.2.2.1.3);
G_2 = dimensionless factor of disturbing wind moment intensity to be determined by Formula (2.2.2.1.4);
W = roll damping coefficient defined in 2.2.2.1.6.

2.2.2.1.3 The dimensionless factor of disturbing wave moment intensity G_1 is determined by the following formula:

$$G_1 = 0{,}00195\,\frac{\bar{\omega}^4\,\omega_\theta^3\,\chi_\theta^2\,h_{3\%}^2}{(1+\mu_{44}/J_x)^2}\exp\left[-0{,}456\,(\bar{\omega}/\omega_\theta)^4\right] \qquad (2.2.2.1.3)$$

where χ_θ = reduction factor defined in 2.2.2.1.5;
$h_{3\%}$ = wave height with 3 % probability of exceeding level, in m, to be determined depending on the navigational area;
$\bar{\omega} = 2\pi/\bar{\tau}$ – mean wave frequency, in 1/s;
$\bar{\tau}$ = mean wave period in question, in s, determined by Fig. 1 and Table 1 in Appendix 1.

2.2.2.1.4 The dimensionless factor of disturbing wind moment intensity is determined by the formula

$$G_2 = \frac{0{,}3133\,M_w^2}{(J_x + \mu_{44})^2\,\omega_\theta^{5/3}\cdot 10^6} \qquad (2.2.2.1.4)$$

where M_w = heeling moment due to design wind pressure, in kNm, determined according to 2.2.1.

2.2.2.1.5 The reduction factor χ_θ is determined by the formula

$$\chi_\theta = \exp\,(-\,a_k\,\omega_\theta^2) \qquad (2.2.2.1.5\text{-}1)$$

where a_k = parameter to be determined, depending on the vertical prismatic coefficient of the hull C_B, breadth B_H, draught d_H, transverse metacentric radius r, initial metacentric height h, by the formula

$$a_k = 0{,}068\,C_B^2\sqrt{B_H d_H C_H r/h_0}; \qquad (2.2.2.1.5\text{-}2)$$

ω_θ = craft's natural frequency of rolling, in s⁻¹, computed for monohulls by the formula

$$\omega_a = \sqrt{\Delta h_0/(J_x + \mu_{44})}; \qquad (2.2.2.1.5\text{-}3)$$

for catamarans:

$$\omega_\theta = \sqrt{h/i} \qquad (2.2.2.1.5\text{-}4)$$

where i is determined by Formula (2.7.4.3-2).

2.2.2.1.6 The roll damping coefficient W is determined by the following formulae:

.1 for craft with a smooth-lined hull:

$$W_S = \sqrt[8]{g/\omega_a^2 h\cdot\omega'_o} \qquad (2.2.2.1.6.1)$$

where ω'_θ = coefficient to be determined by the nomographic charts in Figs. 5 and 6 of the Appendix;

.2 for craft with a smooth-lined hull fitted with center or bilge keels:

$$W_K = W_S\,\frac{715\cdot\sum(S_k\,l_k^3)}{L_H B_H^4} \qquad (2.2.2.1.6.2)$$

where S_k = area of a bilge or center keel, in m²;
l_k = distance between the craft's centre of gravity and the centre of keel area, in m;
Σ = sum of design values computed for each keel if more than one is fitted, in m⁵;

.3 for craft with hard-chine hull:

$$W_{HC} = \frac{k\cdot L_H B_H^4}{J_X + \mu_{44}} \qquad (2.2.2.1.6.3\text{-}1)$$

or by the approximate formula

$$W_{HC} = \frac{0{,}09\,B_H}{C_B\,d_H} \qquad (2.2.2.1.6.3\text{-}2)$$

where $k = 0{,}003$ – dimension factor, in t m⁻⁴ s²;
C_B = craft's block coefficient;
d_H = craft's draught, in m.

2.2.2.1.7 The craft's mass moment of inertia J_x, in t·m·s², about the longitudinal axis going through the craft's centre of gravity is determined by the craft's mass load if the latter is divided into the large number of small items. If the craft's detailed mass load is unavailable, the moment may be determined by one of the following empirical formulae:

Pavlenko's formula:

$$J_X = \frac{\Delta}{16\,g}\,[B_H^2 + D_H^2]; \qquad (2.2.2.1.7\text{-}1)$$

Shimanskii's formula:

$$J_X = \frac{\Delta}{g}[B_H^2 C_{WA}^2 / 11{,}4\, C_B + D_H^2]; \qquad (2.2.2.1.7\text{-}2)$$

Dwire's formula:

$$J_X = \frac{\Delta}{12g}[B_H^2 + 4z_g^2]; \qquad (2.2.2.1.7\text{-}3)$$

or by assessing:

$$J_X = \frac{\Delta}{g}\rho_{XX}^2 \qquad (2.2.2.1.7\text{-}4)$$

where ρ_{XX} = radius of inertia of the mass about the central longitudinal axis going through the craft's centre of gravity which varies within the range $0{,}35 \le \rho_{XX} / B_H \le 0{,}45$ for craft of various types; in this case, the greater values correspond to hard-chine craft.
C_{WA} = waterplane area coefficient;
C_B = craft's block coefficient.

2.2.2.1.8 The moment of inertia of added water mass μ_{44}, in t·m·s², about the central longitudinal axis going through the craft's centre of gravity is determined by the formula

$$\mu_{44} = 0{,}314 / C_B \cdot (J_X \lambda_0') \qquad (2.2.2.1.8)$$

where C_B = craft's block coefficient;
λ_0' = quantity to be determined by the nomographic charts in Figs. 3-1, 3-2 and 3-3 of the Appendix.

2.2.2.2 Calculation of amplitude of motions for non-sailing craft**.**

2.2.2.2.1 The amplitude of motions, in deg., for a round-bilge craft having no bilge keels and bar keel is determined by the formula

$$\theta_{1r} = X_1 X_2 Y \qquad (2.2.2.2.1)$$

where $X_1 X_2$ = dimensionless coefficients;
Y = multiplier, in deg.

The multiplier Y is taken from Table 2.2.2.2.1-1 depending on the craft's design category and the ratio $\sqrt{h_0}/B_H$.

Table 2.2.2.2.1-1

Values of factor *Y*

Design category	$\sqrt{h_0}/B_H$									
	≤0,04	0,05	0,06	0,07	0,08	0,09	0,10	0,11	0,12	≥0,13
A, **A1** and **A2**	24,0	25,0	27,0	29,0	30,7	32,0	33,4	34,4	35,3	36,0
B, **C**, **C1**, **C2** and **C3**	16,0	17,0	19,7	22,8	25,4	27,6	29,2	30,5	31,4	32,0

Factor X_1 is taken from Table 2.2.2.2.1-2 depending on the ratio B_H/d_H.

Table 2.2.2.2.1-2

Values of factor X_1

B_H/d_H	X_1	B_H/d_H	X_1
≤ 2,4	1,0	3,0	0,90
2,5	0,98	3,1	0,88
2,6	0,96	3,2	0,86
2,7	0,95	3,3	0,84
2,8	0,93	3,4	0,82
2,9	0,91	≥ 3,5	0,80

Factor X_2 is taken from Table 2.2.2.2.1-3 depending on the craft's block coefficient C_B.

Table 2.2.2.2.1-3

Values of factor X_2

C_B	≤ 0,45	0,5	0,55	0,6	0,65	≥ 0,7
X_2	0,75	0,82	0,89	0,95	0,97	1,0

2.2.2.2.2 Where the craft is fitted with bilge keels or a bar keel, or both, the amplitude of motions, in deg, is determined by the formula

$$\theta_{2r} = k\theta_{1r} \qquad (2.2.2.2.2)$$

where coefficient k is taken from Table 2.2.2.2.2 depending on the ratio $A_k / (LB)$ wherein A_k = the total overall area of bilge keels, or the area of the side projection of the bar keel, or the sum of those areas, in m².

Table 2.2.2.2.2

Values for coefficient *k*

A_k/LB, %	0	1,0	1,5	2,0	2,5	3,0	3,5	≥ 4,0
k	1,00	0,98	0,95	0,88	0,79	0,74	0,72	0,70

2.2.2.2.3 The amplitude of motions for a hard-chine craft shall be assumed equal to 70 per cent of the amplitude computed by Formula (2.2.2.2.1).

2.2.2.2.4 The amplitude of motions for the craft fitted with stabilizers shall be determined without their functioning.

2.2.2.2.5 The design values of the amplitude of motions should be rounded off to the whole degrees.

2.2.2.3 The design amplitude of rolling shall be assumed not less than the values given below.

2.2.2.3.1 The design roll amplitude $\theta_{3\%}$, in deg, for the sailing and non-sailing craft of design categories **A**, **A1**, **A2**, **B**, **C**, **C1** and **C2** shall be assumed not less than the one determined by the formula

$$\theta_{3\%} = k\theta_W \qquad (2.2.2.3.1)$$

where θ_W = design angle of waveslope – refer to Table 2.2.2.3.1;
$k_r = f(\bar{\tau}_0, \omega_0)$ – coefficient allowing for the probability of the resonance of oscillations, while running beam to sea, is taken from Table 2.2.2.3.1;
$\bar{\omega} = 2\pi/\bar{\tau}$ – mean wave frequency, in s⁻¹;
ω_0 = craft's natural frequency of rolling, in s⁻¹, computed by Formula (2.2.2.1.5-3) or (2.2.2.1.5-4);

$\bar{\tau}$ = mean period of wave in question, in s, to be determined by the diagram in Fig. 1, Appendix 1.

In calculations of the conditions when sails of the total area over 25 per cent of the maximum one are carried, the resonance condition for sailing craft is ignored and the amplitude of motions is assumed equal to the angle of waveslope θ_W.

Table 2.2.2.3.1

Values for coefficient *k*

<table>
<tr><th rowspan="2">Design category</th><th rowspan="2">θ_W in deg.</th><th colspan="8">Frequency ratio: $\omega_0/\bar{\omega} = \bar{\tau}\omega_0/2\pi$</th></tr>
<tr><th>$\le 0,5$</th><th>0,75</th><th>0,87</th><th>1,0</th><th>1,25</th><th>1,5</th><th>2,0</th><th>$\ge 2,5$</th></tr>
<tr><td>A, A1 or A2</td><td>25</td><td rowspan="3">1,0</td><td rowspan="3">1,4</td><td rowspan="3">1,8</td><td rowspan="3">2,0</td><td rowspan="3">1,8</td><td rowspan="3">1,5</td><td rowspan="3">1,2</td><td rowspan="3">1,1</td></tr>
<tr><td>B</td><td>20</td></tr>
<tr><td>C, C1 and C2</td><td>15</td></tr>
</table>

2.2.2.3.2 The assumed roll angle for non-sailing craft of 6,0 m long and over according to ISO 12217-1:2002 shall be assumed at least:

for design categories **A**, **A1** or **A2**:

$$\theta_{3\%} = 25 + 20/V_D; \qquad (2.2.2.3.2\text{-}1)$$

for design category **B**:

$$\theta_{3\%} = 20 + 20/V_D \qquad (2.2.2.3.2\text{-}2)$$

where V_D = craft's volume displacement, in m^3.

2.2.3 The dynamic heeling moment due to breaking wave impact, in kNm, features the kinetic energy acquired by the craft after the wave impact and is determined by the formula

$$M_v = \frac{1{,}3\,[A_v p_{обр}\,(z_{цv} + a_1 a_2 d_A)\,t_{обр}]^2}{J_X + \mu_{44}} \cdot 10^{-3} \qquad (2.2.3)$$

where A_v = maximum area, in m^2, of the projection onto the centre plane of the profile area of the craft's hull, superstructures and deckhouses impacted by the breaking part of the wave throughout a height h_{br} and along a length L_{br} given in Table 1, Appendix 1;

p_{br} = design pressure, in kPa, of the largest breaking wave given in Table 1, Appendix 1;

t_{br} = action time, in s, of the largest breaking wave given in Table 1, Appendix 1;

z_{cv} = elevation of the centre of area A_v above the effective waterline plane, in m;

d_A = mean draught, in m, as the doubled distance from a design waterline to the parallel thereto neutral axis of inertia of the area of the craft's centre plane underwater part (A_{CL}), allowed for hull keels excepting centreboards/leeboards and appendages. It is allowed to assume d_A equal to a midlength draught for the craft with a simply-shaped underwater area;

a_1 and a_2 = coefficients – refer to Tables 2.2.1-1 and 2.2.1-2;

J_x, μ_{44} = mass moments of inertia, in t·m·s^2, refer to 2.2.2.1.7 and 2.2.2.1.8.

2.2.4 The increase of a static stability arm Δl_{10}, in m, is determined by the formula

$$\Delta l_{10} = B_H\left(\sum_{m=1}^{14} A_m f_m - 0{,}01\right) \qquad (2.2.4\text{-}1)$$

where $A_1 = L_H/B_H - 4{,}82$; $A_2 = B_H/d_H - 2{,}67$; $A_3 = D_H/d_H - 1{,}30$; $A_4 = \chi - 0{,}70$; $A_5 = \delta - 0{,}692$; $A_6 = Fr - 0{,}28$; $A_7 = A_1^2$; $A_8 = A_2^2$; $A_9 = A_3^2$; $A_{10} = A_5^2$; $A_{11} = A_6^2$; $A_{12} = A_2 \times A_3$; $A_{13} = A_2 \times A_4$; $A_{14} = A_1 \times A_6$;
$f_1 = -0{,}0020$; $f_2 = -0{,}0035$; $f_3 = 0{,}0170$; $f_4 = 0{,}0040$; $f_5 = 0{,}0192$; $f_6 = 0{,}0260$ at $Fr < 0{,}28$ and $f_6 = -0{,}0274$ at $Fr > 0{,}28$; $f_7 = 0{,}0005$ and is taken into account only at $L_H/B_H < 4{,}82$; $f_8 = -0{,}00080$; $f_9 = 0{,}010$; $f_{10} = -0{,}0040$; $f_{11} = 0{,}0183$; $f_{12} = -0{,}0050$; $f_{13} = -0{,}0244$; $f_{14} = -0{,}0044$;
C_p = vertical prismatic coefficient;
C_L = lateral area coefficient.

If the calculated value $\Delta l_{10} > 0$, then $\Delta l_{10} = 0$ shall be assumed.

For design wave length λ, which differs from the craft length and is within the range $\lambda/L = 0{,}5 \div 2{,}5$, the obtained values Δl_{10} are multiplied by the parameter $F(\lambda/L)$ determined by the formula

$$F(\lambda/L) = 1 + (\lambda/L - 1)(0{,}87 - 1{,}2\,(\lambda/L - 1) + 0{,}21\,(\lambda/L - 1)^2). \qquad (2.2.4\text{-}2)$$

A wave length is determined by the following formulae:

$\lambda = 1{,}56\bar{\tau}^2$ (for relative depth of waters $H/\lambda > 0{,}5$); (2.2.4-3)

$\lambda = 1{,}56\,\bar{\tau}^2\, th\,(2\,\pi\, H/\lambda)$ (for relative depth of waters $H/\lambda \le 0{,}5$). (2.2.4-4)

Froude number Fr is determined with consideration of the speed limit when the craft is underway according to 1.3.9.3.

2.3 MAXIMUM ALLOWABLE HEELING MOMENT

2.3.1 The maximum allowable heeling moment M_{per} is determined from a righting lever curve with use of one of the stated methods depending on the criterion used for assessing the craft's stability.

As the maximum permissible angle of heel θ_f due to the heeling moment, the least among the listed below is assumed:

for sailing craft: a downflooding angle θ_D and an angle of vanishing stability θ_V;

for non-sailing craft: a downflooding angle θ_D, an angle of vanishing stability θ_V and 50°.

2.3.2 In order to assess the weather criterion and the weather criterion considering breaking waves, M_{per} is determined from the righting lever curve allowing for the maximum permissible angle of heel θ_f and the roll amplitude θ_r.

The maximum allowable heeling moment M_{per} is determined by plotting (Fig. 2.3.1) reasoning from the equality of areas ($S_2 = S_1$) on the righting lever curve.

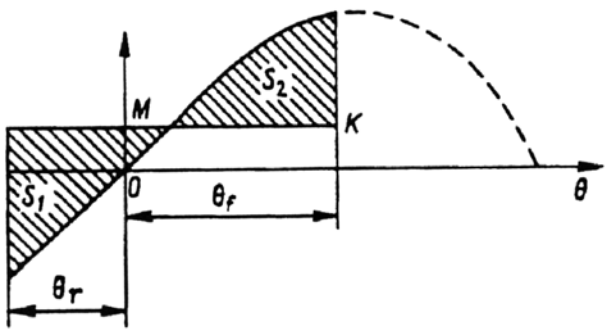


Fig. 2.3.1
Determination of maximum permissible moment M_{per}

The moment M_{per} value, in kNm, corresponds to the craft's displacement Δ, in kN, multiplied by the righting lever l_g, in m, being a segment OM on the righting lever curve.

2.3.3 In order to assess the wind stiffness criterion, the maximum permissible heeling moment M_{per}, in kNm, is determined from the righting lever curve allowing for the maximum permissible angle of heel θ_f:

$$M_{per} = \Delta\, l_{\max}$$

where $l_{\max}$ = maximum righting lever, in m, measured either at the maximum of the righting lever curve or at the angle θ_f, whichever is less.

2.4 RIGHTING LEVER CURVE

2.4.1 The righting lever curve of monohulls shall meet the following requirements:

2.4.1.1 The maximum righting lever $l_{\max}$ shall not be less than 0,25 m at a heeling angle of $\theta_m \geq 30°$.

The angle corresponding to the maximum of the righting lever curve may be reduced down to 25° by agreement with the Register.

Given two maxima of the righting lever curve due to the effect of superstructures or deckhouses, the first one from the upright position shall correspond to the heel of at least 25°.

The positive static stability (an angle of vanishing stability) shall terminate at an angle of no less than 60° for the craft of design categories **A**, **A1**, **A2** and **B**.

The area under the righting lever curve shall not be less than 0,055 m·rad up to the heeling angle of 30° and at least 0,09 m·rad up to the heeling angle of 40°. The area between the heeling angles of 30° and 40° shall not be less than 0,03 m·rad.

2.4.1.2 The craft shall meet the requirements listed in this Chapter allowing for corrections for the free surface effect according to 1.3.9 when plotting righting lever curves.

2.4.1.3 If there are openings considered to be open, through which water can penetrate inside the hull, the stability curves are considered effective up to the angle of flooding. The craft, which do not meet the requirements of this Chapter for an angle of vanishing stability due to the curve terminating at a downflooding angle, may be allowed to operate as the craft of design categories **C, C1** or **C2** depending on the wind pressure the craft withstands being verified for the weather criterion. Nevertheless, it is essential therewith that a conditional angle of vanishing stability, determined under the assumption that the closing appliances of openings associated with downflooding are weathertight, not be less than the one required in this Chapter.

2.4.1.4 The craft having a ratio $B/D > 2$ are allowed to operate at the reduced angle of vanishing stability and at the angle corresponding to the maximum righting lever as compared with those required in 2.4.1:

.1 for the angle of vanishing stability: by a value $\Delta\theta_V$ determined by the formula

$$\Delta\theta_V = 40° (B/D - 2) \cdot (K - 1), \qquad (2.4.1.4.1)$$

depending on the ratio B/D and the stability criterion K required by 2.1.4 or 2.1.5, or 2.1.7.

Where $B/D > 5$ and $K > 1{,}5$, to be assumed are $B/D = 2{,}5$ and $K = 1{,}5$.

The value of $\Delta\theta_V$ shall be rounded off to the nearest integer;

.2 for the angle corresponding to the maximum righting lever: by a value equal to half the decrease of the angle of vanishing stability.

2.4.1.5 The angle of vanishing stability for the craft considered as sailing craft shall be not less than:

.1 for the craft of design categories **A**, **A1** and **A2** having a displacement $\Delta_{\max} > 3000$ kg: $\theta_V = (130 - 0{,}002\,\Delta_{\max})$, in deg., but at least 100°;

.2 for the craft of design category **B** having a displacement $\Delta_{\max} > 1500$ kg: $\theta_V = (130 - 0{,}005\,\Delta_{\max})$, in deg., but at least 95°;

.3 for the craft of design categories **C**, **C1** or **C2** irrespective of a displacement: $\theta_V \geq 90°$;

.4 for the craft of design categories **C3** or **D** irrespective of a displacement: $\theta_V \geq 75°$;

.5 where the hull structure includes flotation elements of the total volume of not less than $\Delta_{\max} / 850$, in m^3, the angle of vanishing stability may be:

$\theta_V \geq 95°$ for the craft of design categories **A, A1** and **A2**;

$\theta_V \geq 75°$ for the craft of design categories **C**, **C1** or **C2.**

2.4.1.6 The following requirements shall be met for the craft considered as non-sailing craft:

.1 maximum righting moment M_{30}, in kNm, at a heeling angle of $\theta_m \geq 30°$ shall be:

$M_{30} \geq 25$ for the craft of design categories **A**, **A1** and **A2**;

$M_{30} \geq 7$ for the craft of design category **B**.

In this case, the righting lever at the heeling angle of 30° shall be $l_{30} \geq 0{,}2$ m for all the craft.

.2 maximum righting moment M_{30}, in kNm, at the heeling angle of $\theta_m \le 30°$ shall be:

$M_{30} \ge 750/\theta_m$ for the craft of design categories **A**, **A1** and **A2**;

$M_{30} \ge 210/\theta_m$ for the craft of design category **B**.

2.5 METACENTRIC HEIGHT

2.5.1 The corrected initial transverse metacentric height h of all craft at all the loading conditions, excepting the "light craft", shall not be less than 0,5 m.

The initial transverse metacentric height h of the motor craft having a length $L_H \ge 6$ m at the loading condition corresponding to the minimum operational load, but with no crew on board, shall be not less than 0,5 m.

2.5.2 The initial transverse metacentric height h of fully-loaded non-sailing craft at the worst, regarding stability, crew accommodation shall be not less than a value of $h_{(R)}$ to be determined by the formula

$$h_{(R)} = M_C / [\Delta g \sin \theta_{0(R)}] \qquad (2.5.2)$$

where M_C = heeling moment due to the people displacement to the side, in kNm;

$\theta_{0(R)}$ = permissible heeling angle of the craft at the people displacement to one side, in deg., to be determined according to 2.5.2.2;

Δ = craft's mass in the corresponding loading condition, in t;

g = gravitational acceleration, 9,81 m/s^2.

2.5.2.1 Heeling moment M_C, in kNm, is determined according to the design scheme of people crowding to one side which corresponds to the most hazardous potential accommodation under the normal conditions of the craft's operation.

Crowding of people to one side is assumed in the areas which are free from any equipment and arrangements considering the restricted admittance of passengers to one or another part of a deck.

The areas under consideration shall include the areas of cockpits and decks whereon may be accommodated people, while the craft is underway, including the areas whereon people may stand, sit, walk or lie.

The areas under consideration shall also include the areas used in steering the craft, for access to compartments, for recreation and setting sails.

The areas under consideration do not comprise: windscreens, a wheelhouse roof unless the presence of people is provided thereon, deck sections inclined over 15° to the horizon and deck sections of under 100 mm wide.

It is acceptable for the craft of a length $L_H \le 4,8$ m to ignore standing people in calculations if such situation is not specified under the craft's operarional conditions.

In calculating the heeling moment, the density of people accommodation is assumed:

in the craft engaged on voyages extended over 24 hours: 4 persons per 1 m^2 of free area;

in the craft engaged on voyages extended under 24 hours: 6 persons per 1 m^2 of free deck area.

The areas of passageways on open decks located near the bulwark or guard rail are assumed with a factor of 0,75 at a width of 0,7 m to 1,0 m and with a factor of 0,5 at a width of 0,7 m and less.

The areas of passageways beween settees (benches, armchairs), where passengers may crowd in addition to those occupying their seats, are assumed with a factor of 0,5.

The mass of a person is assumed equal to 75 kg and a centre of gravity for a standing person is assumed at a height of 1,1 m above the deck, for a sitting one, at a height of 0,3 m above the seat.

2.5.2.2 For the craft having a length of 24 m and less, the permissible heeling angle $\theta_{0(R)}$ of the craft, in deg, with the potential and actual displacement of people to one side at the most unfavourable loading condition is determined by the formula

$$\theta_{0(R)} = 10 + (24 - L_H)^3 / 600. \qquad (2.5.2.2)$$

For the craft with length above 24 m $\theta_{0(R)} = 10$.

2.6 REQUIREMENTS FOR DOWNFLOODING ANGLES

2.6.1 The heeling angle for the craft of a length $L_H \ge 6$ m, which results in craft's flooding overside, across the coaming or through sea openings with their total area over $50 L_H^2$, in mm^2, shall not be less than the values given in Table 2.6.1.

Table 2.6.1

Requirements for downflooding angles of craft having $L_H \ge 6$ m

Design category	Downflooding angle θ_D (determined as the greatest of values)	
Non-sailing craft (refer to 2.6.2)		
A, **A1** and **A2**	$\theta_0 + 25°$	40°
B	$\theta_0 + 15°$	
C, **C1**, **C2** and **C3**	$\theta_0 + 5°$	
D	θ_0	–
Sailing craft (refer to 2.6.3)		
A, **A1**, **A2** and **B**	40°	–
C, **C1**, **C2** and **C3**	35°	–
D	30°	–
Note. $\theta_0 = \theta_{0(R)}$, being determined as per 2.5.2.2.		

2.6.2 Alternatively, the freeboard criterion for an inclined position with the people displacement as per 2.5 may be used instead of the downflooding angle criterion for the non-sailing craft of a length $L_H \ge 6$ m. The freeboard in the inclined position being determined as a vertical distance from the water surface to the lower edge of the craft's side, coaming/openings across/through which water may penetrate the craft shall be not less than the values given in Table 2.6.4.

Table 2.6.4

Minimum freeboard of inclined craft

Design category	$L_H \geq 6$ m	$L_H < 6$ m		
		Craft of type *C* and *E*		Craft of type *A*, *B* and *D*
	Craft of all types	Craft of which buoyancy ensured with flotation elements only	Other craft	
C, **C1**, **C2** and **C3**	$0{,}11\sqrt{L_H}$, in m	150 mm	–	100 mm
D	$0{,}07\sqrt{L_H}$, in m	10 mm	250 mm	10 mm

2.6.3 The requirements of Table 2.6.1 are not mandatory for the sailing craft of design categories **C**, **C1**, **C2**, **C3** or **D** of which buoyancy is ensured with flotation elements only or which may be righted from a capsized position by the actions of the crew.

2.6.4 For the sailing craft of a length $L_H < 6$ m, to be normalized is the freeboard in the inclined position with the people displacement as per 2.6 instead of the downflooding angle. The freeboard values of the inclined craft shall be not less than those in Table 2.6.4.

2.6.5 The termination of a righting lever curve at the downflooding angle as per 2.4.3 with heeling angles below 40° is not allowed.

2.7 ADDITIONAL REQUIREMENTS FOR STABILITY

2.7.1 Pleasure craft.

2.7.1.1 The stability of pleasure craft shall meet the requirements of 2.1.

The stability for compliance with the requirements of 2.7.1.3 and 2.7.1.4 shall also be verified for the loading conditions specified in 2.7.1.2.1 and 2.7.1.2.2.

2.7.1.2 The stability of pleasure craft for the criteria given in 2.1.4 to 2.1.7 shall be verified at the craft's following loading conditions:

.1 fully loaded – with full load, crew, luggage and full stores;

.2 minimal operational loading.

The Register may also demand verifying the craft's stabilty at the partial number of passengers if such loading condition is supposedly less favourable than the above listed.

Verifying the craft's stabilty for basic criteria, all passengers are assumed to be at their standard places, the load is stowed in compliance with the normal operational conditions of the given craft and the crew is at their work stations in steering the craft.

2.7.1.3 The stability of pleasure craft for the loading conditions specified in 2.7.1.2.1 and 2.7.1.2.2 shall be verified in case of the joint action of heeling moments due to wind pressure onto a weather side and the maximum potential crowding of people at a lee-side.

The heeling angle of the craft at the feasible displacement of people to one side is determined for the accommodation of standing people assuming 6 persons per 1 m^2 of open deck with a mass of one person equal to 75 kg.

2.7.1.4 The stability of pleasure craft for the loading conditions specified in 2.7.1.2.1 and 2.7.1.2.2 shall be verified in case of the joint action of the maximum potential crowding of people at one side and the heeling moment being determined according to 2.7.1.5 which arises in the evolutionary period of turning.

2.7.1.5 In verifying stability for compliance with the requirements of 2.7.1.3 and 2.7.1.4, the permissible heeling angle of craft $\theta_{0(R)}$, in deg, at the feasible displacement of people to one side at the most unvafourable loading condition of the craft shall not exceed that specified in 2.5.2.2.

2.7.2 Water bowers.

2.7.2.1 In verifying the water bower's stabilty at the crowding of passengers to one side according to 2.7.1.3, the bower's deck shall not immerse. Where a heeling angle is limited with a downflooding angle, the permissible angle of heel shall be assumed equal to not greater than 0,8 the downflooding angle. In all cases, the heeling angle due to the crowding of passengers shall not exceed 12°.

2.7.2.2 The righting lever l_M at the angle of the θ_M maximum shall be not less than $6/\theta_M$ and 0,2 m.

2.7.2.3 Verifying the berth-connected craft's stabilty, it is recommended to also consider actual wind loads for the berth areas specified which are to be assumed relying on the data of local hydrometeorological stations.

2.7.3 Multihull craft.

2.7.3.1 In verifying the multihull craft's stabilty at the crowding of passengers to one side under conditions of 2.7.1.3 to 2.7.1.4, the deck of any craft's hull shall not immerse. In this case, the bilge of any catamaran's hull shall not come out of water, and as for a trimaran, only one hull may rise off the water.

The righting lever l_M at the angle of the θ_M maximum shall be not less than $6/\theta_M$ and at least 0,25 m.

2.7.4 Catamarans.

2.7.4.1 These requirements apply to the catamarans of design categories **C, C1, C2** and **C3** provided that the catamaran's maximum permissible angle of heel at a coextensive inclination does not exceed the angle when the waterline plane touches the bilge of the hull, which comes out of water, at the midlength section.

2.7.4.2 A heeling lever, in m, for catamarans at the dynamic wind action on the craft is determined by the formula

$$z = z_W - 0{,}5\,d \qquad (2.7.4.2)$$

where z_W = elevation of the windage centre above the craft's base plane, in m;
d = mean draught at the effective waterline, in m.

2.7.4.3 The design roll amplitude, in deg, for the corresponding class catamarans shall be assumed according to Table 2.7.4.3 depending on the values of qB and $V/2L$ (B, L and V = breadth, length and displacement volume of the catamaran, respectively), a multiplier q, in s^{-2}, therewith, should be determined by the formula

$$q = (z_m - z_g)/i \qquad (2.7.4.3\text{-}1)$$

where z_m = ordinate of a transverse metacentre, in m;
z_g = ordinate of the catamaran's centre of gravity, in m;
i = relative moment of inertia of mass including for the added mass of liquid, m·s^2;

$$i = z_g^2\,[5{,}79\,B_k^2/z_g^2\,(\bar{c} + 0{,}61)^2 + 1]/3g \qquad (2.7.4.3\text{-}2)$$

where $\bar{c} = C/2B_k$ – relative horizontal clearanceof the catamaran's hulls;
C = distance between the inner sides of hulls at the midsection at the level of the effective waterline, in m;
B_k = breadth of the catamaran's hull at the midsection at the level of the effective waterline, in m;
g = gravitational acceleration, in m/s^2.
A value of z_m shall be determined according to 2.7.4.4.

Table 2.7.4.3

Design category	Argument qB, in ms^{-2}	Design roll amplitude θ_m, in deg, at values of $V/2L$, in m^2									
		<1,0	2,0	3,0	4,0	5,0	6,0	7,0	8,0	9,0	>10
C and **C1**	<10	11,3	9,9	8,3	6,8	6,0	5,7	5,5	5,3	5,2	5,1
	20	12,0	10,5	8,9	7,4	6,6	6,2	6,0	5,9	5,7	5,6
	30	13,2	11,9	10,3	8,7	7,8	7,5	7,3	7,1	7,0	6,
	40	14,8	13,9	12,3	10,6	9,6	9,3	9,1	9,0	8,8	8,7
	>50	16,5	15,5	13,9	12,2	11,3	10,8	10,6	10,5	10,3	10,2
C2 and **C3**	<10	6,6	5,7	4,5	3,7	3,1	2,7	2,5	2,4	2,3	2,2
	20	7,5	6,5	5,3	4,3	3,6	3,2	2,9	2,7	2,6	2,5
	30	8,9	8,2	6,8	5,7	4,8	4,2	3,7	3,5	3,4	3,3
	40	10,7	10,0	8,6	7,2	6,1	5,3	4,7	4,4	4,2	4,1
	>50	12,4	11,1	9,6	8,1	6,9	5,9	5,3	5,0	4,8	4,7

2.7.4.4 The ordinate of the catamaran's transverse metacentre is determined by the formula

$$z_m = \alpha B_k b\,[\alpha/11{,}4 + (\bar{c} + 0{,}5)^2 + \delta/b^2(\alpha + \delta)]/\delta \qquad (2.7.4.4)$$

where α = effective waterline area coefficient for the catamaran's hull;
b = ratio of the hull breadth B_k to the draught d of the catamaran;
δ = block coefficient of the catamaran's hulls.

2.7.4.5 The dynamic heeling moment, in kNm, applied to the catamaran in the evolutionary period of turning is determined by the formula

$$M_R = 0{,}03\,v_0^2\,\Delta(z_g - 0{,}5\,d)/L \qquad (2.7.4.5)$$

where v_0^2 = catamaran's speed before the turning assumed equal to the full speed on a straight course, in m/s;
Δ = catamaran's weight at the draught at the effective waterline, in t;
z_g = elevation of the catamaran's centre of gravity above the base plane, in m;
L and d = catamaran's length and mean draught at the effective waterline, respectively, in m.

2.7.5 Dynamically supported craft.

These requirements apply to powered planing and semiplaning craft moving in the $Fr > 1$ mode.

2.7.5.1 The stability of dynamically supported craft is determined by an experiment-calculated approach.

Calculations, the results of testing the similar prototype craft or such their combination, which is reasonable for the specific craft, may be used to prove that the requirements providing for the performance of experimental investigations are met. Such evidence shall be agreed with the Register.

2.7.5.2 Specified craft in a displacement mode shall meet the general requirements of 2.1 for the powered craft for the corresponding purpose.

2.7.5.3 The stability of dynamically supported craft shall be checked under all loading conditions specified in 1.3.7.1 and 2.7.1.2 in two modes:

.1 in displacement mode;

.2 under operational conditions.

Stability characteristics shall finally be refined for the displacement mode according to an inclining test, and under the operational conditions, relying on the data of full-scale trials at the most unfavourable operational conditions being carried out in the course of the craft's acceptance trials. The test programmme, report, as well as the Information on Stability compiled on the basis of calculations and experiments are subject to special consideration by the Register.

Note. The experimental verification of stability in the full-size craft is allowed to carry out only for the worst, regarding stability, loading condition which shall be revealed according to the results of calculations or model tests.

The values of the maximum permissible angles of heel shall be refined with the use of the experimental heeling angle dependence of a heeling moment, craft's speed and an angle of rudder.

2.7.5.4 The Information on Stability shall contain the recommendations on reducing speed in turning and in the seas.

2.7.6 Fast displacement craft.

2.7.6.1 The stability of fast displacement craft ($0{,}5 \le Fr_\Delta \le 1{,}5$) shall be verified in testing the type craft.

The verification of stability shall be carried out in turning in calm water with the sequential stepwise increase of an angle of rudder, including giving full rudder opposite to the crowd of passengers and with the sequential stepwise increase of the engines speed up to the greatest one.

2.7.6.2 In testing the pleasure craft, the specially taken in and secured solid ballast shall be used to ensure the corresponding displacement, position of centre of gravity and initial heeling angle due to passengers crowding to one side.

2.7.6.3 In testing, it should be entered in a report:

displacement;

forward and aft draught;

engine speed and craft's corresponding speed;

depth of water area;
weather conditions;
initial heeling angles;
heeling angles for each test mode;
angles of rudder;
level of water surface at the craft's side in heeling.

2.7.6.4 The heeling angles obtained in testing shall be compared with the corresponding permissible angles of heel considering the additional requirements for the various types of craft.

2.7.6.5 The pertinent restrictions on the combination of the main engine speed and the angles of rudder obtained in tests should be entered in the Information on Stability.

2.7.6.6 The test programme, the report, as well as the Information on Stability of the craft compiled on the basis of calculations and tests shall be approved by the Register.

2.7.9 Sailing craft.

2.7.9.1 General requirements for stability.

The stability of sailing craft shall be determined for all the options of the sails carried, as specified according to 5.7, Part III " Equipment, Arrangements and Outfit" of these Rules, and shall meet the requirements of 2.1.

2.7.9.2 Wind stiffness of sailing craft of design categories **C3** and **D**.

The wind stiffness test of the craft is carried out according to the method given in ISO 12217-2:2002 for the craft of a length $L_H \geq 6$ m to be constructed for compliance with the requirements of EC Directive No.94/25/EC.

2.7.9.2.1 The test is carried out with the craft in the light condition with the added weight of 75 kg placed at the centreline within reach of the helm. Sails shall be stowed ready for hoisting. Centreboards and sliding keels shall be raised unless they can be purposely fixed in the lowered position while underway.

2.7.9.2.2 The calculated wind velocity v_C needed to produce a heeling angle $\theta_T = 45°$ is determined by the formula

$$v_C = \sqrt{\frac{13\,M_T + 390\,B_H}{A_s\,(h_{CE} + h_{LP})\,(\cos\theta_T)^{1,3}}} \qquad (2.7.9.2.2)$$

where A'_S = the actual profile projected area of the standard sail plan, in m^2;
h_{CE} = height of the geometrical centre of A'_S above the waterline, in m;
h_{LP} = height of the waterline above the geometrical centre of lateral profile area of the immersed hull and keel/centerboard and rudder, when upright, in m.
In calculations, if a downflooding angle $\theta_D < 45°$, it is assumed $\theta_T = \theta_D$.

2.7.9.2.3 The craft is considered fully complying with the wind resistance criterion if the calculated value of v_C is not less than $v_{C(R)}$ given in Table 2.7.9.2.

2.7.9.2.4 If the calculated wind velocity is less than required according to Table 2.7.9.2, the craft may be permitted to operate on condition that the requirements on reducing the sail area A'_S will be entered in the Information on Stability.

Table 2.7.9.2

Required wind velocity $v_{C(R)}$, in m/s

Design category	C3	D
Craft other than those below	13	8
Craft of which buoyancy is ensured with flotation elements only	11	6

2.7.9.3 Stability of sailing multihull craft.

2.7.9.3.1 The stability of the sailing multihull craft is verified according to the method given in ISO 12217-2:2002 for the craft to be constructed for compliance with the requirements of EC Directive No.94/25/EC.

2.7.9.3.1.1 If the multihull craft's length $L_H > 5\,B_{CB}$, the craft shall meet the requirements for monohulls.

2.7.9.3.1.2 The size factor F of the multihull craft having length $L_H \geq 6$ m is determined by the formula

$$F = 1{,}75\,m_{MOC}\,\sqrt{L_H B_H}. \qquad (2.7.9.3.1.2)$$

2.7.9.3.1.3 To provide protection against being inverted by breaking waves, the multihull size factor shall exceed the required values given in Table 2.7.9.3.1.3.

Table 2.7.9.3.1.3

Required multihull size factor for craft having $L_H \geq 6$

Design category by EC Directive No. 94/25/EC	Required multihull size factor		
	$L/B < 2{,}2$	$2{,}2 \leq L/B \leq 3{,}2$	$L/B > 3{,}2$
A	$193600/(L/B)^2$	40000	$313600/(6 - L/B)^2$
B	$72600/(L/B)^2$	15000	$117600/(6 - L/B)^2$
C	Not applicable		

Note. For catamarans: $L/B = L_H/B_{CB}$; for trimarans: $L/B = 2\,L_H/B_{CB}$.

2.7.9.3.1.4 Alternatively, where the capsized craft may be returned to the upright position by the actions of the crew, the requirements in 2.7.9.3.1.2 and 2.7.9.3.1.3 do not apply.

2.7.9.3.1.5 The recommendations on carrying sails, the data on hazardous heeling angles and the ways to be used to recover the capsized multihull shall be provided in the Information on Stability.

2.7.9.3.1.6 Where inhabited spaces are available inside the hulls, catamarans shall be provided with hatches for access into the hulls and for coming out in case of capsizing. The requirements cover the craft constructed in 2001 and later on.

The hatch of a capsized catamaran shall raise above the water surface.

2.7.9.4 Stability index.

2.7.9.4.1 The verification of the sailing craft for the stability index is carried out according to the method given in ISO 12217-2:2002 for the craft to be constructed for compliance with the requirements of EC Directive No. 94/25/EC and with giving the design category to the craft in compliance with that Directive and ISO standards.

2.7.9.4.1.1 The stability index ***STIX*** shall be not less than the values given in Table 2.7.9.4.1.1 depending on the navigational area.

Table 2.7.9.4.1.1

Requirements for index *STIX*

Design category according to ISO 12217	A	B	C	D
STIX ≥	32	23	14	5

The index ***STIX*** is used for the overall assessment of dependability of the sailing monohull craft having a length of $L_H \geq 6$ m.

If factors ***FDS***, ***FIR***, ***FKR***, etc., which make up the index ***STIX*** and are obtained by calculations, fall outside of the permissible limits, their values shall be taken equal to the top and bottom limits of the given factor respectively.

The index is determined by the formula

$$STIX = (7 + 2{,}25\,L_{BS})\,(FDS \times FIR \times FKR \times FDL \times FBD \times \times FWM \times FDF)^{0{,}5} + \delta \qquad (2.7.9.4.1.1)$$

where $\delta = 5$ if the craft has flotation elements and also has $l_{90} > 0°$ when the craft is fully flooded with water. Otherwise, $\delta = 0$ is assumed.

2.7.9.4.1.2 The dynamic stability factor ***FDS*** with the limiting values of $0{,}5 \leq$ ***FDS*** $\leq 1{,}5$ is determined by the formula

$$FDS = \frac{A_{GZ}}{15{,}81\sqrt{L_H}} \qquad (2.7.9.4.1.2)$$

where A_l = positive area under the righting lever curve, in m·deg.

2.7.9.4.1.3 The inversion recovery factor ***FIR*** with the limiting values of $0{,}4 \leq$ ***FIR*** $\leq 1{,}5$ is determined by the formula

$$FIR = \theta_V/(125 - m/1600) \quad \text{if } m < 40000 \text{ kg}; \qquad (2.7.9.4.1.3\text{-}1)$$

$$FIR = \theta_V/100 \quad \text{if } m \geq 40000 \text{ kg} \qquad (2.7.9.4.1.3\text{-}2)$$

where m = mass of the craft in the appropriate loading condition, in kg.

2.7.9.4.1.4 The knockdown recovery factor ***FKR*** with the limiting values of $0{,}5 \leq$ ***FKR*** $\leq 1{,}5$ is determined by the formula:

$$FKR = 0{,}875 + 0{,}0833\,F_R \quad \text{if } F_R \geq 1{,}5; \qquad (2.7.9.4.1.4\text{-}1)$$

$$FKR = 0{,}5 + 0{,}333\,F_R \quad \text{if } F_R < 1{,}5; \qquad (2.7.9.4.1.4\text{-}2)$$

$$FKR = 0{,}5 \quad \text{if } \theta_V < 90°, \qquad (2.7.9.4.1.4\text{-}3)$$

where $F_R = l_{90}\,m/2A'_S h_{CE}$; (2.7.9.4.1.4-4)

l_{90} = righting lever at $\theta = 90°$, in m;

h_{sc} = height of the craft's windage centre above the waterline, in m.

2.7.9.4.1.5 The displacement-length factor ***FDL*** with the limiting values of $0{,}75 \leq$ ***FDL*** $\leq 1{,}25$ is determined by the formula

$$FDL = \sqrt{0{,}6 + 15\,m\,F_L/L_{BS}^3(333 - 8\,L_{BS})} \qquad (2.7.9.4.1.5)$$

where $L_{BS} = (2\,L_{WL} + L_H)/3$, inm; $F_L = (L_{BS}/11)^{0{,}2}$.

2.7.9.4.1.6 The beam-displacement factor ***FBD*** with the limiting values of $0{,}75 \leq$ ***FBD*** $\leq 1{,}25$ is determined by the formula

$$FBD = \sqrt{13{,}31\,B_{WL}/(B_H - F_B^3)} \quad \text{if } F_B > 2{,}20; \qquad (2.7.9.4.1.6\text{-}1);$$

$$FBD = 1{,}118\sqrt{B_{WL}/B_H} \quad \text{if } F_B = 1{,}45\ldots2{,}20; \qquad (2.7.9.4.1.6\text{-}2);$$

$$FBD = \sqrt{B_{WL}F_B^2/(1{,}682\,B_H)} \quad \text{if } F_B < 1{,}45 \qquad (2.7.9.4.1.6\text{-}3),$$

where $F_B = 3{,}3\,B_H\sqrt[3]{0{,}03\,m}$ (2.7.9.4.1.6-4)

2.7.9.4.1.7 The wind moment factor ***FWM*** with the limiting values of $0{,}5 \leq$ ***FWM*** $\leq 1{,}0$ is determined by the formula

$$FWM = 1 \quad \text{if } \theta_D \geq 90°; \qquad (2.7.9.4.1.7\text{-}1)$$

$$FWM = v_{AW}/17 \quad \text{if } \theta_D < 90°; \qquad (2.7.9.4.1.7\text{-}2)$$

$$v_{AW} = \sqrt{\frac{13\,m\,l_D}{A_S(h_{CE} + h_{LP}) \cdot |\cos\theta_D|^{1{,}3}}} \qquad (2.7.9.4.1.7\text{-}3)$$

where v_{AW} = wind velocity, in m/s;

l_D = righting lever at $\theta = \theta_D$, in m;

h_{LP} = height of the waterline above the centre of lateral resistance with centreboards, keels and rudders in the lowered position, in m.

2.7.9.4.1.8 The downflooding factor ***FDF*** with the limiting values of $0{,}5 \leq$ ***FDF*** $\leq 1{,}25$ is determined by the formula

$$FDF = \theta_D/90. \qquad (2.7.9.4.1.8)$$

2.7.10 Verification of stability of craft with reserve of buoyancy provided by flotation elements.

2.7.10.1 When the reserve of buoyancy is verified, the loading condition of the non-sailing craft shall include at least 25 per cent of stores and outfit being part of the full load. This loading shall be assumed at the level of the accommodation deck (or cockpit) on the centreline amidships.

2.7.10.2 The reserve of buoyancy of sailing craft is verified in the full load condition.

2.7.10.3 Where the craft's reserve of buoyancy is provided by air space, the number of air chambers open to atmosphere during testing shall be assumed according to Table 2.7.10.3.

Table 2.7.10.3

Number of air chambers to be opened

Total number of air spaces	Number to be opened
< 4	Single largest
4 ... 8	Two largest
> 8	Three largest

2.7.10.4 After complete flooding the craft with water, it shall remain afloat with an additional load (refer to Table 2.7.10.4) applied to the inner surface of the craft's bottom or to the location where people is usually accommodated.

Table 2.7.10.4

Loading for verification of reserve of buoyancy

Design category	**A, A1, A2 and B**	**C, C1, C2 and C3**	**D**
Loading, in kg	$4\,m_{MTL}/3$	$60 + 15\,n$	$50 + 10\,n$
Note: m_{MTL} = maximum loading (deadweight) of craft; n = number of people allowed on board.			

2.7.10.5 The craft shall remain afloat with the requirements in 2.7.10.3 met having the heel and trim within 12° and, therewith, at least 2/3 of its sheerline (or gunwale) above water.

2.7.10.6 The positive buoyancy for the craft of a length L_H < 4,8 m fitted with buoyancy blocks under the conditions of 2.7.10.3 shall be ensured with an additional load of 75 kg on the craft's bottom.

2.7.10.7 The monohull sailing craft shall be fitted with the flotation elements of the total volume equal to at least the displacement volume of the fully loaded craft.

2.7.10.8 Where the reserve of buoyancy of the multihull sailing craft is provided with flotation elements, their total volume shall be at least 120 per cent of the displacement volume of the fully loaded craft.

2.7.10.9 The fully flooded craft shall not capsize at the heeling loading of $6\,n$ (n = number of people allowed on board), in kg, applied to its hull side, but not less than 15 kg.

The points to apply the heeling loading shall be assumed at the hull side alternatelyat a distance of $L_H/3$ from the bow and stern. Where the forward and aft boundaries of a cockpit are closer to the middle, the points of applying the heeling loading shall correspond to those boundaries.

2.7.10.10 The flooded craft stability shall be verified by alternate applying all the loading to the forward and aft points on the starboard and port sides. In this case, the craft's heel shall not exceed 45°.

2.7.10.10.1 The craft flooded with water, fully outfitted and loaded to simulate the weight of engines, batteries, etc. and with the permanent equipment according to Figs. 2.7.10.10.1-1 and 2.7.10.10.1-2 shall be tested by applying the heeling loading P_H, in kg, determined by the formula

$$P_H = (10 + 5\,N) \geq 25 \qquad (2.7.10.10.1)$$

where N = total number of people allowed for accommocdation on board craft.

2.7.10.10.2 The points to apply the heeling loading shall be assumed at the hull side alternately at a distance of $L_H/3$ from the bow and stern. Where the forward and aft boundaries of a cockpit are closer to the middle, the points of applying the heeling loading shall correspond to those boundaries.

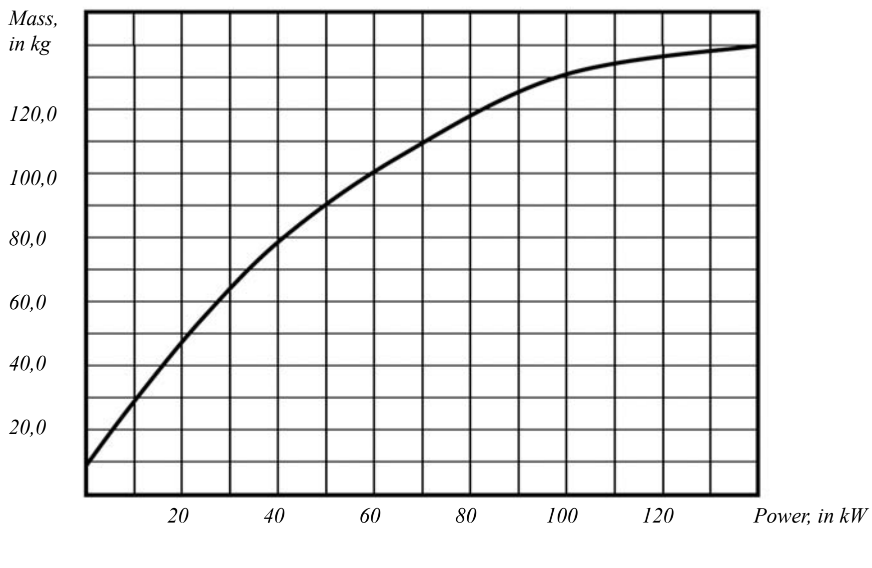


Fig. 2.7.10.10.1-1
Mass of outboard petrol engine against power

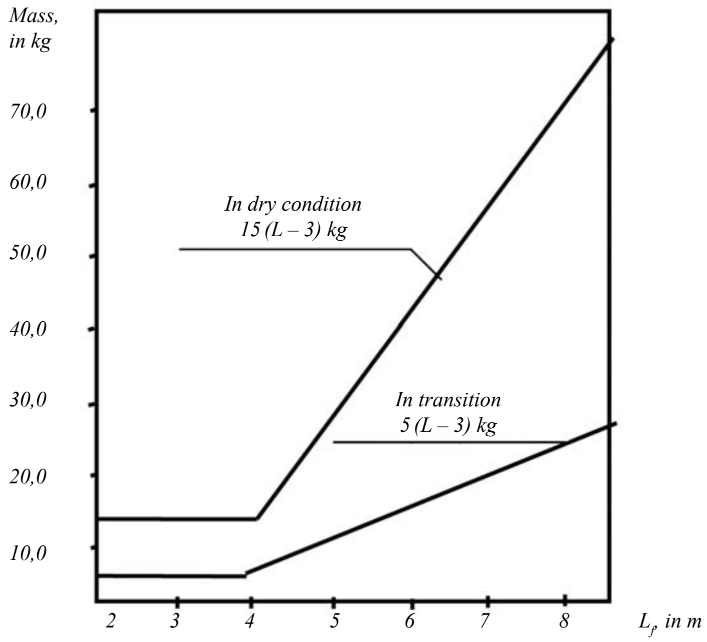


Fig. 2.7.10.10-2
Total mass of anchor, anchor rope, mooring equipment, oars, fire extinguisher, etc. against the craft's full length.
The mass, in kg, should be rounded up to the nearest whole number divisible by 5

The stability of the craft flooded with water should be verified by alternate applying all the loading to the forward and aft points on the starboard and port sides. In this case, the craft's heel shall not exceed 45°.

2.7.10.10.3 The masses (of cargoes) which simulate the weight of the engine and equipment shall be located, as far as pracicable, at the regular places thereof.

2.7.10.10.4 Flotation elements shall be located so that the powered craft has positive stability at an inclination of 60° as well.

2.7.10.10.5 The sailing craft shall not invert and after being knocked down shall remain afloat with its masthead (no sails) touching the water surface.

3 RESERVE OF BUOYANCY

3.1 GENERAL

3.1.1 The reserve of buoyancy of small pleasure craft shall be provided depending on the craft's class.

3.1.1.1 The reserve of buoyancy for the craft of design categories **A**, **A1**, **A2** and **B** shall be such that with any one watertight compartment flooded the craft's defined margin line does not immerse and the requirements in 3.1.3.1 are met.

3.1.1.2 The reserve of buoyancy for the craft of design categories **C**, **C1**, **C2, C3** and **D** shall provide positive buoyancy when any one compartment is flooded, and compliance with the requirements of 3.1.3.2.

3.1.1.3 If agreed with the Register, the craft of design category **D** may dispense with the reserve of buoyancy where the craft is provided with personal life-saving appliances for every person on board.

3.1.1.4 The craft's reserve of buoyancy shall be specified in the Owner's Manual and the Information on Stability.

3.1.2 The damaged craft's reserve of buoyancy may be provided by one of the following ways:

.1 dividing the hull in watertight compartments;

.2 fitting flotation elements in the craft's hull, supestructures and deckhouses including soft elements filled with foamed polymers or air at an excessive (above atmospheric) pressure of 10 kPa;

.3 applying soft flotation elements inflated at the craft's damage and securely fitted inside or outside the craft's hull;

.4 any combination of the above ways.

The material and structure of the flotation elements used, including their anchoring to the craft, and systems for filling soft elements shall be approved by the Register.

3.1.3 The damaged craft's stability shall meet the following requuirements:

.1 in the final stage of flooding, a transverse metacentric height for the craft of design categories **A**, **A1**, **A2** and

B in the upright position shall not be less than 0,05 m in all loading conditions;

.2 in the final stage of flooding for the craft of design categories **C**, **C1**, **C2, C3** and **D,** the damage stability of the craft, which meets the requirements for the reserve of buoyancy, shall comply with the requirements in 2.7.10.

3.1.4 The margin line for the type *A*, *B* and *D* craft is the waterline at which:

the freeboard deck does not immerse;

a distance from the lower edge of openings, which have no closing appliances of at least the tightness Degree 2, to the damage waterline is not less than the value of the freeboard assigned to the craft.

The type *C* and *E* craft qualify as the craft which shall meet only the requirements for the level of the reserve of buoyancy.

3.1.5 The requirements for the righting lever curve of the damaged craft are subject to special consideration by the Register in each case.

3.2 SUBDIVISION

3.2.1 The structural arrangements associated with subdivision shall meet the requirements for the structures strength and tightness set forth in Part II “Hull”, Part III “Equipment, Arrangements and Outfit” and Part V “Machinery Installations. Machinery. Systems and Piping” of these Rules.

3.2.2 Only those compartments are considered watertight (as implied in 3.1.2.1) which have a length equal to at least 10 per cent of the craft’s length, but not less than 2 m, excepting the forepeak and afterpeak.

3.2.3 Where the length of the compartment adjacent to the collision bulkhead is less than 10 per cent of the craft’s length or less than 2 m, the forepeak and this compartment in calculating the damage trim and stability are considered as being simultaneously flooded, but their total length shall not be less than specified in 3.2.2.

3.2.4 All transverse subdivision bulkheads shall be watertight and be brought to the upper deck or bulkhead deck. In addition, crew’s accommodations and passenger spaces shall be separated with watertight bulkheads from the engine room and cargo holds.

Given the engine room in the craft, it shall be separated from other spaces with watertight bulkheads.

3.2.5 The transverse bulkhead may have a step (recess) provided that all parts of the latter are at a distance of more than 1/5 of the craft’s breadth from the outer shell, but at least 0,5 m. If this requirement is not met, the compartment length is determined as a distance till the nearest recess of this bulkhead.

Pipelines with open holes and vent ducts shall be laid so that other spaces or reservoirs are safe from flooding in case of leakage. In this regard, the safety is assumed to be provided if the pipelines or vent ducts are at a distance of more than 1/5 of the craft’s breadth from the craft’s side plating, but at least 0,5 m; this distance therewith shall be measured normally to the craft’s centerplane at the level of the maximum draught. Where this provision is not applicable, the pipelines crossing several compartments and having open holes therein shall have the closing appliances remotely-controlled from the location above the upper deck or bulkhead deck; this rule also covers the case when those pipelines are laid at a height of less than 0,2 m above the craft’s bottom shell.

Cables shall be laid so that the watertightness of structures subdividing the craft remains intact.

3.2.6 Watertight windows may be fitted in side plating below the margin line provided they cannot be opened and are sufficiently strong.

3.2.7 The permeability of compartments shall be generally assumed equal to 95 per cent. If ascertained by calculations that the average permeability of some compartment is less than 95 per cent, this lesser value may be assumed as the design one. However, under no conditions the permeability may be assumed less than the following values:

Spaces intended for crew and passengers – 95 per cent;

engine spaces – 85 per cent;

storerooms and baggage rooms – 75 per cent;

double bottom, fuel oil and other tanks (whichever results in more heavy consequences) – 0 % to 95 %.

3.2.8 The ships of a length $L_H \geq 4{,}0$ m shall have a watertight forward collision bulkhead within

10 per cent to 15 per cent of L_H from the the forward point of the length L_{WL}, but not father than 1,5 m, as well as an aft watertight bulkhead which isolates either the compartment or cockpit for an outbourd or inboard engine.

3.2.9 Transverse watertight bulkheads subdividing the craft, but the engine room bulkheads, may have hatches of tightness degree 1 for passage between compartments which may, due to their design and location, be used in any craft’s condition including when inverted.

Inspection arrangements of tightness degree 1 and classed as fire-retarding (class “B”) or other structures of the same strength, which allow beforehand to make sure in safe opening the hatch, shall be fitted at the top and bottom parts of the above hatch coaming or on the hatch.

Every hatch shall be provided with an automatic alarm indicating its opened position (untight fit to the coaming) with the corresponding visual and acknowledged audible signals at the craft’s conning position.

Where such equipment is fitted on board, the Owner’s Manual and the Information on Stability shall contain explicit instructions on its use including a necessity to keep them permanently closed at sea, particularly with deteriorating weather conditions, during craft’s movement in narrow waters or areas of heavy traffic, and with similar hazards.

The bulkheads (on both sides) in way of the above hatches shall have the relevant instructions on their use.

3.2.10 The hulls of the multihull sailing craft of a length $L_H \geq 6{,}0$ m shall have transverse bulkheads (or buoyancy blocks) located so that the craft remains afloat and retains positive stability when at least half the length of one hull is flooded.

3.2.11 Where the multihull craft's hull of a length $L_H \geq 6{,}0$ m has no inhabited, service or cargo spaces, the length of its compartment shall be within 4 m.

4 REQUIREMENTS FOR FLOTATION ELEMENTS

4.1 Flotation elements shall meet the requirements in Table 4.1.

4.2 The airtightness of integrated air tanks and air containers is checked by pressure in compliance with Table 4.2.

Table 4.1

Requirements for flotation elements

Requirements	Integrated air space	Air container	Inflated bag	Low density material
Airtightness	RT	RT	R	–
Mechanical robustness or protection	R	R	R	R
Draining facility	R	R	–	–
Resistance to or protection from sunlight	–	R	R	R
Fitted with an inflation point	–	–	R	–
Temperature resistant -40 °C to +60 °C	–	–	–	R
Water absorption max. 8 % by volume	–	–	–	R
Securely fastened	–	R	R	R
Encapsulated or resistant to liquids	–	–	R	R
Label: "Do not puncture air space/container/bag"	R	R	R	–
Symbols: R – checked by means of examination during craft's survey by the Register. RT – checked by means of testing during craft's special survey by the Register.				

Table 4.2

Pressure for checking tightness

Initial overpressure	12,5 kPa (1,25 m water head)
Maximum pressure drop in 30 s	0,75 kPa (75 mm water head)
Maximum pressure drop in 60 min	7,5 kPa (750 mm water head)

4.3 The water absorption of low density material used for flotation elements shall not exceed 8 per cent of their volume after complete immersing and holding under this condition for 8 days.

5 PROTECTION AGAINST FLOODING

5.1 GENERAL

5.1.1 The monohull craft of design categories **A**, **A1**, **A2**, **B** and **C** shall have the structure of the type *A*, *B* or *D* craft. The cockpits of those craft, if provided, shall be quick-draining. This requirement is not applicable to the inflated hull craft.

5.1.2 The multihull sailing craft of any category shall have the structure of the type *A*, *B* or *D* craft for all the hulls. This requirement may be ignored for the craft of design category **D**.

5.1.3 High-speed powered craft shall have deck forward within one third of the hull length. Alternatively, a spray shield or an awning may be fitted to effectively protect the cockpit against splashing and whipping.

5.1.4 Where the cockpit is quick-draining, the requirement in 5.3 may be omitted for the craft of design categories **C3** and **D**.

5.2 HULL OPENINGS

5.2.1 All the openings leading into the craft's hull or enclosed superstructures shall be fitted with weathertight closing appliances in compliance with the requirements for tightness set forth in Section 9, Part III "Equipment, Arrangements and Outfit" and paragraphs 4.7 to 4.9, Part V "Machinery Installations. Machinery. Systems and Piping".

5.2.2 No openings shall be fitted in the hull less than 0,2 m above a load waterline, excepting the openings being emergency escape hatches or the elements of systems provided with special closing appliances.

5.2.3 The openings being opened inwards the craft (outboard motor wells, etc.) shall be considered as the openings of potential flooding.

5.2.4 The requirements of this Chapter do not apply to the hull openings which are:

.1 the holes leading into the watertight wells of a total volume less than $L_H B_H F_M / 40$ or the quick-draining wells and cockpits;

.2 pipes drains from watertight wells which if filled would not lead to downflooding or capsizing if the craft is upright;

.3 the openings to be opened in the homeport only;

.4 the opening holes in the craft's sides corresponding to watertightness degree 2 which shall be permanently closed at sea while underway;

.5 the engine exhausts or other openings connected to craft's systems only;

.6 the openings in the sides of the outboard motor well (see Fig. 5.2.4.6) which are of:

watertightness degree 2 and are located at a height of 0,1 m above the design waterline;

watertightness degree 3 and are located at a height of 0,2 m above the load waterline and also above the top of the transom in way of the engine mounting, provided that well drain holes are fitted;

watertightness degree 4 and are located at a height of 0,2 m above the load waterline and also above the top of the transom in way of the engine mounting, provided that well drain holes are fitted. In this case, the length of the interior into which water may be admitted shall not exceed $L_H / 6$ with the height of the coaming isolating this space equal to at least 0,2 m above the design waterline (see Fig. 5.2.4.6).

5.2.5 Appropriate warning entries "SAFETY PRECAUTION" regarding closing the openings specified in 5.2.4.3 and 5.2.4.4 shall be made in the Owner's Manual.

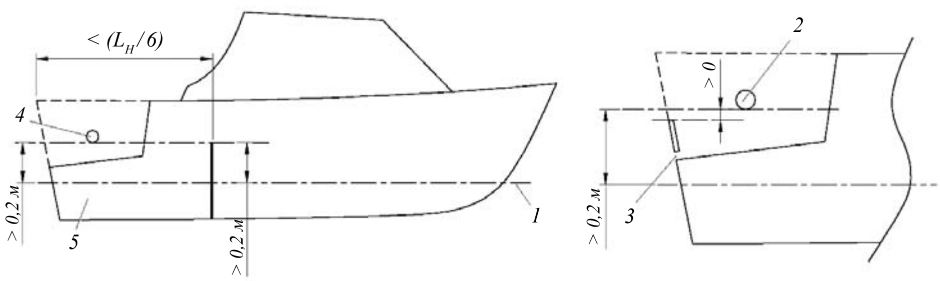


Fig. 5.2.4.6
Openings in outboard engine wells:
1 – waterline at 100 % loading (design waterline); *2* – opening of watertightness degree 3; *3* – drain of outboard engine well; *4* – opening of watertightness degree 4; *5* – non-quick-draining space

6 FREEBOARD AND LOADLINE

6.1 GENERAL

6.1.1 The present Section is framed on the understanding that the nature and stowage of the cargo, ballast, stores, etc. are such as to provide adequate stability of the craft and to avoid excessive structural stresses.

The freeboard and the downflooding height according to the requirements of this Section are specified assuming that the sailing of the craft of design categories **C**, **C1**, **C2**, **C3** and **D** will be suspended with weather conditions causing a risk to exceed the limiting wave height representative for the area of the craft's navigation, and making the craft underway head for a place of refuge as soon as possible.

6.1.2 The Register shall be satisfied that the craft's structural strength is adequate for the draught corresponding to the freeboard assigned and the navigational area.

The craft constructed and maintained in compliance with the requirements of the Register's Rules or Rules of another recognized classification society is considered as having sufficient strength for the corresponding freeboard.

6.1.3 The value of freeboard is entered in the craft's Seaworthiness Certificate.

6.1.4 The Register assigns the freeboard to the craft with structural features, which make the application of this Section requirements inexpedient and impracticable, in such a way that the safety conditions are equivalent to those prescribed in this Section.

6.2 DECK LINE AND LOADLINE

6.2.1 The deck line is a horizontal line of 200 mm in length and 20 mm in breadth. The line shall be marked amidships on each side of the craft, and its upper edge shall normally pass through the point where the continuation outwards of the upper surface of the freeboard deck intersects the outer surface of the side shell.

Where it is impossible or inconvenient to mark the deck line by the above method, the one may be marked at another level provided the freeboard value is correspondingle corrected.

The deck line is not marked if the loadline is not.

6.2.2 Loadline.

6.2.2.1 The loadline mark shall consist of a ring of 200 mm in outside diameter and 20 mm wide separated by a vertical line of 20 mm wide and intersected by a horizontal line of 300 mm in length and 20 mm in breadth in such a way that the upper edge of that line passes through the ring centre.

The ring centre shall be placed amidships at a distance equal to the freeboard assigned for the given navigational area, measured vertically below the upper edge of the deck line (Fig. 6.2.2.1).

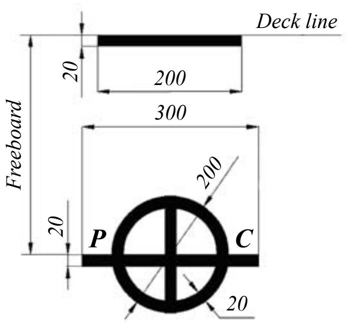


Fig. 6.2.2.1
Load line mark

6.2.2.2 The load line may be omitted on all the craft of less than 10 m long.

6.2.2.3 The loadline shall be marked on both sides of the craft.

6.2.2.4 The letters shall be of a normal script of 75 mm high.

6.2.2.5 The loadline mark and letters shall be painted white on a dark background and black on a light background. They may be welded to or marked by another approved way which ensures their durability.

6.3 ASSIGNMENT OF MINIMUM FREEBOARD

6.3.1 Conditions of freeboard assignment.

6.3.1.1 The craft's design and arrangements shall prevent the flooding of holds or restrict its consequences under normal navigational conditions in the area of craft's operation.

To the extent that it is practicable and necessary, the craft shall have watertight bulkheads which ensure effective subdivision, as well as appropriate systems for draining compartments.

6.3.1.2 The design of superstructures and coamings on the freeboard deck shall meet the requuirements of Part II "Hull".

6.3.1.3 The coaming height for closures located in any part of the craft shall correspond to the one specified in Section 9, Part III "Equipment, Arrangements and Outfit".

6.3.1.4 The doors of enclosed superstructures and the covers of companion hatchways in a space inside the hull shall meet the requirements of Section 9, Part III "Equipment, Arrangements and Outfit".

6.3.1.5 The design of scuttles, windows and skyights shall meet the requirements of Section 9, Part III "Equipment, Arrangements and Outfit".

6.3.1.6 The freeboard shall be not less than the required in 6.4.3.

6.3.1.7 The minimum freeboard for the type *C* craft shall be assigned not less than the tabular one specified in 6.4.1; in this case, the downflooding height determined in 6.4.2 and 6.4.3 shall not be reduced.

6.3.1.8 The minimum freeboard for the type *E* craft shall be assigned not less than the downflooding height determined in 6.4.2 and 6.4.3.

6.3.1.9 The minimum freeboard for the type *A*, *B* and *D* craft may be established not less than the tabular one taking into account the set forth in 6.3.2 and 6.3.3; in this case, the downflooding height determined according to 6.4.2 and 6.4.3 shall not be reduced.

6.3.2 Freeboard of craft of design categories A, A1, A2 and B.

6.3.2.1 The freeboard assigned to the craft meeting the requirements of these Rules shall be not less than the tabular one given in Table 6.4.1.

6.3.2.2 The tabular freeboard shall be increased by the value of the corrections specified in 6.3.2.3 to 6.3.2.5.

6.3.2.3 Correction for depth.

If the design depth D exceeds $L_{WL} / 15$, the tabular freeboard shall be increased by the value, in mm:

$$(D - L_{WL} / 15)\, L_{WL} / 0{,}48. \qquad (6.3.2.3)$$

If D is less than $L_{WL}/15$, the tabular freeboard is not reduced.

6.3.2.4 Correction for coaming height.

The craft's tabular freeboard may be increased where the height of even one coamings of the deck openings leading to the spaces which are considered as independent compartments in verifying floodability is less than the required by these Rules.

The increase of the tabular freeboard height shall be:

$$\Delta f = h_H - h_A \tag{6.3.2.4}$$

where $h_H - h_A$ = the greatest difference of the required and the actual coaming heights.

6.3.2.5 Correction for angle of deck edge immersion[1].

Irrespective of the requirements in 6.3.2.1, 6.3.2.3 and 6.3.2.4, the freeboard of pleasure craft shall be such that the angle of deck edge immersion is at least 12° for the craft of under 15 m in length and at least 6° for the craft of 24 m in length. Intermediate values are to be determined by linear interpolation.

6.3.2.6 Minimum bow height of freeboard.

6.3.2.6.1 The minimum bow height of freeboard defined as the vertical distance at the forward perpendicular between the waterline corresponding to the freeboard assigned at the maximum designed trim at the bow, and the top of the exposed deck at the craft's side, shall not be less than, in mm:

$$56L\,(1 - 0{,}002\,L_{WL}). \tag{6.3.2.6.1}$$

6.3.2.6.2 The extension of sheer or a superstructure attributed to the bow height of freeboard and specified in 6.3.2.6.1 shall meet the requirements of 6.3.2.6.5 or 6.3.2.6.6, respectively.

6.3.2.6.3 Irrespective of the requirement in 6.3.2.6.1, the minimum "protected freeboard" being measured similarly to the bow height of freeboard according to 6.3.2.6.1, but to the top of the bulwark rail or visor shall not be less than $0{,}1\,L_{WL}$.

6.3.2.6.4 Where the required bow height of the "protected freeboard" as required is obtained by provision of a bulwark or visor, the latter shall extend from the stem to the point located at a distance of not less than $0{,}1\,L_{WL}$ aft of the forward perpendicular.

6.3.2.6.5 The extension of sheer attributed to the minimum bow height of freeboard and specified in 6.3.2.6.1 shall not be less than $0{,}15\,L_{WL}$ from the forward perpendicular. In this case, every point of the real sheer shall be situated not lower than the parabolic curve having its origin at $0{,}15\,L_{WL}$ abaft the forward perpendicular to the straight line which is drawn through the point of the real sheer at the craft's middle of the length and passes through the point at the fore perpendicular which corresponds to the minimum freeboard forward.

6.3.2.6.6 The extension of a superstructure attributed to the bow height freeboard and specified in 6.3.2.6.1 shall not be less than $0{,}07\,L_{WL}$ aft from the forward perpendicular. The superstructure shall be enclosed.

6.3.2.7 Minimum stern height of freeboard.

6.3.2.7.1 Minimum stern height of freeboard which is determined similarly to 6.3.2.6.1, but at the after perpendicular at the maximum designed trim by the stern shall be not less than half the bow height of freeboard as specified in 6.3.2.6.1.

6.3.2.7.2 Where the stern height of freeboard specified in 6.3.2.7.1 is attributed to sheer or a superstructure, the extension thereof shall be not less than half that required in 6.3.2.6.5 and 6.3.2.6.6, respectively.

6.3.3 Freeboard of craft of design categories C, C1, C2 and C3.

6.3.3.1 The freeboard assigned to the craft meeting the requirements of these Rules and having no watertight superstructures shall be not less than the tabular one given in Table 6.4.1.

6.3.3.2 The bow height of the freeboard for the craft of design categories **C** and **C1** dealing with the *A*, *B* or *D* types shall be at least 500 mm and the stern height of the freeboard, not less than the minimum freeboard amidships.

The bow and stern height of the freeboard for the craft of design categories **C** and **C1** dealing with the *C* or *E* types shall be determined in compliance with the set forth in 6.3.2.6 and 6.3.2.7.

6.3.3.3 No increase of the freeboard forward and aft is required for the craft of design categories **C2**, **C3** and **D** dealing with the *A*, *B* or *D* types.

The bow height of the freeboard within a length of $L_H/3$ for the craft of design categories **C2**, **C3** and **D** dealing with the *C* or *E* types shall be increased according to Fig. 6.3.3.3.

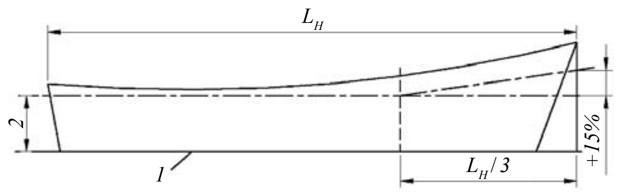


Fig. 6.3.3.3
Increased freeboard as required:
1 – waterline; *2* – minimum freeboard

6.3.3.4 The freeboard for the craft of design categories **C2**, **C3** and **D,** which meet the requirements in 3.3, may be locally reduced by 20 per cent in way of the outboard motor installation.

6.4 TABULAR FREEBOARD AND DOWNFLOODING HEIGHT

6.4.1 The tabular freeboard F_0 is determined by Table 6.4.1 depending on the craft's design category and type.

[1] An angle of deck edge immersion is the angle measured in the craft's midsection between a waterline and a straight line connecting the point of intersection of the waterline with the centre line and the point at the craft's side at the level of the moulded depth.

Table 6.4.1

Tabular freeboard

<table>
<tr><td colspan="2" rowspan="2">Craft's characteristics</td><td colspan="9">Tabular freeboard F_0, in mm</td></tr>
<tr><td colspan="9">Design category</td></tr>
<tr><td>Type</td><td>Length L_H, in m</td><td>A</td><td>A1</td><td>A2</td><td>B</td><td>C</td><td>C1</td><td>C2</td><td>C3</td><td>D</td></tr>
<tr><td rowspan="4">A</td><td>24</td><td>500</td><td colspan="3">400</td><td rowspan="4">300</td><td rowspan="4">250</td><td rowspan="4">200</td><td rowspan="4">150</td><td rowspan="4">100</td></tr>
<tr><td>20</td><td>–</td><td colspan="3">375</td></tr>
<tr><td>15</td><td colspan="2">–</td><td colspan="2">340</td></tr>
<tr><td>≤ 10</td><td colspan="4">–</td></tr>
<tr><td rowspan="4">B</td><td>24</td><td>500</td><td>400</td><td>400</td><td>400</td><td rowspan="4">235</td><td rowspan="4">180</td><td rowspan="4">160</td><td rowspan="4">120</td><td rowspan="4">100</td></tr>
<tr><td>20</td><td>–</td><td>375</td><td>375</td><td>375</td></tr>
<tr><td>15</td><td colspan="2">–</td><td>340</td><td>340</td></tr>
<tr><td>≤ 10</td><td colspan="4">–</td></tr>
<tr><td>C</td><td>Any</td><td colspan="5">No operation</td><td>1000</td><td>600</td><td>300</td><td>100</td></tr>
<tr><td>D</td><td>Any</td><td colspan="4">No operation</td><td>400</td><td>300</td><td>250</td><td>200</td><td>100</td></tr>
<tr><td>E</td><td>Any</td><td colspan="5">No operation</td><td>1900</td><td>1000</td><td>500</td><td>400</td></tr>
<tr><td colspan="11">N o t e . Quantities of F_0 for intermediate values of L_H are determined by linear interpolation.</td></tr>
</table>

6.4.2 The downflooding height is determined by Tables 6.4.2 and 6.4.3 depending on the craft's design category and type, as well as on the location of closing appliances on the craft's hull and superstructures in ways specified in 9.1, Part III "Equipment, Arrangements and Outfit".

Table 6.4.2

Downflooding height

<table>
<tr><td rowspan="3">Craft's type</td><td colspan="9">Downflooding height, in mm</td></tr>
<tr><td colspan="9">Design category</td></tr>
<tr><td>A</td><td>A1</td><td>A2</td><td>B</td><td>C</td><td>C1</td><td>C2</td><td>C3</td><td>D</td></tr>
<tr><td>C</td><td colspan="5">No operation</td><td>1200</td><td>1000</td><td>500</td><td>250</td></tr>
<tr><td>D</td><td colspan="4">No operation</td><td>800</td><td>700</td><td>600</td><td>300</td><td>200</td></tr>
</table>

6.4.3 The downflooding height determined according to 6.4.2 shall be increased up to the values given in Table 6.4.3 and specified in ISO 12217-1:2002, ISO 12217-2:2002 and ISO 12217-3:2002 depending on the craft's constructive type, length and design category.

Table 6.4.3

Downflooding height

<table>
<tr><td colspan="3">Craft of length L_H < 4,8 m</td></tr>
<tr><td>Design category</td><td>Craft's type</td><td>Downflooding height, in m</td></tr>
<tr><td>C1 and C2</td><td>Any</td><td>≥ 0,30 m</td></tr>
<tr><td rowspan="2">C3 and D</td><td>A, B</td><td>L_H/20, but at least 0,20 m</td></tr>
<tr><td>Any</td><td>≥ 0,20 m</td></tr>
<tr><td colspan="3">Craft of length 4,8 ≤ L_H < 6 m</td></tr>
<tr><td>Design category</td><td>Craft's type</td><td>Downflooding height, in m</td></tr>
<tr><td rowspan="3">C1 and C2</td><td>A, B</td><td>L_H/17, but at least 0,30 m</td></tr>
<tr><td>D</td><td>L_H/15 – for craft with a stationary main engine, and at least 0,3 m for others</td></tr>
<tr><td>C, E</td><td>L_H/12</td></tr>
<tr><td rowspan="3">C3 and D</td><td>A, B</td><td>L_H/20</td></tr>
<tr><td>D</td><td>L_H/15 – for craft with a stationary main engine, and L_H/24 m for others</td></tr>
<tr><td>C, E</td><td>L_H/14, but at least 0,40 m</td></tr>
<tr><td>D</td><td>C, E</td><td>≥ 0,40 m</td></tr>
<tr><td colspan="3">Sailing craft of length L_H ≥ 6 m</td></tr>
<tr><td>Design category</td><td>Craft's type</td><td>Downflooding height, in m</td></tr>
<tr><td>A, A1, A2 and B</td><td>A, B</td><td>L_H/17</td></tr>
<tr><td>C</td><td>A, B, D</td><td>L_H/17</td></tr>
<tr><td rowspan="3">C1</td><td>A, B</td><td>L_H/17, but not more than 0,75 m</td></tr>
<tr><td>D</td><td>L_H/17, but not more than 0,90 m</td></tr>
<tr><td>C</td><td>L_H/17</td></tr>
<tr><td rowspan="2">C2</td><td>A, B, D</td><td>L_H/17, but not more than 0,70 m</td></tr>
<tr><td>C, E</td><td>L_H/17</td></tr>
<tr><td rowspan="2">C3</td><td>A, B, D</td><td>L_H/17, but not more than 0,40 m</td></tr>
<tr><td>C, E</td><td>L_H/17, but at least 0,70 m</td></tr>
<tr><td>D</td><td>Any</td><td>L_H/17, but at least 0,40 m</td></tr>
</table>

Table 6.4.3 – continued

Non-sailing craft of length $L_H \geq 6$ m		
Design category	Craft's type	**Downflooding height, in m**
A, **A1**, **A3** and **B**	*A*, *B*	$L_H/17$
C	*A*, *B*, *D*	$L_H/17$
C1	*C*	$L_H/12$, but not more than 1,30 m
	A, *B*, *D*	$L_H/17$, but not more than 0,75 m
	A, *B*, *D*	$L_H/20$, but not more than 0,75 m where the downflooding height and angles are determined from the waterline corresponding to the displacement determined as 133 per cent of the maximum permissible
C2	*E*	$L_H/10$, but not more than 1,30 m
	C	$L_H/12$, but not more than 1,20 m
	A, *B*, *D*	$L_H/17$, but not more than 0,75 m
	A, *B*, *D*	$L_H/20$, but not more than 0,75 m where the downflooding height and angles are determined from the waterline corresponding to the displacement determined as 133 per cent of the maximum permissible
C3	*E*	$L_H/20$, but not more than 0,75 m
	C	$L_H/20$, but not more than 0,60 m
	A, *B*, *D*	$L_H/20$, but not more than 0,40 m
	A, *B*, *D*	$L_H/24$, but not more than 0,40 m where the downflooding height and angles are determined from the waterline corresponding to the displacement determined as 133 per cent of the maximum permissible
D	Any	$L_H/20$, but not more than 0,40 m
	A, *B*, *D*	$L_H/24$, but not more than 0,40 m where the downflooding height and angles are determined from the waterline corresponding to the displacement determined as 133 per cent of the maximum permissible

6.4.4 Sea openings for the craft of design categories **C**, **C1**, **C2**, **C3** and **D** are allowed within the aft quarter of the hull length L_H with their total area of not more than $50 L_H^2$, in mm^2, and the height above the load waterline of at least 75 per cent of the required in 6.4.3.

6.4.5 The downflooding height of sailing craft for open centreboard, drop keel and dagger-board casings shall be not less than half the minimum required in 6.4.3.

6.5 DRAUGHT SCALES

6.5.1 Draught scales shall be graduated in at least decimetres. The scale shall be marked with a clearly visible paint by means of the alternate stripes of different colours and shall present the range from the minimum to maximum draught potential in the craft's operation.

The draught scales shall be marked in the craft of over 6,0 m long.

The draught scales in the craft of over 15,0 m long shall be marked in the craft's forward and aft ends.

The draught scales in the craft of over 12,0 m long shall be welded on or marked by another Register-approved way ensuring their durability.

APPENDIX

ADDITIONAL MATERIALS FOR STABILITY CALCULATIONS

1 PARAMETERS OF IRREGULAR WAVES

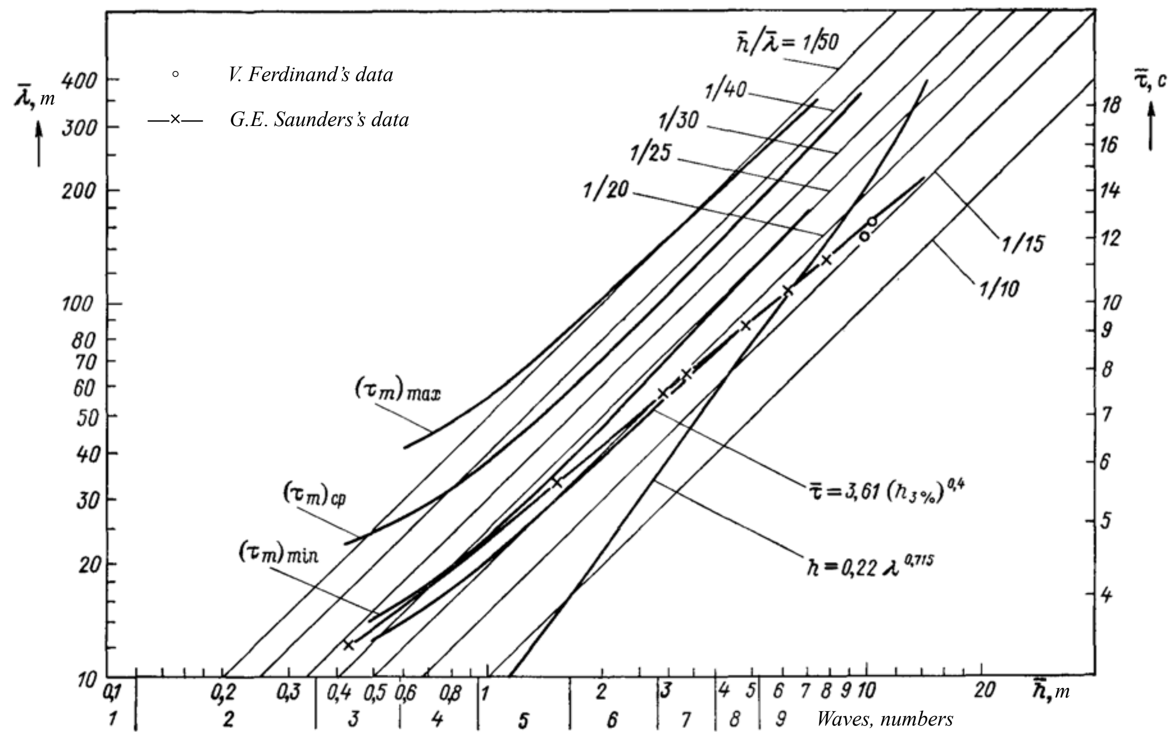


Fig. 1
Parameters of irregular waves

2 CHARACTERISTICS OF WAVE IMPACT FOR DEVELOPING WAVES OF VARIOUS INTENSITY

Table

Characteristic	Unit	Sea state, number						
		2	3	4	5	6	7	8
Basic parameters of design wind waves spectrum								
Wave height, $h_{3\%}$	m	0,52	1,25	2,0	3,5	6,0	8,5	11,0
Mean period of developing waves, $\bar{\tau}$	s	2,0	3,1	4,0	5,2	6,8	8,1	9,2
Variance of wave ordinates, D_{ζ}	m^2	0,001	0,056	0,143	0,438	1,29	2,58	4,33
Characteristics of the greatest breaking wave								
Length, L_{br}	m	3,1	7,5	12,0	21,1	35,6	50,7	95,0
Velocity, V_{br}	m/s	2,2	3,4	4,2	5,6	7,3	8,7	9,9
Height, h_{br}	m	0,24	0,6	0,9	1,6	2,8	3,9	5,1
Period, τ_{br}	s	1,1	1,6	2,1	2,8	3,6	4,3	4,
Action time, t_{br}	s	0,27	0,4	0,5	0,7	0,9	1,1	1,2
Pressure, p_{br}	kPa	2,4	5,8	9,2	16,0	27,5	39,0	50,0

The characteristics of the largest plunger breaking wave in the seas of a given intensity are determined using the following parameters:

wave height with 3 % probability of exceeding level, in m $h_{3\%} = 2{,}11\,\overline{h}$;

maximum wave height, in m $h_{\max} = h_{1\%} \approx 1{,}15\,h_{3\%}$;

height of the breaking part of the wave, in m $h_{br} = 0{,}4\,h_{\max}$;

length of the breaking part of the wave, in m $L_{br} = 0{,}5\,\overline{L} = g/4\pi\,\overline{\tau}^2$

periodicity of wave impact, in s $\tau_{br} \approx 0{,}53\,\tau$;

breaking velocity, in m/s $v_{br} \approx 1{,}08\,\overline{\tau}$;

action time, in s $t_{br} = 0{,}25\,\tau_{br}$;

pressure in the breaking base, in kPa $p_{br} = \rho\, g\, h_{br}$.

3 GRAPHICAL CHARTS FOR CALCULATING THE MOMENT OF INERTIA OF ADDED WATER MASSES AND THE DAMPING COEFFICIENT

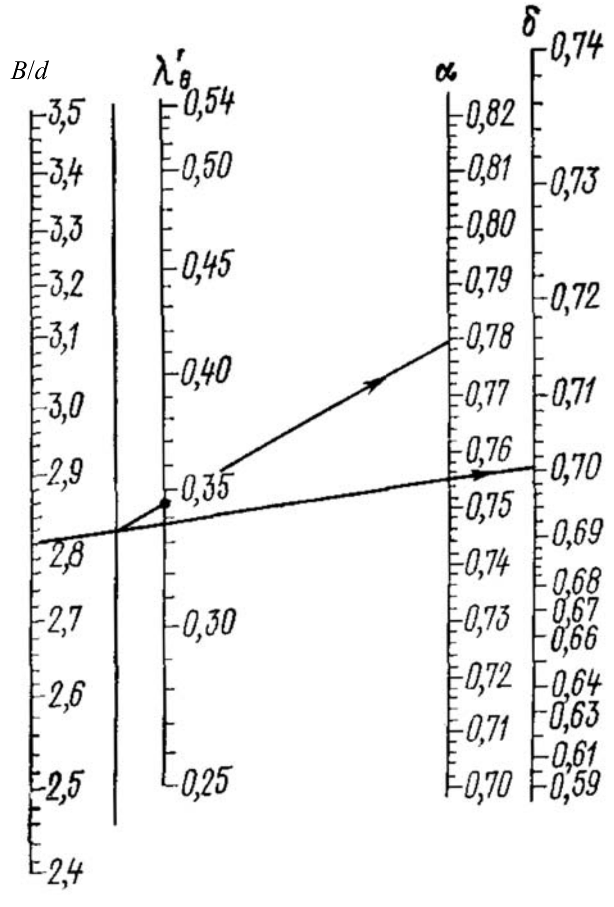


Fig. 3-1
Graphical chart for determining the equivalent moment of inertia of added water masses λ_0'

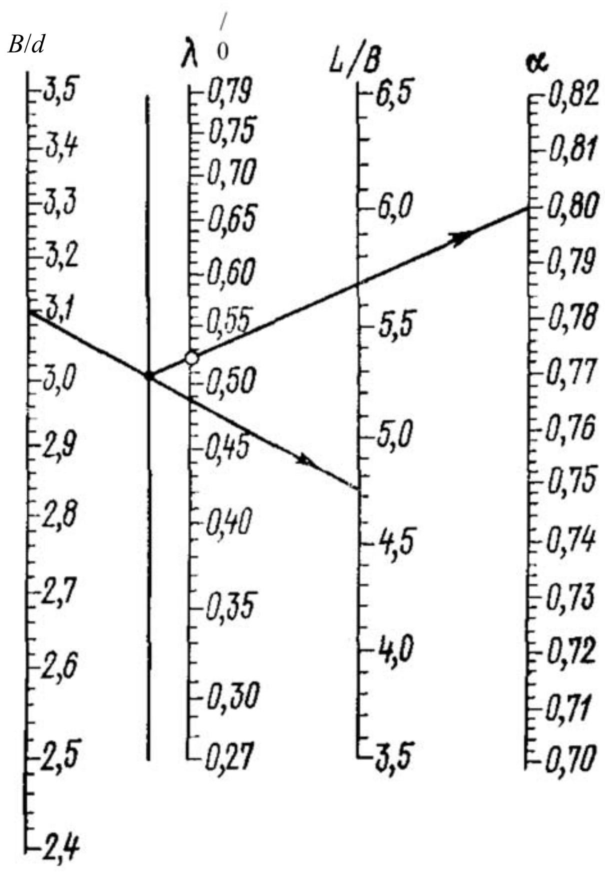


Fig. 3-2
Graphical chart for determining the equivalent moment of inertia of added water masses λ_0' for craft with the large ratio L_H/B_H

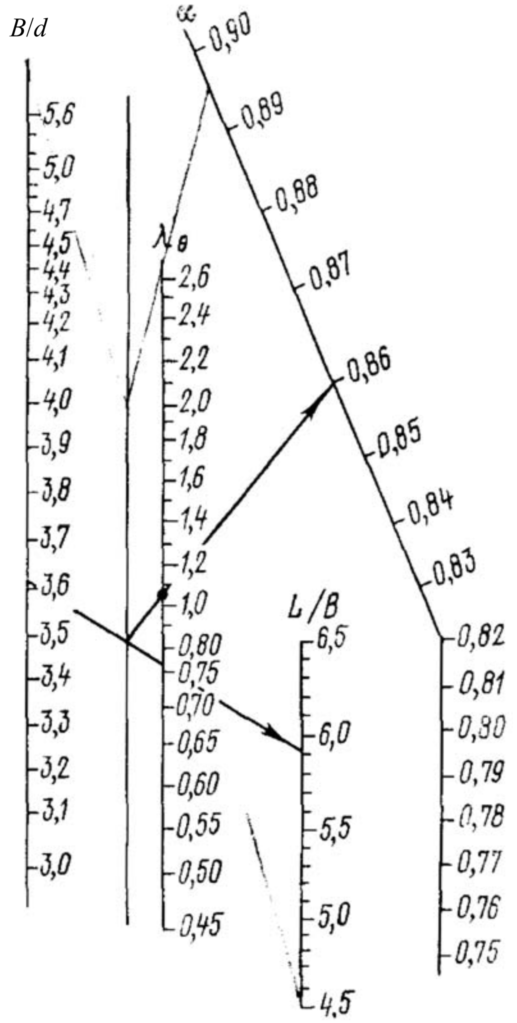


Fig. 3-3
Graphical chart for determining the equivalent moment of inertia of added water masses λ_0' for craft with the large ratio B_H/d_H

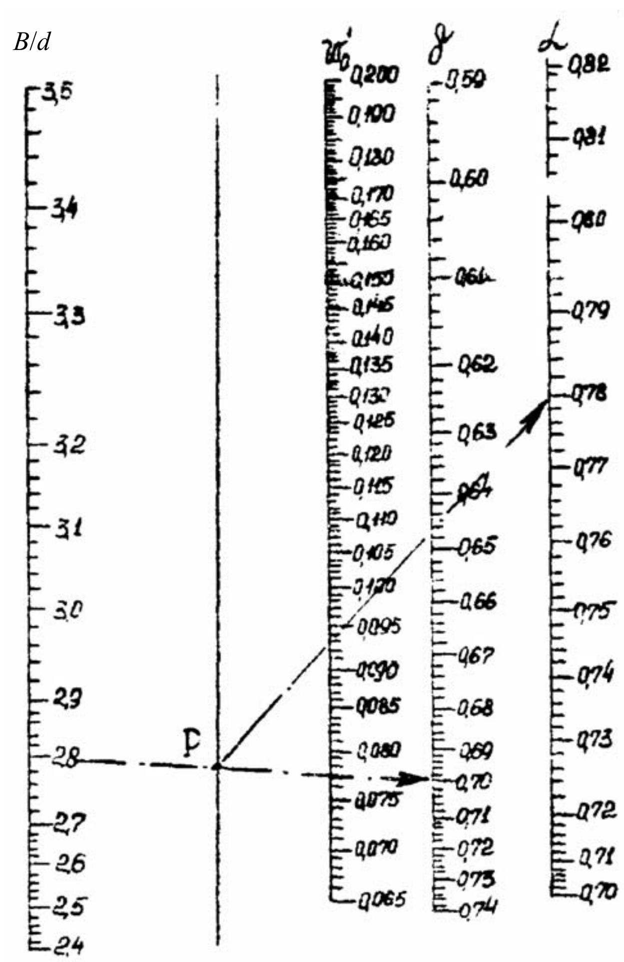


Fig. 3-4
Graphical chart for determining the reduced damping coefficient ω_0' for craft with the large block coefficient

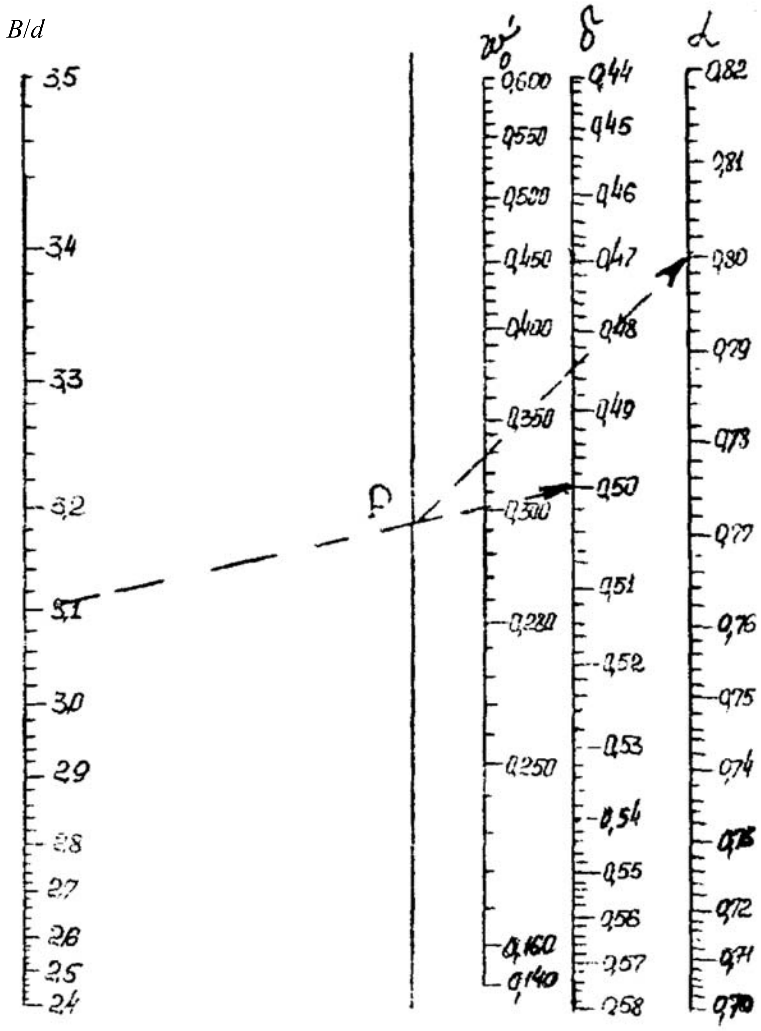


Fig. 3-5
Graphical chart for determining the reduced damping coefficient ω_0' for craft with the small block coefficient

PART V. MACHNERY INSTALLATIONS. MACHINERY. SYSTEMS AND PIPING

1 GENERAL

1.1 APPLICATION

1.1.1 The requirements of this Part of the Rules apply to machinery installations, machinery, propellers, systems and piping used in the small pleasure craft.

1.1.2 Application of the requirements of this Part is defined in relevant Sections: "Machinery Installations", "Machinery" and "Systems and Piping".

1.2 DEFINITIONS AND EXPLANATIONS

1.2.1 Definitions and explanations relating to general terminology of the Rules are given in the General Regulations.

For the purpose of this Part of the Rules, the following definitions and explanations have been adopted:

Fittings mean stop, regulating and other devices intended for distribution control and regulation of consumption and other parameters of the conveyed medium by means of entire or partial closing of flow section.

Auxiliary machinery means machinery necessary for operation of main machinery, supply of the craft with electric power and other kinds of energy, as well as functioning of the systems and arrangements subject to supervision of the Register.

Auxiliary active means of the craft's steering means a propulsion and steering unit ensuring propulsion and steering of a craft at low speed or steering of a craft at zero speed when the craft is equipped with main means of propulsion and steering , and is used either in combination with the latter or when the main means of propulsion and steering are inoperative.

Exit means an opening in bulkhead or deck provided with closing means and intended for the passage of persons.

Means of escape means an escape route leading from the lowest part of the machinery space floor plates to the exit from that space.

Main engines mean the machinery intended for driving propellers.

Main machinery means machinery being part of the propulsion plant.

Main active means of the craft's steering means a propulsion and steering unit being part of the propulsion plant.

Outboard engines mean main engines installed on the transom of the craft.

Remote control means changing of the speed and direction of rotation as well as starting and stopping of the machinery from a remote position.

Engine room means a machinery space intended for the main engines, and in case of craft with electric propulsion plants, the main generators.

Machinery spaces mean spaces containing main machinery, shafting, boilers, internal combustion engines, electric generators and other major electrical machinery, ventilation and air – conditioning installations, steering engines and similar spaces.

Local control station means a control station fitted with controls, indicators, means of communication (if necessary) intended for control, located in proximity to, or directly on, the engine.

Torsional vibration stresses mean stresses resulting from the alternating torque, which is superimposed on the mean torque.

Equipment means all types of filters, heat exchangers, tanks and other arrangements ensuring normal operation of the machinery installation.

Pipeline fire resistance means the ability of pipeline to maintain strength and functional properties within the set period of time at flame exposure.

Plastic materials mean thermoplastic (thermoplasts) and thermosetting (thermosets) materials with or without reinforcement, such as polyvinylchloride (PVC) and fiber reinforced plastic (FRP).

Propusion plant means the totality of machinery and arrangements intended for generating, converting and transmitting power ensuring propulsion of the craft at all specified rates of speed and comprising propellers, shafting, main gearing and main engines.

Rated power means the maximum continuous (not time-limited) power adopted in calculations under the Rules and stated in documents issued by the Register.

Rated speed means the speed corresponding to the rated power.

System means a combination of piplines, machinery, apparatus, devices, appliances and reservoirs intended for performance of certain functions providing craft's operation.

Inboard engines mean main engines installed permanently in the engine room or in a special compartment or in a specially allocated space on deck.

Active means of the craft's steering (AMCS) mean special propulsion and steering units and any combination of them or with the main propulsion devices , capable of producing thrust or traction force both at a fixed angle to the center line plane of the craft and at a variable angle, either under all running conditions or part thereof, including low and zero speed.

The active means of the craft's steering comprise steerable propellers including tiltable and retractable units, active rudders, vertical-axis propellers, water-jets, propellers in transverse channels (transverse thrust units), separate steering nozzles and other devices of similar purpose, special propulsion and steering units and outboard engines of the craft and any combination of them or with the main propulsion devices, capable of producing thrust or traction force both at a fixed angle to the center line plane of the craft and at a variable angle, either under all running conditions or part thereof, including low and zero speed.

Pipeline means a combination of pipes, fittings, formed components, pipe joints, any internal and external linings, insulation coatings, fastening elements and components for protection of pipes intended for conveying of liquid, gaseous and compound media, as well as for transmission of pressure and sound waves.

Pipelines formed components mean bends, T-pieces, bulkhead and deck penetrations and other elements of pipelines, intended for pipeline branching, changing of conveying medium direction and ensuring of hull structure tightness.

Navigating bridge means a space or part thereof, open area or an area enclosed by detachable structures, from which navigation and control of the craft is normally exercised and where controls of the main steering gear (steering gear control system), remote controls of the main and auxiliary engines, CP-propellers, main and auxiliary active means of the craft's steering, instruments, alarm devices and means of communication are located.

2 MACHINERY INSTALLATIONS

2.1 APPLICATION

2.1.1 The requirements of this Section of the Rules apply to craft machinery installations subdivided in accordance with 2.1.2 , equipment of machinery spaces, shafting lines, propellers and spare parts of motor, motor-sailing, sailing-motor and self-propelled craft, as well as non-self-propelled and berth-connected craft fitted up with machinery and systems as specified in 1.2.2, Part I "Classification" and in Section 2 of the General Regulations.

2.1.2 The machinery installations of the craft are subdivided:

.1 by the main engines location:

in enclosed machinery space;

in exposed machinery area (cockpit, machinery compartment);

on craft's transom;

on weather deck or in a pod (with aerial propeller);

.2 by the type of fuel oil used by the main engines:

diesel engines with flash point of fuel not lower than 55 °C. Use of diesel oil with flash point below 55 °C is subject to special consideration by the Register in each case;

carburetor (petrol) engines.

2.1.3 For craft intended for operation in offshore and sheltered areas of navigation (design categories **C, C1, C2, C3** and **D,** see 4.2.2 and 4.2.3 of the General Regulations), the internal combustion engines which are serially manufactured for automobile industry and have the Manufacturer's certificate may be used as main engines.

2.1.4 For craft intended for operation in offshore areas of navigation (design categories **C, C1, C2** and **C3,** see 4.2.2, General Regulations), updating of such an engine and testing of it shall be carried out under the Register's technical supervision, in accordance with the technical documentation and test program being part of the craft's design documentation.

2.1.5 For craft intended for operation in sheltered areas of navigation (design category **D**, see 4.2.3, General Regulations), use of the main engines and propulsion systems (reduction gear – shafting line – propeller) manufactured without the Register technical supervision, if their power output does not exceed 25 kW is subject to special consideration by the Register.

2.2 SCOPE OF TECHNICAL SUPERVISION

2.2.1 Subject to the Register technical supervision, including the approval of technical documentation according to 3.1.7, Part I "Classification" are the following components and items:

.1 shafting as assembled, including propeller shafts, shaft bearings, thrust blocks and sterntube bearings, sterntube seals as assembled;

.2 propellers, including vertical-axis propellers and water-jets, aerial propellers, steerable propellers, outboard engines, transverse thrusters, pitch control units and control systems of propellers.

2.2.2 Subject to the Register technical supervision is the assembling of the machinery space equipment and testing of the following components of the machinery installation:

.1 main machinery;

.2 heat exchangers and pressure vessels;

.3 auxiliary machinery listed in 3.1.1.3 to 3.1.1.13;

.4 control, monitoring and alarm systems of the machinery installation;

.5 shafting and propellers;

.6 active means of the craft's steering.

2.2.3 After assembling of machinery, equipment, systems and piping arrangements on board the craft, the machinery installation shall be tested according to the program approved by the Register.

At that the test conditions and power measurements of the engine forming part of the propulsion plant requested by the manufacturer may be specified taking into consideration ISO 8665 "Small craft – Marine propulsion engines and systems – Power measurements and declarations".

2.3 POWER OF THE MAIN ENGINES

2.3.1 The power of the main engines providing running of a small pleasure craft shall ensure:

.1 speed in calm water not less than:

for craft of design categories **A**, **A1**, **A2**, **B**, **C**, **C1** and **C2** – 6 kn (abt. 11 km/hr);

for craft of design categories **C3** and **D** – 6 km/hr, but not less than the speed ensuring fulfillment of the requirements set out in 2.2.2.2, Part III "Arrangements, Equipment and Outfit";

.2 capability of running astern to maintain necessary maneuvering of the craft under all normal service conditions;

.3 with the potential speed increase over 14,0 m/s, the craft shall additionally meet the requirements of the Rules for the Classification and Construction of High-Speed Ships, and in this case craft with hull length equal to and less than 8 m shall be tested in accordance with the requirements of ISO standard 11592-2001.

2.3.2 Installation of the main engines having total power output in excess of the requirements of 2.3.3 to 2.3.5 is subject to special consideration by the Register in each case.

2.3.3 The maximum allowable power output of the main engines being part of the propulsion plant installed on the transom of a pleasure craft having hull length equal to and below 8,0 m shall be determined in accordance with 2.3.4, depending on:

.1 factor λ calculated by the formula

$$\lambda = L_H \cdot B_T \qquad (2.3.3.1)$$

where L_H = the craft hull length, in m, see 3.2.4 of the General Regulations;
B_T = the transom width, in m, see 3.1 of the General Regulations.

.2 structural design of the propulsion plant:

ensuring active steering of the craft (see definition of the "Active Means of the Craft's Steering", given in 1.2);

not ensuring active steering of the craft.

.3 deadrise angle β, determined according to 3.2.21 of the General Regulations.

2.3.4 The maximum allowable power output of the propulsion plant installed on the transom of a pleasure craft having hull length equal to and below 8,0 m shall be determined in accordance with 2.3.4.1 and 2.3.4.2:

.1 factor λ ≤ 5,1 according to the graph shown in Fig. 2.3.4.1 and in this case:

the upper line of the graph is used at the deadrise angle β ≥ 5,0°;

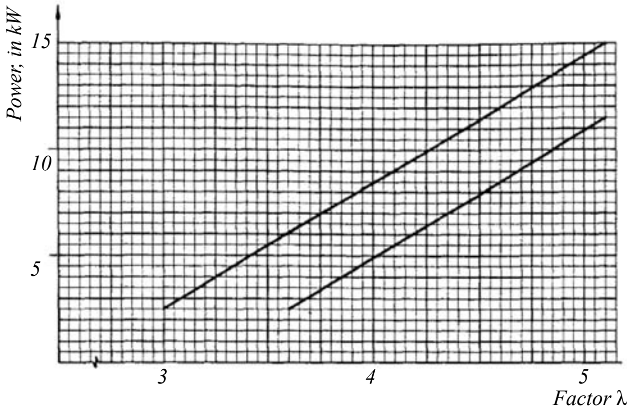


Fig. 2.3.4.1

the lower line of the graph is used at the deadrise angle β < 5,0°;

.2 using the formulae given below at factor λ > 5,1 for a propulsion plant, in kW, ensuring active steering of the craft, regardless of the value of the deadrise angle:

$$N_e = 16\lambda - 67; \qquad (2.3.4.2\text{-}1)$$

for a propulsion plant, in kW, not ensuring active steering of the craft, at the deadrise angle β ≥ 5,0°:

$$N_e = 6{,}4\lambda - 19; \qquad (2.3.4.2\text{-}2)$$

for a propulsion plant, in kW, not ensuring active steering of the craft, at the deadrise angle β < 5,0°:

$$N_e = 4{,}2\lambda - 11. \qquad (2.3.4.2\text{-}3)$$

2.3.5 It is advisable to determine the maximum allowable power of the outboard engines of craft having the overall length of the hull equal to and below 5,5 m, depending on the coefficient *K*, from a combined graph (Fig. 2.3.5), having regard to the following:

.1 for motor boats with remote control and transom height more than 510 mm at *K* ≥ 52, by graph N1;

.2 for motor boats with transom height less than 510 mm, by graph N2;

.3 for all motor boat with rounded chine, by graph N3;

.4 for motor boats mentioned in 2.3.5.1 and 2.3.5.2 at *K* < 52, by graph N4;

.5 the maximum allowable power output of the outboard engines in all cases shall not be less than 100 kW.

Coefficient *K* is determined from the combined graph, Fig. 2.3.5, depending on the transom width or hull length, or by the formula

$$K = 10{,}6 \cdot \lambda \qquad (2.3.5.5)$$

where λ, see 2.3.3.1.

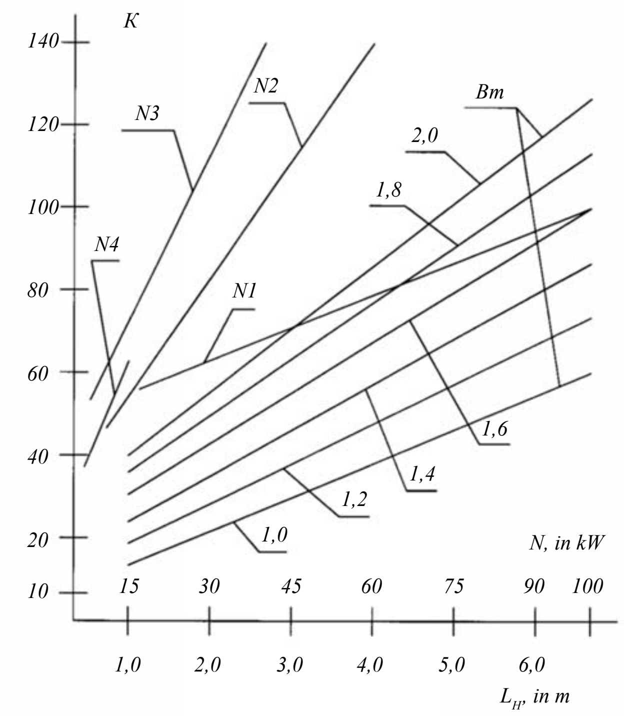


Fig. 2.3.5
The maximum allowable power output of the outboard engines of craft with the overall hull length equal to and below 5,5 m.

2.4 CONTROL DEVICES AND STATIONS. MEANS OF COMMUNICATION

2.4.1 Main and auxiliary machinery essential for the propulsion, control and safety of the craft shall be provided with effective means for their operation and control.

2.4.2 Main engines of craft of design categories **A**, **A1**, **A2**, **B** and **C** shall be fitted with pneumatic or electric starting system.

The electrically-started engines shall be fitted with attached generators and provided with a device for automatic recharging the starting accumulator batteries.

2.4.3 Main engines of craft of design categories **C1**, **C2**, **C3** and **D** may be fitted both with electrical starting system and with a device for manual starting by means of a starting handle or a starter cord.

2.4.4 In case where in addition to electric starting, manual drive of the engine is also provided, such manual drive shall be automatically disengaged when the electric drive is actuated, and an interlocking system shall be provided to preclude simultaneous operation of the two drives.

The starting handle of the manual drive and starter cord shall be made so that the safety of starting is provided.

The starter cord shall be provided with a device which ensures self-disconnection of the cord from the engine.

The starting handle shall be provided with a device which precludes translational travel in the direction opposite to the applied force necessary for engine starting.

2.4.5 Starting and reversing arrangements shall be so designed and placed that each engine can be started or reversed by one operator. The force applied to one handle in this case shall not exceed 160 N.

The proper working direction of control handles and handwheels shall be clearly indicated by arrows and relevant inscriptions.

The setting of maneuvering handles of the main machinery from, or to the right of, the operator, or turning the handwheel clockwise, at control stations on the navigating bridge , shall correspond to the ahead speed direction of the craft.

Control arrangements shall be so designed as to eliminate the possibility of spontaneous changing the positions prescribed.

The outboard engines shall be provided with a device which excludes starting of the engine in engagement with the propeller, except when:

static thrust provided by the engine does not exceed 500 N;

engine is fitted with a limiter which provides a thrust up to 500 N at the time of starting.

2.4.6 The duration of reversing (a period of time from the reversing of a steering control to the beginning of the propeller operation with a thrust opposite in direction) shall not exceed:

.1 for internal combustion engines of power output 55 kW and above:

25 s at full speed;

15 s at low speed;

.2 for internal combustion engines of power output less than 55 kW:

10 s at full speed;

5 s at low speed.

2.4.7 The inboard main engines and outboard engines of power output more than 15 kW, as a rule, shall be provided with remote control or remote automated control system.

The remote automated control system shall meet the requirements of Part VI “Automation”.

The main engines of power output less than 25 kW to be installed in exposed machinery spaces or on transom (see 2.1.2.1) of craft of design categories **C2, C3** may be devoid of the remote control or remote automated control system.

2.4.8 The main machinery remote automated control system operable from the navigating bridge, shall be designed so as to provide an alarm in the event of failure. As far as practicable, the prescribed propeller speed and thrust direction shall remain unchanged until control is transferred to a local station. Among other factors, the loss of power supply (electric, pneumatic or hydraulic power) shall not substantially affect the power of main engines or change the direction of propeller rotation.

In case of remote control with the use of mechanical linkage, activation of the alarm to warn of the remote control failure need not be provided.

2.4.9 The bridge control stations of main machinery and propellers, with any type of remote control, shall be equipped with:

.1 controls for the operation of main engines and propellers. For installations comprising CP-propellers, vertical-axis and similar type propellers, the navigating bridge may be equipped with means for remote control of propellers only;

.2 indicators of:

propeller shaft rotation speed and direction if a fixed pitch propeller is installed;

propeller shaft speed and blade position if a controllable pitch propeller is installed;

main engine speed if a disengaging clutch is provided;

.3 indicating means to show that the main engines and remote control systems are ready for operation;

.4 indicating means to show from which station the control is exercised;

.5 means of communication in accordance with 2.4.17;

.6 main machinery emergency stop device, independent of the control system. If disengaging clutches are provided for disconnection of main machinery from propellers, it is permissible that emergency disengagement of these clutches only is effected from the navigating bridge;

.7 device to override the automatic protection covering full range of parameters, except those parameters which being exceeded, may result in serious damage, complete failure or explosion;

.8 indication for the override operation, alarm for activation of protection devices and the emergency stop;

.9 alarm for low starting air pressure, set at the level permitting three starting attempts of main engines duly prepared for operation;

.10 alarm for minimum oil pressure in pitch control system, overload alarm where the main engines operates with a CP-propeller.

2.4.10 Control stations on the navigating bridge, where outboard engines and main engines permanently installed in exposed machinery spaces are remotely controlled with the use of mechanical linkage, shall be equipped with:

.1 controls for the operation of main engines and propellers;

.2 indicators of:

propeller shaft or main engine speed;

propeller shaft speed and blade positions if CP-propeller is installed;

.3 indicating means to show that the main engines and remote control systems are ready for operation (recommendational);

.4 main engine emergency stop device. If disengaging clutches are provided for disconnection of main engines from propellers, it is permissible that emergency disengagement of these clutches only is effected.

2.4.11 The emergency stop devices of main engines and the overrides of protection arrangements shall be so constructed as to preclude inadvertent operation thereof.

2.4.12 With a remote control system in use, provision shall also be made for local control of main engines and propellers.

Where, however, mechanical linkage is fitted for remote control, the local controls may be dispensed with.

The local control station of main engines shall be equipped with instruments as specified in 3.2.3.

2.4.13 Remote control of main engines and propellers shall be performed only from one control station. The transfer of control between the navigating bridge and engine room shall be possible only from the engine room.

2.4.14 Main engines shall be remotely controlled from the wheelhouse by means of a single control element per propeller with all operating modes automatically executed, including, if appropriate, the means preventing overloading and continuous running of the main engines within the restricted rotation speed ranges. In installations with CP-propellers, systems with two control elements may be used.

2.4.15 The sequence of the main engine operation modes assigned from the navigating bridge, including reversal from the full ahead speed in case of emergency, shall be automatically controlled with the time intervals admissible for main engines. The modes assigned shall be indicated at the local control stations of the main engines.

2.4.16 All the indicating instruments, with the exception of liquid-filled thermometers, shall be checked by competent bodies recognized by the Register.

Tachometers accuracy shall be within ± 2,5 per cent. With restricted speed ranges, the accuracy shall not be below ± 2,0 per cent, and the ranges shall be marked with bright color on the scales of tachometers or in another way.

2.4.17 Means of communication.

2.4.17.1 For craft of design categories **A**, **A1**, **A2** and **B**, where local control station of main machinery is available, at least two independent means shall be provided for communicating orders from the navigating bridge to the position in the machinery space or in the control station, from which the speed and direction of thrust of the propellers are normally controlled.

One of these means shall provide visible indication of orders and responses both in the machinery space and on the navigating bridge and which is fitted with a sound signal clearly audible in any part of the machinery space while the machinery is at work, and distinct in tone from all other signals in that machinery space.

2.4.17.2 For craft of design categories **C**, **C1**, **C2** and **C3**, where local control station of main machinery is available, a means shall be provided for communicating orders from the navigating bridge to the position in the machinery space or in the control station, from which the speed and direction of thrust of propellers are normally controlled, and which shall provide visible indication of orders and responses both in the machinery space and on the navigating bridge and shall be fitted with a sound signal clearly audible in any part of the machinery space while the machinery is at work, and distinct in tone from all other signals in that machinery space.

2.5 MACHINERY SPACES

2.5.1 Enclosed machinery spaces.

2.5.1.1 A watertight bulkhead meeting the requirements of 2.2.2 and 2.3, Part X "Fire Protection" shall isolate the machinery space from all other adjacent compartments.

2.5.1.2 The main and auxiliary machinery shall be so arranged in the machinery space as to provide free passageways from their control stations and servicing flats to the escape routes from these spaces. The width of passageways shall not be less than 500 mm over the whole length.

2.5.1.3 The width of ladders serving as escape routes and the width of exit doors shall not be less than 500 mm.

2.5.1.4 Escape routes from machinery spaces shall lead to such places which provide ready access to the exposed deck.

Workshops, spaces for fuel oil units, boilers, oil equipment testing, etc., enclosed within machinery spaces may have exits into these spaces.

The engine control room and the main switchboard space enclosed within the engine room shall have their own independent escape routes, in addition to entrances to the engine room.

In case of small engine room (not more than 35 m^2), or where exits from these spaces are located close (not farther than 5 m) to the engine room exit, an independent escape route from the engine control room may be omitted on agreement with the Register.

If two adjacent machinery spaces communicate through doors and each of them has only one escape route through the casing, these escape routes shall be located on opposite sides.

The second escape route is not required:

.1 from machinery spaces of not more than 25 m^2 in area if the available escape route does not lead to the adjacent machinery or accommodation space;

.2 from auxiliary spaces enclosed within the machinery space provided with two escape routes;

.3 from enclosed engine control rooms where main switchboards are located;

.4 from spaces which contain no oil-fired machinery.

2.5.1.5 All the doors as well as the covers of companionways and skylights which may serve as means of escape from machinery spaces, shall be capable of being opened and closed both from inside and outside. The covers of companionways and skylights shall bear clear inscription prohibiting stowage of any load on them.

2.5.1.6 Ventilation of enclosed machinery spaces shall comply with the requirements of 4.9.

2.5.1.7 Moving parts of machinery and equipment shall be guarded.

2.5.1.8 Detachable plating (floor ceiling) in machinery spaces shall be made of ribbed metal. Plates shall be reliably installed on special frames or on the hull framing and provided with securing devices to prevent them from displacement out from their standard positions in case of heavy heel and trim of the craft and have non-slip surface. All the moving parts of machinery and drives which may constitute a threat to the attending personnel shall be protected by handrails and guards.

2.5.2 Exposed machinery spaces (cockpits, motor compartments).

2.5.2.1 In craft the hull of which is made of non-combustible materials, the boundary structures of the machinery space where internal combustion engine is permanently installed shall be protected by non-combustible heat-insulating material and sheet steel.

2.5.2.2 Floors installed in front of, or behind, the engine shall be watertight and form a collecting tray. The upper edge of the watertight floors enclosing the machinery space (engine) shall be by 150 mm above the floor plating level of the engine room abutting thereon from the outside.

Trays shall be installed under the fuel oil tanks, canisters, filters, fittings and all other units of fuel oil system in which fuel oil leakage is likely to occur.

2.5.2.3 When arranged in one compartment the fuel oil tanks and canisters shall be located at a distance of not less that 800 mm from the engine and exhaust piping.

2.3.2.4 Detachable flooring shall be suitably installed, secured and have non-slip surface.

2.6 ARRANGEMENT OF MACHINERY AND EQUIPMENT

2.6.1 Main engines, auxiliary machinery, equipment, pipes and fittings shall be so arranged as to provide easy access for servicing and damage repair; the requirements stated in 2.5.1.1 shall also be met.

2.6.2 Main engines and machinery with horizontal arrangement of the shaft shall be installed parallel to the center line of the craft.

Such machinery may be installed in any other direction about the center line provided that the construction of machinery provides for operation under the conditions stated in 2.3, Part VII "Machinery Installations" of the Rules for the Classification and Construction of Sea-Going Ships

2.6.3 The machinery and equipment constituting the machinery installation shall be installed on strong and rigid seatings and securely attached thereto. The construction of seatings shall comply with the requirements set out in Part II "Hull".

2.6.4 The main engines, their gears, thrust bearings of shafts shall in part be secured to seatings with fitted bolts. The bolts may be omitted, if appropriate stops are provided.

2.6.5 The bolts securing the main engines and auxiliary machinery and shaft bearings to their seatings , end nuts of shafts as well as bolts connecting the length of shafting shall be fitted with appropriate lockers against spontaneous loosening.

2.6.6 Where the machinery shall be mounted on shock absorbers, the design of the latter shall be approved by the Register.

Shock adsorbing fasteners of the machinery and equipment shall:

maintain vibration-proof properties when the shock-absorbed machinery and equipment operate in the environmental conditions stated in 2.3, Part VII "Machinery Installations" of the Rules for the Classification and Construction of Sea-Going Ships;

be resistant to the corrosive media and temperatures;

be equipped with a yielding grounding jumper of sufficient length to prevent radio reception interference and comply with the safety engineering requirements;

eliminate the interference with operation of other equipment, devices and systems.

2.6.7 Installation of the equipment on pads made of polymeric material is subject to special consideration by the Register in each case.

2.6.8 Installation of the outboard engines on the transom of the craft shall ensure a secure attachment and provide for an additional cable for attaching the engine to the transom or to any robust hull structure.

2.6.9 Mounting of inboard engines and installation of carburetor (petrol) engines.

2.6.9.1 The inboard carburetor (petrol) engines as well as outboard engines shall not be used in craft of design categories **A**, **A1**, **A2** and **B**.

2.6.9.2 The inboard carburetor (petrol) engines as well as outboard engines may be used in craft of design categories **C1**, **C2**, **C3** and **D**, having the product of the craft length by its breadth which does not exceed 20, provided that the following requirements for the inboard engines are complied with.

2.6.9.2.1 In craft of open type and in exposed machinery spaces (motor compartments), the inboard engines shall be protected by casings manufactured of non-combustible materials.

2.6.9.2.2 The detachable engine casings shall be provided with vent pipes of not less than 80 mm in diameter. One such pipe shall stop short of the craft hull bottom by 70 mm and the other pipe shall come from opening in the highest part of the casing cover.

The upper ends of vent pipes shall be fitted with ventilator heads with flame arresters.

2.6.9.2.3 Suction pipes of the carburetors shall be led outside the detachable casings and elevate above those by at least 500 mm. The ends of the suction pipes shall be fitted with ventilator heads with flame arresters.

2.6.9.2.4 Where engines are installed in enclosed machinery spaces the inlets of the carburetor suction pipes shall be located at a height of not less than 300 mm above the cylinder covers and fitted with flame arresting screens. Where suction pipes at the carburetor air inlet are not provided, flame arresters shall be fitted.

2.7 ARRANGEMENT OF FUEL OIL TANKS

2.7.1 Arrangement of fuel oil tanks shall meet the requirements of 4.10.2.

2.7.2 Fuel oil tanks shall not be located above ladders, internal combustion engines, machinery and equipment with surface temperature under insulation over 220 °C, exhaust pipes, smoke uptakes, electrical equipment and main machinery control stations and, as far as practicable, shall be arranged far apart therefrom. The fuel oil tanks shall be located at not less than 800 mm from the engine and exhaust unless a metal bulkhead is provided in between.

2.8 INSULATION OF HEATED SURFACES

2.8.1 All parts of machinery, equipment and piping which may be heated to a temperature over 60 °C and constitute a threat to the attending personnel shall be provided with means that prevent or restrict thermal radiation.

2.8.2 Surfaces of machinery, equipment and piping with temperatures above 220 °C shall be insulated. Measures shall be taken to prevent destruction of insulation from vibration and mechanical damages.

2.8.3 Insulating materials and surface of insulation shall comply with the requirements of 2.3.7, 2.3.8 and 2.5.2, Part X "Fire Protection".

2.9 SHAFTING

2.9.1 General.

2.9.1.1 The minimum shaft diameters without allowance for subsequent turning on lathe during service life shall be determined by the formulae given in this Section. It is assumed that torsional vibrations are comply with the requirement of 2.11.

2.9.1.2 In craft with no obstruction for the propeller shaft to slip out of the sterntube, means shall be provided which, in the event of the propeller shaft breaking, will prevent its slipping out of the sterntube gland; or measures shall be taken to preclude flooding of the engine room, should the propeller shaft is lost.

2.9.1.3 Shafts are recommended to be manufactured from steel with tensile strength of 400 to 800 MPa.

The use of other materials is subject to special consideration by the Register in each case.

In all cases, the tensile strength in Formula (2.9.2.1) shall be taken to be not more than 800 MPa for intermediate and thrust shafts and not more than 600 MPa for the propeller shaft.

2.9.1.4 It is advisable to install propeller shafts having one thrust bearing which takes up the ahead and astern loads and two line shaft bearings which take up weight loads of the shaft itself and bending loads due to possible deformations of the craft hull in heavy sea.

Any constructions and units (reduction gears, cardan and flexible shafts, etc.), if justified, may be used in shafting.

It is advisable to use such construction of the reduction gear which would make it possible to house the ahead and astern thrust bearings and the forward line shaft bearing of propeller shaft in the reduction gear case. The aft line shaft bearing of propeller shaft is recommended to be installed either on a pedestal on the craft hull or immediately ahead of the propeller shaft exit from the hull in way of sternpost or countertimber.

2.9.2 Construction and diameters of shafts.

2.9.2.1 Intermediate shaft.

The diameter of the intermediate shaft d_{int}, or the diameter of the propeller shaft in case of a common shaft from the engine to the propeller, in cm, shall not be less than that determined by the following formula:

$$d_{int} = 677{,}7\sqrt[3]{N(1+k)/(n\cdot\tau_{all})} \qquad (2.9.2.1)$$

where N = rated power transmitted by intermediate shaft, in kW;
n = rated speed of intermediate shaft, in min^{-1};
τ_{all} = allowable tangential stress in shaft cross-section, in MPa;
$k = q(a-1)$ – for installations with internal combustion engines;
$q = 1{,}4J_p/(J+1{,}4J_p)$, or if there are no data on the mass moments of inertia, the value q may be specified, respectively:
q = 0,5 for installations with two-stroke engines;
q = 0,4 for installations with four-stroke engines;
J_p = mass moment of inertia of propeller shaft with propeller without considering the added water mass, in kg·m^2;
$J = J_{ENG} + J_M$ = mass moment of inertia of propulsion plant without reduction gear, in kg·m^2;
$J = (J_{ENG} + J_M)(n_{ENG}/n)^2$ = mass moment of inertia of propulsion plant with reduction gear, in kg·m^2;
J_{ENG} = moment of inertia of all gyrating and reciprocating masses of propulsion plant, in kg·m^2;
J_{FW} = mass moment of inertia of flywheel, in kg·m^2;
N_{ENG} = rated speed of engine shaft, in min^{-1};
a = factor defined as a ratio of maximum indicated torque as based on the aggregate of measurements made throughout the engine to the mean indicated torque. Value of the factor shall be determined from cumulative diagram of tangential forces constructed for the whole engine or from Table 2.9.2.1 which holds true only at equal crank angles.

Table 2.9.2.1

Number of cylinders	Type of internal combustion engine		Number of cylinders	Type of internal combustion engine	
	Four-stroke	Two-stroke		Four-stroke	Two-stroke
1	14,0	8,0	7	2,20	1,30
2	6,40	3,8	8	2,00	1,20
3	4,50	2,6	9	1,85	1,15
4	2,80	2,2	10	1,60	1,15
5	2,40	1,8	11	1,50	1,10
6	2,15	1,5	12	1,40	1,05

The diameter of intermediate shaft shall be taken to be not less than 25 mm.

2.9.2.2 The design diameter of the propeller shaft, d_p, in cm, shall be not less than that determined by the following formula:

$$d_p = k\cdot d_{int} \qquad (2.9.2.2)$$

where k = factor assumed as follows proceeding from the shaft design features:
for the portion of propeller shaft between the propeller shaft base cone or the aft face of the propeller shaft flange and the forward edge of the aftermost shaft bearing, (subject to a minimum of $2{,}5\cdot d_p$):
1,22, where the propeller is keyless fitted onto the propeller shaft taper or is attached to an integral propeller shaft flange;
1,26 where the propeller is keyed onto the propeller shaft taper;
for the portion of propeller shaft between the forward edge of the aftermost shaft bearing and the forward edge of the forward sterntube seal k = 1,15 for all types of design.

On the portion of propeller shaft forward of the forward edge of the forward sterntube seal, the diameter of the propeller shaft may be tapered to the actual diameter of the intermediate shaft.

Where surface hardening is used, the diameters of propeller shafts may be reduced on agreement with the Register.

Portions of the propeller shaft which are in contact with water, in case where the shaft has no continuous liner or is not effectively protected by some other method, shall have the outer diameter which exceeds by 5 per cent the diameter determined by Formula (2.9.2.2).

2.9.2.3 The diameter of thrust shaft in external sliding bearing on a length equal to thrust shaft diameter on either side of the thrust collar and, where roller thrust bearings are used, on a length within the housing of thrust bearing, shall not be less than 1,05 times the intermediate shaft diameter determined by Formula (2.9.2.1).

Beyond the said lengths, the diameter of the thrust shaft may be tapered to that of the intermediate shaft.

2.9.2.4 Propeller shafts shall be effectively protected against corrosion.

For shafts made of corrosion-resistant steel, no protective coating is required, subject to the condition that the surfaces which are in contact with sea water are polished.

For craft of design categories **A**, **A1**, **A2**, **B**, **C** and **C1**, the propeller shaft made of carbon or low-alloyed steel, shall have a liner made of such alloys which posses sufficient corrosion resistance in sea water.

For craft of design categories **C2**, **C3** and **D**, liners are recommended to be used.

The thickness of the liner shall not be less than 5 mm.

In case of non-continuous liners, the portion of the shaft between the liners shall be protected against the action of sea water by a method approved by the Register.

The liners shall be shrunk on the shaft in such a way as to provide tight interference between mating surfaces. The use of pins or other parts for securing the liners to the shaft is not permitted.

2.9.2.5 If the shaft has a central hole, its bore shall not exceed 0,4 of the design diameter of the shaft.

If considered necessary, the bore of the central hole may be increased to the value obtained from the formula

$$d_c \le (d_a^4 - 0{,}97\, d^3 d_a)\, 1/4 \qquad (2.9.2.5)$$

where d_c = bore of central hole;
d_a = actual shaft diameter;
d = design diameter of the shaft without the central hole.

2.9.2.6 The diameter of a shaft having a longitudinal slot shall be increased by at least 0,2 of the design diameter of the shaft. The slot length shall be not more than 1,4 and the slot width not more than 0,2 of the design diameter of the shaft.

The bossed portion of the shaft shall be of such length as to extend beyond the slot, either side, for 0,25 of the design diameter of the shaft.

Transition from one diameter to another shall be smooth. The ends of the slot shall be rounded to a radius of half the width of the slot and the edges – to a radius of at least 0,35 times the width; the surface of the slot shall have a smooth finish.

2.9.2.7 Where the shaft has a radial or transverse hole, the shaft diameter shall be increased over a length of at least seven bores of the hole. The hole shall be located at mid-length of the bossed portion of the shaft and its bore shall not exceed 0,3 of the shaft design diameter.

In all cases, irrespective of the hole bore, the shaft diameter shall be increased by not less than 0,1 times the design diameter. The edges of the hole shall be rounded to a radius not less than 0,35 times its bore and the inner surface shall have a smooth finish.

2.9.2.8 The diameter of a shaft having a keyway shall be increased by at least 0,1 times its design diameter. After a length of not less than 0,2 of the design diameter from the ends of the keyway, no increase of the shaft diameter is required.

If the keyway is made on the outboard end of the propeller shaft, the diameter need not be increased.

Fillet radii in the transverse section of the bottom of the keyway shall not be less than 0,0125 of the shaft diameter, but at least 1 mm.

2.9.2.9 On the cone base side, the keyways in shaft cones shall be ski-shaped, while in propeller shaft cones they shall be spoon-shaped in addition.

For the outboard end of a propeller shaft having the diameter in excess of 100 mm, the distance between the cone base and the spoon-shaped keyway end shall be at least:

0,2 of the design shaft diameter – with the ratio of the keyway depth to the shaft

diameter less than 0,1;

0,5 of the required shaft diameter – with the ratio of the keyway depth to the shaft diameter more than 0,1.

In coupling shaft cones, the ski-shaped keyway end shall not extend beyond the cone base.

For shafts of less than 100 mm in diameter, the spoon-shaped keyway ends may be dispensed with.

Where the key is secured by screws in the keyway, the first screw shall be positioned at least 1/3 of the shaft cone length from the shaft cone base. The bore depth shall not exceed the screw diameter. The bore edges shall be rounded off. Where the shaft has blind axial bores, the bore edges and end shall also be rounded off. The fillet radius shall not be less than specified in 2.9.2.8.

2.9.2.10 Where keys are used to fit the propeller on the propeller shaft cone, the latter shall have a taper not in excess of 1:12, and in case of keyless fitting – according to 2.9.2.11.

2.9.2.11 In case of keyless fitted propellers and shaft couplings, the taper of the shaft cone shall not exceed 1:15.

A keyless assembly shall generally be constructed without an intermediate sleeve between the propeller boss and shaft.

2.9.2.12 When fitting the keyless shrunk assembly, the axial pull-up of the propeller boss or coupling in relation to the shaft, as soon as the contact between mating surfaces is obtained after eliminating the clearance, shall be determined by formulae given in 5.4, Part VII "Machinery Installations" of the Rules for the Classification and Construction of Sea-Going Ships.

2.9.2.13 End nuts by which the propellers or couplings are secured to the propeller shaft cone shall be fitted with effective stoppers.

The major thread diameter of the end nut used for securing the propeller to the propeller shaft cone shall not be less than 0,6 of the cone base diameter.

2.9.2.14 The stoppers of the end nuts shall be secured to the shaft.

In case of shafts having diameter less than 100 mm, the nut is allowed to be stopped in relation to the propeller boss.

2.9.3 Shaft couplings.

2.9.3.1 The bolts used at the coupling flanges of shafts shall be fitted bolts. The possibility of using coupling flanges without fitted bolts is subject to special consideration by the Register in each case.

2.9.3.2 The coupling bolt diameter, in mm, shall be not less than that determined by Formula (5.3.2), Part VII "Machinery Installations" of the Rules for the Classification and Construction of Sea-Going Ships.

2.9.3.3 The thickness of coupling flanges of the intermediate and thrust shafts as well as the inboard end of the propeller shaft shall not be less than 0,2 of the required diameter of the intermediate shaft or not less than the bolt diameter determined according to 2.9.3.2 for the shaft material, whichever is the greater.

2.9.3.4 The keyways at the shaft ends for the coupling flange muffs shall conform to the requirements of 2.9.2.8 and 2.9.2.9.

2.9.4 Shaft bearings

2.9.4.1 The length of the bearing nearest to the propeller shall be taken according to Table 2.9.4.1.

Table 2.9.4.1

Relative length of bearing

Bearing material	L/d[1]
White metal	2[2]
Lignum vitae	4
Rubber or other synthetic water-lubricated materials approved by the Register	4[3]

[1] L = bearing length; d = design shaft diameter in way of bearing.

[2] The bearing length may be reduced if the pressure on the bearing does not exceed 0,8 MPa. In this case, the mass of the propeller shaft and the propeller shall be taken as the load, assuming that it acts on the aft bearing only. In all cases, the length of the bearing shall not be less than twice the actual shaft diameter in way of the bearing.

[3] The bearing length may be reduced to two design diameters of the shaft in way of the bearing.

2.9.4.2 The water cooling and lubrication of sterntube bearings shall be of forced type.

The water supply system is recommended to be provided with a flow indicator or with the minimum water flow alarms having regard to the sterntube arrangement design.

The shut-off valve controlling the supply of water to sterntube bearings shall be fitted on the sterntube or on the afterpeak bulkhead.

2.9.4.3 If the sterntube bearings are oil-lubricated, the propeller shaft seals of a type approved by the Register shall be used.

The lubricating oil gravity tanks shall be located above the margin line and fitted with oil level indicators.

Forced lubricating oil cooling and oil or bearing liner temperature monitoring are recommended to be implemented having regard to the sterntube arrangement design.

2.9.4.4 The distance between the centers of adjacent shaft bearings , where there are no concentrated masses in the span, shall meet the following condition:

$$5{,}5\sqrt{d} \le l \le \lambda\sqrt{d} \qquad (2.9.4.4)$$

where l = distance between the centers of adjacent bearings, in m;
d = shaft diameters between bearings, in m;
λ = factor taken equal to:
14 for $n \le 500$ rpm;
$300/\sqrt{n}$ for $n > 500$ rpm;
n = rated shaft speed, in rpm.

2.9.4.5 It is recommended to seek the minimum number of shafting supports and the maximum possible length of span between them.

The maximum allowable length of the spans between the shaft supports (bearings) determined according to 2.9.4.4, shall be checked by the bending vibration calculation.

2.9.5 The shafting shall comprise the appropriate braking devices. Such devices may be a brake, a stopper preventing rotation of the shaft in the event the main engine goes out of action.

For shafting of less than 60 mm in diameter such devices are recommended to be used.

2.9.6 Cardan shafts.

2.9.6.1 Shafting is allowed to comprise cardan shafts to be used as intermediate shafts, subject to condition that appropriate strength calculations of the shafts and articulated joints are submitted to the Register.

2.9.6.2 In craft of design categories **A**, **A1**, **A2** and **B**, the use of cardan shafts is subject to special consideration by the Register.

2.9.7 Hydraulic tests.

2.9.7.1 Propeller shaft liners and sterntubes shall be hydraulically tested by a pressure of 0,2 MPa upon completion of machining.

2.9.7.2 After assembling, the sterntube seals, where sterntube bearing are oil-lubricated, shall be tested for tightness by a pressure head up to the working level of liquid in gravity tanks. In general, the test shall be carried out while the propeller shaft is turning.

2.10 PROPELLERS

2.10.1 The requirements of this Chapter apply to metal fixed-pitch propellers, both solid and detachable-blade propellers, as well as to controllable-pitch propellers.

Design of propellers or blades made of non-metal materials is subject to special consideration by the Register in each case.

2.10.2 Blade thickness.

2.10.2.1 Propeller blade thickness, in mm, in two sections being controlled shall not to be less than that determined by the following formula:

$$S_p = \frac{3{,}2A}{\sqrt[3]{(0{,}312 + H/D)^2}}\sqrt{\frac{N}{n B_p Z M}} \qquad (2.10.2.1)$$

where S_p = maximum thickness of expanded blade in the coaxial cylindrical section which is measured normally away from the driving surface (leading edge) or the standard blade section chord, for the blade section being measured, which is the nearest section to the boss, i.e. at the radius:
$0{,}20R$ – for solid propellers where the propeller boss radius is smaller than $0{,}20R$;
$0{,}25R$ – for solid propellers where the propeller boss radius is greater than or equal to $0{,}20R$;
$0{,}30R$ – for detachable-blade propellers;
$0{,}35R$ – for CPP;
$0{,}6R$ – for all propellers irrespective of the propeller boss diameter;
A = coefficient to be determined from Table 2.10.2.1 for the radius to be calculated and also depending on the blade rake angle; if the blade rake angle differs from the values listed in the Table, the coefficient A shall be taken as for the nearest greater value of the angle;
N = rated power of main engine, in kW;
n = rated propeller speed, in min^{-1};
Z = number of blades;
B_p = expanded blade width at the design radius, in m;
D = propeller diameter;
R = propeller radius, m;
H/D = pitch ratio at the radius $0{,}7R$;
$M = 0{,}6R_{m(s)} + 180$ MPa, but not more than:

610 MPa – for copper alloys;
570 MPa – for steel;
$R_{m(s)}$ = tensile strength of blade material, in MPa.

Table 2.10.2.1

Blade radius	Blade rake angle measured on the blade driving surface, in deg.								
	0	2	4	6	8	10	12	14	16
0,20 R	390	391	393	395	397	400	403	407	411
0,25 R	378	379	381	383	385	388	391	394	398
0,30 R	367	368	369	371	373	376	379	383	387
0,35 R	355	356	357	359	361	364	367	370	374
0,60 R	236	237	238	240	241	243	245	247	249

2.10.2.2 The blade tip thickness shall not be less than 0,0035 D. The intermediate blade thicknesses shall be so selected that the lines connecting the maximum thicknesses points of sections, from the root section through the intermediate one up to the tip section, are fair .

In sound cases, the blade thickness calculated according to 2.10.2 and 2.10.3 may be reduced, provided detailed strength calculations are submitted to the Register.

2.10.3 Propeller boss and blade fastening parts.

2.10.3.1 Fillet radii of the transition from the root of a blade to the boss shall not be less than 0,04 D on the suction side and shall not be less than 0,03 D on the pressure side (D is the propeller diameter). If the blade has no rake, the fillet radius on both sides shall be at least 0,03 D.

Smooth transition from the blade to the boss using a variable radius may be allowed.

2.10.3.2 Empty spaces between the propeller boss and the shaft cone, as well as inside the propeller cap shall be filled with non-corrosive mass.

2.10.3.3 The diameter of the bolts (studs), by which the blades are secured to the propeller boss or the minor diameter of the thread of such bolts (studs), whichever is less, shall not be less than that determined by the following formula:

$$d_s = ks\sqrt{\frac{b\,R_{mbl}}{b\,R_{mb}}} \qquad (2.10.3.3)$$

where k = 0,33 in case of three studs in blade flange at the driving surface;
0,30 in case of four studs in blade flange at the driving surface;
0,28 in case of five studs in blade flange at the driving surface;
s = maximum actual thickness of the blade at the design root section (refer to 6.2.1), in mm;
b = width of expanded cylindrical section of the blade at the design root section, in mm;
R_{mbl} = tensile strength of blade material, in MPa;
R_{mb} = tensile strength of bolt/stud material, in MPa;
d = diameter of bolt pitch circle; with other arrangement of bolts;
d = 0,85 l, where l = the distance between the most distant studs, in m.

2.10.4 Propeller balancing.

The completely finished propeller shall be statically balanced.

2.10.5 Controllable pitch, adjustable pitch, foldable blade propellers.

2.10.5.1 The hydraulic power system of the CPP, the overload protection system of the main engines, the lubrication system of the CPP shall meet the requirements of 6.5, Part VII "Machinery Installations" of the Rules for the Classification and Construction of Sea-Going Ships.

2.10.5.2 Construction of the adjustable pitch propellers and the foldable blade propellers is subject to special consideration by the Register in each case.

2.10.6 Other propulsors.

Construction of other propulsors such as water-jets, paddle wheels, aerial propellers is subject to special consideration by the Register in each case.

2.11 TORSIONAL VIBRATION

2.11.1 The requirements of this Chapter apply to machinery installations with the main engines having a power output of 37 kW and over.

2.11.2 For the machinery installations with the main engines having a power output from 37 up to 75 kW, the torsional vibration calculations shall include:

.1 specifications of the basic installation components;

.2 natural frequency calculation results for all modes of vibration having resonances within the rated shaft speed range from 0,2 to 1,2 ;

.3 results of determination of the design stresses in critical sections of shafts caused by the existing resonances. If the resonance zone of the basic order is situated in the proximity to the range from 0,85 to 1,05 of the working shaft speeds (idle running, rated speed on ahead or astern run) or natural frequencies of hull structures, stresses due to non-resonance forced vibration caused by the resonance frequencies of basic order shall be calculated for these ranges.

The permissible stresses due to resonance, near-resonance and non-resonance forced vibration under conditions of continuous running shall not exceed those defined in 2.11.3.

2.11.3 For the machinery installations with the main engines having a power output of 75 kW and over, the requirements set out in Section 8, Part VII "Machinery Installations" of the Rules for the Classification and Construction of Sea-Going Ships shall be complied with in so much as they are applicable, depending on the installation type. Where the technical opportunity of making torsional vibration measurement on board (e.g. in installations with water-jets, outboard engines, steerable propellers, etc.) is unavailable or impracticable, absence of dangerous torsional vibration over the entire working speed range in all specified operating modes of the installation shall be supported by a calculation.

2.12 ACTIVE MEANS OF CRAFT'S STEERING

2.12.1 General.

2.12.1.1 The requirements of the present Section apply to AMCS as defined in 1.2.

The requirements for steering nozzles and steering system of active rudders are given in Part III "Arrangements, Equipment and Outfit".

2.12.1.2 Where AMCS is intended for the main propulsion and steering of the motor craft of design categories **A**, **A1**, **A2** and **B**, a minimum of two AMCS shall be provided.

In this case, provision shall be made for control stations equipped with the necessary devices and, if required, means of communication, as specified in 2.4.

2.12.1.3 A single AMCS may be installed for the main propulsion and steering of the motor craft of design categories **C**, **C1**, **C2**, **C3** and **D**, as well as the sailing-motor and motor-sailing craft.

2.12.1.4 The requirements for installation of AMCS machinery and equipment are given in 2.2.

2.12.1.5 For the main AMCS, size and materials of shafts, couplings, coupling bolts, propulsors, gearings, as well as electrical equipment shall meet the requirements of the relevant Parts and Sections of the present Rules. Moreover, the applicable requirements of the relevant Sections of the present Rules which relate to the rudder and steering gear shall be met as well.

When the Rules contain no requirements for particular components of AMCS, the possibility of using them is subject to special consideration by the Register in each case.

2.12.1.6 Calculations of the AMCS gearing shall be made following the procedure outlined in 4.2, Part IX "Machinery" of the Rules for the Classification and Construction of Sea-Going Ships, in so much as they are applicable and sufficient, unless otherwise specified in these Rules.

2.12.1.7 Spaces containing AMCS machinery shall be equipped with appropriate ventilating, fire extinguishing, drainage, heating and lighting arrangements.

2.12.2 The requirements for construction, alarm devices, hydraulic tests shall be fulfilled consistently with those set out in 7.2 to 7.4, Part VII "Machinery Installations" of the Rules for the Classification and Construction of Sea-Going Ships, in so much as they are applicable and sufficient, unless specified otherwise in these Rules.

2.13 VIBRATION

2.13.1 Where necessary, appropriate measures shall be taken so that the vibration arising during operation of machinery and equipment has no detrimental effect upon the people and does not interfere with the normal operation of the craft.

2.13.2 Vibration standards are extended to cover the internal combustion engines with 55 kW and above in power output and rotational speed ≤ 3000 min^{-1}, the requirements for which are specified in Section 9, Part VII "Machinery Installations" of the Rules for the Classification and Construction of Sea-Going Ships, in so much as they are applicable and sufficient in each particular case.

2.14 MATERIALS AND WELDING

2.14.1 Materials intended for the manufacture of parts of the shafts and propellers shall comply with the requirements given in column 4, Table 1.3.2.3 and in 2.4.1 to 2.4.6, Part VII "Machinery Installations" and in the relevant Sections of Part XIII "Materials" of the Rules for the Classification and Construction of Sea-Going Ships, in so much as they are applicable and sufficient, unless specified otherwise in these Rules.

2.14.2 Welding procedures and non-destructive testing of welded joints shall comply with the requirements of Part XIV "Welding" of the Rules for the Classification and Construction of Sea-Going Ships, in so much as they are applicable and sufficient, unless specified otherwise in these Rules.

2.15 SPARE PARTS

2.15.1 The required minimum of spare parts is not regulated.

It is advisable to keep on board a minimum amount of spare parts for machinery and equipment essential for propulsion and safety of the craft and to have a set of special tools and appliances necessary for dismantling and assembling of the machinery in service conditions.

The spare parts and special appliances (if available) shall be properly secured in easily accessible places and efficiently protected against corrosion.

3 MACHINERY

3.1 APPLICATION. SCOPE OF TECHNICAL SUPERVISION

3.1.1 The requirements of this Section apply to the following engines and machinery:

.1 main internal combustion engines;

.2 internal combustion engines driving electric generators or auxiliary machinery, units in assembly;

.3 gears and coupling;

.4 pumps included into systems covered by the requirements of Section 4 of this Part and Part X "Fire Protection", except for manually operated pumps;

.5 power driven air compressors;

.6 centrifugal separators for fuel oil and lubricating oil;

.7 turbochargers of internal combustion engines;

.8 fans included into systems covered the requirementsby Section 4;

.9 steering gear;

.10 anchor machinery;

.11 mooring machinery;

.12 hydraulic drives.

3.1.2 Subject to the Register technical supervision during manufacture are engines and machinery listed in 3.1.1.

The scope of technical supervision, hydraulic tests, operation tests, general technical requirements, materials and welding shall comply with the requirements of 1.2 to 1.6, Part IX "Machinery" of the Rules for the Classification and Construction of Sea-Going Ships, in so much as applicable and sufficient unless expressly specified otherwise in these Rules.

3.2 INTERNAL COMBUSTION ENGINES

3.2.1 General provisions.

3.2.1.1 The requirements of the present Chapter apply to all internal combustion engines of power output 37 kW and above.

Application of these requirements to the internal combustion engines of power output less than 37 kW is subject to special consideration by the Register in each case.

3.2.1.2 The engines shall be capable of working with an overload exceeding the rated power by at least 10 per cent for not less than one hour.

3.2.1.3 The engines intended to be used as main engines shall also comply with the requirements of 2.3.

3.2.1.4 Irregularity of speed of a.c. diesel generating sets intended for parallel operation shall be such that the amplitude of angle oscillations of the generator shaft does not exceed $3{,}5°/P$, where P is the number of pairs of generator poles.

3.2.1.5 The diesel generating sets intended to be used as emergency units shall be provided with self-contained fuel supply, cooling and lubrication systems.

3.2.1.6 Engines intended to drive emergency generators which may also be used as electrical power sources for non-emergency consumers shall be equipped with fuel oil and lubricating oil filters, as well as with instruments, alarm and protective devices as required for the prime movers of the main sources of electrical power when in unattended operation. Along with that, their fuel oil service tanks shall be fitted with an alarm for low fuel oil level which corresponds to the capacity of the fuel oil daily service tank of the emergency diesel generator.

Moreover, such engines shall have design and maintenance system ensuring their constant availability for use as emergency units when the craft is at sea.

3.2.1.7 The rated power output of the engines shall be determined under environmental conditions cited in 2.2.7, Part VII "Machinery Installations" of the Rules for the Classification and Construction of Sea-Going Ships.

3.2.1.8 Fuel oil and lubricating oil pipes, fittings, flanged connections, filters shall be screened or otherwise protected so that in case of their failure petroleum products falling onto hot surfaces is prevented.

3.2.2 Engine frame, crankshaft, scavenging and supercharging, fuel oil system, lubrication, starting arrangements, exhaust arrangements, control, protection and regulation, torsional vibration damper, antivibrator.

3.2.2.1 Engine frame, crankshaft, scavenging and supercharging, fuel oil system, lubrication, starting arrangements, exhaust arrangements, control, protection and regulation, torsional vibration damper, antivibrator shall comply with the requirements of 2.3 to 2.11, 2.13, Part IX "Machinery" of the Rules for the Classification and Construction of Sea-Going Ships in so much as applicable and sufficient unless expressly specified otherwise in these Rules.

3.2.3 Instruments and alarm devices.

3.2.3.1 Main and auxiliary engines shall be fitted with instruments for measuring:

.1 lubricating oil pressure at engine inlet;

.2 freshwater pressure (or flow) in the engine cooling system;

.3 starting air pressure at main starting valve or starting device inlet (where compressed air starting system is provided);

.4 exhaust gas temperature in exhaust gas pipe;

.5 lubricating oil temperature at engine inlet;

.6 freshwater (coolant) temperature at engine outlet and inlet.

The engines with a compensating tank installed on the engine, only the freshwater (cooling water) temperature at engine outlet is allowed to be measured;

.7 temperature of cylinder multiple head of the directly air cooled engines.

N o t e . Proceeding from the structural features of the engines, changes may be introduced to the list of measuring instruments on agreement with the Register.

3.2.3.2 Each driving engine with a power output exceeding 37 kW shall be fitted with audible and visual warning alarm device actuating signals when the lubricating oil pressure in the circulating lubrication system drops below the permissible level.

3.2.3.3 Local control stations of main engines shall be equipped with instruments for measuring:

.1 lubricating oil pressure at engine and reduction gear inlet;

.2 freshwater (coolant) pressure (or flow) in the engine cooling system;

.3 starting air pressure at main starting air valve or starting device inlet (where compressed air starting system is provided);

.4 current strength and voltage in the starter battery charging circuit (where electrical starting system is provided);

.5 crankshaft speed, and where disengaging clutches are fitted, with an instrument for measuring propeller shaft speed as well;

.6 temperature of cylinder multiple head of the directly air cooled engines.

N o t e . Proceeding from the structural features of the engines, changes may be introduced to the list of measuring instruments on agreement with the Register.

3.2.3.4 Local control stations of main reversible engines or main engines with reverse-reduction gear, in addition to the instruments listed in 3.2.3.3, shall be equipped with:

propeller shaft rotation indicators;

devices for emergency stop of the engine or disengaging of the clutches, operating irrespective of remote control.

N o t e . Outboard engines (attached to transom) are fitted with measuring instruments with consideration for their structural features and the Manufacturer's recommendations.

3.2.3.5 Local control stations of auxiliary engines shall be equipped with instruments for measuring:

.1 lubricating oil pressure at engine and reduction gear inlet;

.2 freshwater (coolant) pressure (or flow) in the engine cooling system);

.3 current strength and voltage in the started battery charging circuit (where electrical starting system is provided) – recommendational;

.4 crankshaft speed.

3.2.4 Marking.

3.2.4.1 The marking shall contain the following information:

trade mark or trade name of the engine Manufacturer;

type of engine, its group (family), if any;

identification number of the engine;

power and speed.

3.2.4.2 The marking shall be in indelible paint. When a label or a nameplate is used, their attachment shall remain reliable throughout the standard service life of the engine and preclude their detachment without damaging them.

3.2.4.3 The marking shall be made on those parts of the engine, the removal of which renders operation of the engine impossible.

3.2.4.4 The marking shall be so located that it can be clearly visible to a person of a medium height, after the engine is mounted with all components necessary for its operation.

3.3 GEARS, DISENGAGING COUPLINGS

3.3.1 Gears, disengaging couplings of engines and machinery listed in 3.1.1 shall comply with the requirements of Section 4, Part IX "Machinery" of the Rules for the Classification and Construction of Sea-Going Ships, in so much as applicable and sufficient unless expressly provided otherwise below.

3.4 AUXILIARY MACHINERY

3.4.1 Power driven air compressors, fans and turbochargers, power driven centrifugal separators shall comply with the requirements of Section 5, Part IX "Machinery" of the Rules for the Classification and Construction of Sea-Going Ships, in so much as applicable and sufficient unless expressly provided otherwise below.

3.5 DECK MACHINERY

3.5.1 Steering gear, anchor and mooring machinery shall comply with the requirements of Section 6, Part VIII "Machinery" of the Rules for the Classification and Construction of Inland Navigation Ships (for European Inland Waterways), in so much as applicable and sufficient unless expressly provided otherwise below.

3.6 HYDRAULIC DRIVES

3.6.1 Hydraulic drives of machinery listed in 3.1.1 shall comply with the requirements of Section 7, Part VIII "Machinery" of the Rules for the Classification and Construction of Inland Navigation Ships (for European Inland Waterways), in so much as applicable and sufficient unless expressly provided otherwise below.

4 SYSTEMS AND PIPING

4.1 APPLICATION

4.1.1 The requirements of this Part apply to the following systems and piping used in craft:

.1 bilge pumping and drain;

.2 ballast;

.3 fuel oil;

.4 lubricating oil;

.5 water cooling;

.6 compressed air;

.7 air, overflow, sounding;

.8 exhaust gas;

.9 ventilation;

.10 hydraulic drives;

.11 domestic liquefied gas.

Pumping and piping of berth-connected craft shall comply with the requirements of the present Part of the Rules, in so much as applicable and sufficient unless provided otherwise below.

4.1.2 Fuel oil used in craft shall comply with the requirements of 2.1.2.1.

4.1.3 Machinery and other components of the systems indicated in 4.1.1 shall remain operative under environmental conditions specified in 2.3, Part VII "Machinery installation" of the Rules for the Classification and Construction of Sea-Going Ships.

4.1.4 For the purpose of determining test categories, types of joints, thermal treatment, welding procedures, pipes are subdivided into three classes as indicated in Table 4.1.4.

4.1.5 Fittings of pipes of all Classes as well as air pipe covers, flexible joints, expansion joints, mechanical joints, insulating joints may be delivered to pleasure craft with a copy of the Type Approval Certificate of the Register.

In case where the type approval of the Register is unavailable, the above equipment for use on a particular craft may be accepted by the Surveyor to the Register after verification of the Manufacturer's certificates, verification of the conformity of used materials with the Rules requirements and test performance.

4.1.6 Protection and insulation of piping.

4.1.6.1 Steel pipes of sea water, as well as air, sounding and overflow pipes of water tanks and tanks for alternate carriage of water ballast and fuel oil shall be protected against corrosion by a method approved by the Register.

Galvanic coating, zinc coating applied by a hot method, plastic coating and also paint coating applied on external surfaces may be used as such protection.

Upon completion of all welding work during manufacture of pipe sections, the damaged portions of coating shall be restored or protected by other method approved by the Register.

Application of galvanic coating does not supersede the measures for protection of pipes against contact and electrochemical corrosion.

4.1.6.2 Where bottom and side fittings of non-ferrous metal alloys are used, provision shall be made for protection of the craft's shell plating and all components coming into contact with those fittings, against contact corrosion. Cathodic protection of welded suction and discharge branch pipes with fittings against contact corrosion shall be made with the use of standard ring end or ring inter-flange protectors to be mounted on the branch pipe flanges. The use of electric insulating joints of the mating components made in accordance with the approved standards is allowed; in this case, bottom and side fittings shall be insulated on both sides with the obligatory measuring of the joint insulation resistance upon completion of installation.

4.1.6.3 Where steel pipes of sea water systems are connected to fittings, pump casings, machinery units and heat exchangers of non-ferrous metal alloys, provision shall be made for protection against contact corrosion.

4.1.6.4 Flow velocity for pipe portions incorporating formed components, throttle diaphragms, as well as through-hull and seacock distance pieces shall not exceed the values specified in Table 4.1.6.4.

Table 4.1.6.4

Pipe material	Permissible flow velocity, in m/s
Steel, including galvanized steel	2,5
Copper-nickel and aluminum-brass alloys	2,0

4.1.6.5 Protection against excessive pressure.

4.1.6.5.1 Pipelines in which pressure in excess of the design pressure is likely to arise, shall be fitted with safety devices so that the pressure would not exceed the design pressure for the pipes.

The liquied diversion from relief valves of pumps transferring flammable liquids shall be effected into the suction side of the pump or to the suction pipeline. This requirement does not apply to centrifugal pumps.

4.1.6.5.2 Where provision is made for a reducing valve on the pipeline, a pressure gauge and a safety valve shall be installed after the reducing valve. An arrangement for by-passing the reducing valve is allowed for use.

4.1.6.6 Insulation of piping.

Insulation of piping shall comply with the requirements of 2.8

4.1.7 Flexible joints (hoses).

4.1.7.1 The type and design of flexible joints used in the systems listed in 4.1.1 shall be approved by the Register. The material of flexible joints shall be selected with regard to the used media to be conveyed, pressures, temperatures and environmental conditions. The bursting pres-

Table 4.1.4

Media conveyed	Class I	Class II	Class III
Inflammable media heated above flash point or having flash point below 60 °C, liquefied gases	Without special safeguards	With special safeguards[1]	–
Fuel oil, lubricating oil, hydraulic oil with flash point of 60 °C and above[2]	$p > 1{,}6$ or $t > 150$	$p \le 1{,}6$ and $t \le 150$	$p \le 0{,}7$ and $t \le 60$
Other media[2, 3, 4]	$p > 4{,}0$ or $t > 300$	$p \le 4{,}0$ and $t \le 300$	$p \le 1{,}6$ and $t \le 200$

[1] Safeguards for reducing leakage possibility and limiting its consequences through proper pipe installation, use of special ducts, protective casings, screening, etc. are subject to special consideration by the Register in each case.

[2] p = design pressure, in MPa; t = design temperature, in °C (see 4.2).

[3] Including water, air, gases, non-flammable hydraulic fluids.

[4] For open-ended pipes (drain, overflow, vent, air and steam lines from safety valves) irrespective of the temperature, Class III pipes may be used.

sure of the flexible joints (except ventilation systems) shall be at least 4 times higher than the design pressure.

4.1.7.2 In the pipelines conveying fuel oil, lubricating oil and other flammable liquids, as well as in pipelines connected with the drives of watertight doors or with the openings in shell plating only fire-resistant flexible joints made as fabricated inserts with end connections (flanges or nipples) are allowed for use. No clamping arrangements are allowed. Where such flexible joints are installed in machinery spaces, provision shall be made for their disconnection in the event of failure. Disconnecting valves shall be located in readily accessible places, in the immediate vicinity of flexible joints so that any flexible joint can be replaced without having to stop other machinery.

4.1.7.3 A joint is considered fire-resistant if, being connected to a pipeline in which water is circulating at a temperature not lower than 80 °C, at the maximum pressure, it withstand heating by fire during 30 min at a temperature of 800 °C and retains its integrity during and after a proof pressure test. As an alternative to this test, are the above-mentioned fire tests with circulating water pressure equal to 0,5 MPa with subsequent hydraulic test for double design pressure.

4.1.7.4 Where a flexible joint is made of steel or other equivalent material complying with the Register requirements for fire-resistance, fire test is not required.

4.1.7.5 In pipelines listed in 4.1.6.2 with bore not more than 10 mm and design pressure of the medium to be conveyed $p \leq 0{,}34$ MPa, as well as in case of bore in excess of 10 mm and the design pressure of the medium to be conveyed $p \leq 0{,}25$ MPa, fire-resistant flexible joints with fire-resistant fuel hoses complying with ISO 7840:2004 may be used.

4.1.7.6 Non-fire-resistant fuel hoses complying with ISO 8469:2004 with bore up to and including 63 mm and design pressure of medium to be conveyed $p \leq 0{,}25$ MPa, may be used for taking over and delivery of oily liquids.

4.1.8 Welding and non-destructive testing of welds.

Welding and non-destructive testing of welds in pipes shall be carried out in compliance with the requirements of Part XIV "Welding" of the Rules for the Classification and Construction of Sea-Going Ships.

4.1.9 Machinery, equipment and control devices.

4.1.9.1 Fans, pumps, compressors and their electric drives used in systems covered by the present Part of the Rules shall comply with the requirements of Section 3 of the present Part and Part VII "Electrical Equipment".

4.1.9.2 Control and monitoring devices of piping systems shall comply with the requirements of Part VI "Automation".

4.1.9.3 Heat exchangers and pressure vessels used in the systems shall comply with the requirements of Part X "Boilers, Heat Exchangers and Pressure Vessels" of the Rules for the Classification and Construction of Sea-Going Ships.

4.2 METAL PIPING

4.2.1 Materials used for pipes and fittings, as well as the methods of testing the materials shall comply with the requirements of Part XIII "Materials" of the Rules for the Classification and Construction of Sea-Going Ships.

The fuel oil pipes shall be manufactured of steel or other material meeting the Register requirements as to its strength and fire-resistance.

These requirements apply also to lubricating oil pipes in machinery spaces and to pipes conveying other flammable oil products including hydraulic and thermal liquids, if they are located in spaces containing sources of ignition.

4.2.2 In general, pipes and fittings of carbon steel and carbon-manganese steel shall be used for media with temperature not exceeding 400 °C and those of low-alloy steel – with temperature not exceeding 500 °C.

These steels may be admitted for temperatures higher than above mentioned, if their mechanical properties and ultimate long-term strength comply with the effective standards and are guaranteed by the steel Maker as suitable for the high temperature service.

Pipes and fittings for media with temperature above 500 °C shall be manufactured of alloy steel. This requirement does not cover exhaust gas pipes.

4.2.3 Copper and copper alloy pipes shall be seamless pipes or of other type approved by the Register.

Copper pipes for Classes I and II shall be seamless.

Pipes and fittings of copper and copper alloys shall generally be used for media having temperature not exceeding 200 °C, and those for copper-nickel alloys, for media with temperature not over 300 °C. Bronze fittings may be admitted for media having temperatures up to 200 °C.

4.2.4 Use of spheroidal or nodular graphite cast iron or aluminium alloys for pipes listed in 4.1.1 is subject to special consideration by the Register in each case.

4.2.5 Pipe wall thickness.

4.2.5.1 The wall thickness of metal pipes (except cast iron and aluminium alloy pipes) operating under the internal pressure shall not be less than that specified in Table 4.2.5.1.

The wall thickness of bilge, air, overflow and sounding pipes passing through fuel oil and ballast tanks is subject to special consideration by the Register in each case.

Table 4.2.5.1

External diameter, mm	Minimum pipe wall thickness, mm				
	Steel pipes			Copper	Copper alloys
	Pipes of systems other than stated in columns 3 and 4	Venting, overflow, sounding pipes of built-in tanks	Sea water pipes (bilge pumping, ballast, cooling water, fire-extinguishing systems)		
6,0	–	–	–	1,0	0,8
10,2	1,6	–	–	1,0	0,8
12,0	1,6	–	–	1,2	1,0
14,0	1,6	–	–	1,2	1,0
16,0	1,8	–	–	1,2	1,0
22,0	2,0	–	3,2	1,2	1,0
25,0	2,0	–	3,2	1,5	1,0
26,9	2,0	–	3,2	1,5	1,0
30,0	2,0	–	3,2	1,5	1,0
32,0	2,0	–	3,2	1,5	1,2
38,0	2,0	4,5	3,6	1,5	1,2
42,4	2,0	4,5	3,6	1,5	1,2
45,0	2,0	4,5	3,6	1,5	1,2
48,3	2,3	4,5	3,6	2,0	1,5
54,0	2,3	4,5	4,0	2,0	1,5
57,0	2,3	4,5	4,0	2,0	1,5
63,5	2,3	4,5	4,0	2,0	1,5
70,0	2,6	4,5	4,0	2,0	1,5
76,0	2,6	4,5	4,5	2,0	1,5
82,5	2,6	4,5	4,5	2,0	1,5
89,0	2,6	4,5	4,5	2,5	2,0
101,6	2,9	4,5	4,5	2,5	2,0

Notes: 1. For pipes with thicknesses and diameters indicated in the Table, the nearest values specified in national or international standards may be accepted on agreement with the Register.

2. The tabulated values require no allowance for negative manufacturing tolerance and reduction in thickness due to bending.

3. The tabulted values do not cover the stainless steel pipes the minimum thicknesses of which are subject to special consideration by the Register.

4. For the diameters greater than those stated in the Table, the minimum thicknesses are subject to special consideration by the Register in each case.

5. If pipes are effectively protected, then, at the discretion of the Register, the wall thicknesses of pipes stated in columns 3 and 4 may be reduced by an amount of not more than 1 mm.

6. For sounding pipes, the thicknesses stated in column 3 apply to the parts which are outside the tanks for which these pipes are intended.

7. For threaded pipes, the wall thickness shown is the minimum thickness at the bottom of the thread.

The data given in Table 4.2.5.1 do not apply to exhaust gas pipes.

4.2.5.2 The wall thicknesses of pipes made of spheroidal graphite cast iron, aluminium alloys, titanium alloys and corrosion-resistant alloys are subject to special consideration by the Register in each case.

4.2.5.3 For the carbon dioxide smothering system, the wall thickness of pipes on a length from cylinders to release valves shall not be less than 4,0 mm and from release valves to discharge nozzles the thickness shall not be less than 3,0 mm.

4.2.6 Radii of pipe bends. Heat treatment after bending.

4.2.6.1 Radii of pipe bends and heat treatment after bending shall comply with the requirements of 2.2, Part VIII "Systems and Piping" of the Rules for the Classification and Construction of Sea-Going Ships, in so much as applicable and sufficient unless expressly provided otherwise below.

4.2.7 Pipe joints.

4.2.7.1 Use of welded, flanged, threaded and mechanical joints, made in accordance with the standards approved by the Register may be allowed.

4.2.7.2 The welded, flanged, threaded and mechanical joints shall comply with the requirements of 2.4, Part VIII "Systems and Piping" of the Rules for the Classification and Construction of Sea-Going Ships in so much as applicable and sufficient unless expressly provided otherwise below.

4.3 PLASTIC PIPING

4.3.1 Scope of application. General requirements.

4.3.1.1 The present requirements apply to all pipes made of plastics.

The requirements do not apply to flexible non-metal joints, rubber hoses, as well as to mechanical joints used in systems with metal pipes.

4.3.1.2 General requirements for plastic pipes and formed components are stated in 6.8, Part XIII "Materials" of the Rules for the Classification and Construction of Sea-Going Ships.

4.3.2 Requirements for piping depending on their purpose.

4.3.2.1 Fire-resistance.

4.3.2.1.1 Pipes and formed components, integrity of which has significant influence on safety of a craft, shall meet the requirements of fire-resistance.

4.3.2.1.2 Depending on pipeline ability to maintain integrity during fire tests according to the procedure stated in Annexes 1 and 2 to IMO Resolution A.753(18), three levels of fire-resistance are specified:

L1: for pipelines withstanding fire test in dry condition during 1 hour;

L2: for pipelines withstanding fire test in dry condition during 30 min;

L3: for pipelines withstanding fire test in filled condition during 30 min.

The scope of application of plastic pipelines depending on fire-resistance level, location and media conveyed is given in Table 4.3.2.1.2.

4.3.2.2 Flame spreading, fire-retardant coatings.

4.3.2.2.1 All pipes, with the exception of pipes located on exposed decks, in cofferdams, etc., shall have the characteristic of slow flame-spread on the surface, not exceeding the average values fixed in IMO Resolution A.653(16) and determined according to the procedure given in Annex 3 to the Resolution, considering the changes arising from curved surface of pipes or specified by other standards approved by the Register.

4.3.2.2.2 When fire-retardant coatings are applied to provide the required level of fire-resistance, they shall comply with the requirements of Part XI "Materials".

Fire-retardant coatings shall be used according to the approved recommendations of the Manufacturer.

4.3.2.2.3 Fire-retardant coatings in junctions shall be applied after conducting of hydraulic tests of the system in compliance with the pipe Manufacturer's recommendations, according to the procedure approved by the Register in each case.

Table 4.3.2.1.2

Application of plastic pipelines.

Nos.	Medium to be conveyed	Piping systems	Location					
			A	G	H	I	J	K
1	Flammable liquids with flash point > 60 °C	Fuel oil	+	0	0	0	L1	L1
		Lubricating oil	+	–	–	0	L1	L1
		Hydraulic	+	0	0	0	L1	L1
2	Sea water	Drainage	L1	0	0	0	–	L1
		Drain pipes of internal spaces	L1[1]	0	0	0	0	0
		Sanitary drains (internal)	0	0	0	0	0	0
		Drainage from weather decks	0[2]	0	0	0	0[2]	0
		Fire main systems	L1	–	0	0	+	L1
		Ballast	L3	0	0	0	L2	L2
		Essential cooling systems	L3	–	0	0	–	L2
		Non-essential cooling systems	0	0	0	0	0	0
3	Fresh water	Essential cooling systems	L3	0	0	0	0	0
		Non-essential cooling systems	0	0	0	0	0	0
4	Other media	Air, sounding and overflow pipes: water tanks and dry compartments	0	0	0	0	0	0
		Flammable liquids, $T_{flash} > 60$ °C	+	0	0	0	+	+
		Pneumatic control systems	L1[3]	0	0	0	L1[3]	L1[3]
		Air pipes for domestic services	0	0	0	0	0	0
		Low pressure steam, water heating	L2	0	0	0	0	0

Symbols:
A – machinery spaces;
G – fuel oil tanks and trunks;
H – ballast tanks and trunks;
I – cofferdams, dry compartments, etc.;
J – accommodation, service spaces and control stations;
K – weather decks;
0 – fire test is not required;
"–" – not applicable;
"+" – only metal materials with fusion point above 925 °C.

[1] For drainage pipes serving only the particular space, "0" may be used instead of "L1".
[2] Scupper holes of weather decks shall be "+", if they are not provided with the appropriate blanking means.
[3] When control functions are not foreseen, "0" may be used instead of "L1".

4.3.3 Installation requirements.

4.3.3.1 Installation work shall be performed in accordance with the Manufacturer's recommendations.

4.3.3.2 Distances between supports shall not exceed the values recommended by the Manufacturer.

In selecting supports and distances between them, pipe sizes, mechanical and physical properties of pipe material, mass of pipes and liquid contained therein, working temperature, influence of heat expansion, loads due to external forces, axial forces, hydraulic impacts, vibration, which may occur in the system, shall be taken into consideration. Allowance shall be made for possible simultaneous effect of the above mentioned loads.

The load from pipe weight shall be equally distributed over the entire load-bearing face of the support. Measures shall be taken to minimize pipe wear at junctions of the pipes with the supports.

4.3.3.3 Components of the system having significant mass shall be fitted with separate supports. In pipe laying, allowance shall be made for periodically involved concentrated loads.

When necessary, pipes shall be protected from mechanical damage.

4.3.3.4 Where plastic pipelines pass through watertight and fire-resistant decks and bulkheads, the requirements of 4.5.1.1, 4.5.1.4 and 4.5.1.5 shall be met.

4.3.3.5 When assembling plastic pipelines, account shall be taken of the compensation tolerance for relative displacement between piping and steel structures with regard to difference in heat expansion ratios and craft's hull deformation.

When calculating heat expansions, the working temperature of the system and the temperature at which assembling is carried out, shall be taken into consideration.

4.3.3.6 When laying pipes, allowance shall be made for periodically involved concentrated loads, if their action is possible. As a minimum, the force caused by one person of 100 kg in mass at the middle of span of any pipe with outer diameter over 100 mm shall be taken into consideration.

4.3.3.7 In systems for transferring liquids, such as diesel oil and petrol, pipes of electrically conductive material shall be used.

Regardless of the liquids transferred, the plastic pipes passing through dangerous zones shall be electrically conductive.

Resistance in any point of the piping system as relative to the earth shall not exceed 10^6 Ohm. Pipes and formed components having electrically conductive layers shall preferably be of equal conductivity.

Such pipes shall be sufficiently protected from damage by electric discharge caused by difference in electrical conductivity of layers.

After installation earth connection shall be checked. Earthing wires shall be accessible for examination.

4.3.3.8 Pipelines may be connected with the use of glued, welded, flanged or other joints.

Strength of joints shall not be less than strength of a pipeline where they are mounted.

4.3.3.9 The method of pipe connection (junction) shall be developed and approved prior to installation.

4.3.3.10 Surveys and tests stated in this Section shall precede the approval of the method.

4.3.3.11 To be reflected in the method of joint connection are: the applied materials, used tools and accessories, the requirements for preparation of joints, temperature conditions, the requirements for dimensions and tolerances, as well as the acceptance criteria upon completion of work and tests.

4.3.3.12 For the inspection of pipe joint quality, it is necessary, in accordance with the accepted procedure to prepare test assemblies which shall include at least one pipe joint with a pipe and a pipe with a formed component.

The test assembly shall comprise a pipe with the maximum diameter.

4.3.3.13 Following joint setting, a test connection shall be subjected to a hydraulic test by a pressure 2,5 times higher than the design pressure, during 1 hour. Leakage and breaks of joint are not allowed.

4.3.3.14 After installation on board, essential piping system shall be hydraulically tested by a pressure at least 1,5 times higher than the design pressure.

Non-essential piping system, after installation on board, may be tested for tightness with the working pressure.

4.4 FITTINGS

4.4.1 Construction, marking, arrangement and installation of fittings.

4.4.1.1 Construction of valves shall comply with the requirements of 4.1.1, Part VIII "Systems and Piping" of the Rules for the Classification and Construction of Sea-Going Ships.

4.4.1.2 Marking of fittings.

4.4.1.2.1 Shut-off fittings shall be provided with conspicuous nameplates fixed in place and bearing clear inscriptions to show the purpose of fittings.

4.4.1.2.2 Remote-controlled valves at control stations shall have attached identification plates showing their purpose, as well as position indicators "open" and "closed".

Where the remote control is used only to close the valve, the indicators need not be fitted.

4.4.1.3 Arrangement and installation of fittings.

4.4.1.3.1 Fittings arranged on watertight bulkheads shall be secured to welded pads by studs, or alternatively the fittings may be welded to bulkhead pieces.

The stud holes in welded pads shall not be through holes.

4.4.1.3.2 Measuring instruments of fuel oil and lubricating oil systems shall be provided with valves or cocks to cut the instruments off from piping.

Thermometer sensors shall be encased in compact sleeves.

4.4.1.3.3 Sight glasses in fuel oil and lubricating oil pipes shall be heat-resistant.

4.4.2 Filters.

4.4.2.1 Filters shall be provided with a device to indicate that there is no pressure therein before they are opened.

The tubes of such devices shall be carried to trays so that spillages are not sprayed around.

4.4.2.2 Filters forming part of systems with combustible working medium shall be located as far away as practicable from potential sources of ignition.

4.4.3 Sea chests and ice boxes. Bottom and side fittings. Openings in shell plating.

4.4.3.1 Sea chests and ice boxes.

4.4.3.1.1 On craft with special ice strengthening meeting the requirements of the

Rules and with a mark "**Ice**" added to the class notation, which allows operation in cake ice, one of the sea chests shall function as an ice box.

4.4.3.1.2 Sea inlet valves shall be secured directly to sea chests.

4.4.3.1.3 The sea inlet valves may be attached to welded pads or fitted on distance pieces directly welded to the hull bottom shell plating.

The distance piece shall have welded flange joint. The wall thickness of a distance piece shall not be less than the thickness of the bottom plate, but in no case it shall be less than 6 mm.

4.4.3.1.4 All the openings in shell plating for sea chests, welded inlet connections and inlet distance pieces shall be fitted with gratings. Instead of gratings, holes or slots in the shell plating are allowed. The net area through the gratings or slots shall not be less than 2,5 times the area of the valve connected to the sea inlet.

The diameter of holes or the width of slots in gratings or shell plating shall be about 20 mm.

The sea chest gratings are recommended to be cleared by compressed air. The pressure of compressed air in the clearing system shall not exceed 0,3 MPa. Clearing pipes shall be provided with non-return shut-off valves.

4.4.3.1.5 Provision shall be made for the access into sea chests via detachable gratings or manholes of the side sea chests and ice boxes, if the manhole is located above the deepest load line.

4.4.3.1.6 In craft assigned mark "**Ice**" attached to the class notation, cooling water recirculation shall be used for ice boxes and bottom sea chests.

For ice boxes, the recirculated water pipes shall be laid to the upper and lower part of the box, and the total sectional area of these pipes shall not be less than the sectional area of the cooling water discharge pipe.

For sea chests, the diameter of the water recirculated pipe shall not be less than 0,85 of the discharge pipe diameter.

4.4.3.2 Openings in shell plating. Bottom and side fittings.

4.4.3.2.1 The location of sea inlet and discharge openings in shell plating shall be such as to prevent:

.1 sewage, domestic waste water and other wastes being sucked by sea water pumps;

.2 sewage, domestic and discharge water penetrating into the craft's spaces through side scuttles, as well as any discharge of water into lifeboats and liferafts when lowered.

Where it is impracticable to comply with the requirements of 4.4.3.2.1, discharge openings shall be fitted with appropriate arrangements to prevent water penetration into the craft's spaces, lifeboats and liferafts.

4.4.3.2.2 The overboard discharges from the enclosed spaces below the freeboard deck may be provided only with one locally controlled non-return shut-off valve.

4.4.3.2.3 The scuppers and overboard discharge pipes from open decks and spaces, led outboard at less than 600 mm above the deepest waterline, shall be fitted with non-return valves (dampers) at the outer shell.

No valves may be provided if the wall thickness of these pipes installed below the freeboard deck is not less than the thickness of the shell plating, but in no case it shall be less than 5 mm.

4.4.3.2.4 In machinery spaces, all the sea inlets and discharges of systems and piping in connection with operation of the main and auxiliary machinery shall be provided with readily accessible shut-off valves or sluice valves, locally controlled. The controls shall be fitted with an indicator to show whether the valve is open or closed.

4.4.3.2.5 The controls of bottom and inlet fittings shall be located in readily accessible places and shall be fitted with a device to indicate whether the valve is open or closed.

4.4.3.2.6 In machinery spaces, the controls of the bottom inlet and side outlet fittings of the sea water system that lie located below the waterline, and the control gear of the ejector drainage system shall be so arranged that there is enough time to access and activate them from a position above the level of water incoming to the space.

It is recommended that the controls of the bottom and side fittings of the sea water system, which lie below the waterline, be located above the freeboard deck.

4.4.3.2.7 Bottom and side fittings shall be attached to welded pads.

Fittings may be also installed on welded distance pieces with welded flange joints.

The wall thickness of a distance piece shall not be less than the minimum thickness of shell plating in the ends of the craft.

Stud holes in welded pads shall not penetrate the shell plating.

4.4.3.2.8 Flange gaskets of bottom and side fittings shall not be manufactured of materials easily deteriorating in case of fire.

4.4.3.2.9 Spindles and closing parts of bottom and side fittings shall be manufactured of corrosion-resistant materials.

4.5 PIPING LAYING

4.5.1 Piping laying through watertight and fire-resistant structures.

4.5.1.1 The number of pipelines passing through the watertight bulkheads shall be kept to a minimum.

The collision bulkhead shall not be pierced below the bulkhead deck by more than one pipeline for dealing with the contents of the forepeak.

Each pipe passing through the collision bulkhead shall be fitted with a screw-down valve installed directly on the collision bulkhead inside the forepeak, operable from a readily accessible position on the bulkhead deck.

The shut-off valve may be omitted on the pipelines passing through the collision bulkhead above the bulkhead deck or freeboard deck.

4.5.1.2 Where pipelines pass through watertight bulkheads, decks and other watertight structures, the appropriate sockets, welded pads and other details to ensure the integrity of the structure concerned shall be used.

The holes for studs shall not penetrate watertight structures and shall be kept within the welded pads.

Gaskets made of materials readily deteriorated in the event of fire, shall not be used.

4.5.1.3 Where pipelines pass through fire-resistant divisions, the requirements of Part X "Fire Protection" shall be met.

4.5.1.4 Where plastic pipes pass through watertight bulkheads and decks forming boundaries of watertight compartments, valves capable of being operated from a position above the bulkhead deck shall be fitted.

The valves shall be of steel or another material equivalent to steel in fire resistance.

4.5.1.5 Where plastic pipes pass through a division of the main vertical fire zone, provision shall be made for steel bulkhead sockets of appropriate length and valves that may be closed from either side of the bulkhead. The valves shall be of steel or another material equivalent to steel in fire resistance.

4.5.2 Piping laying in spaces and tanks.

4.5.2.1 Fresh water pipelines shall not be laid through fuel oil and lubricating oil tanks, nor shall fuel oil and lubricating oil pipes pass through fresh water tanks, unless the pipes are laid in oiltight ducts.

Sea water and lubricating oil piping, as well as air, sounding and overflow pipes may pass through fuel oil tanks if these pipes are of seamless type and have no detachable joints inside the tanks.

4.5.2.2 Pipes passing through chain lockers and other spaces, in which they are subject to mechanical damage, shall be adequately protected.

4.5.2.3 Pipes conveying fuel oil shall not be laid through the accommodation and service spaces as well as under the lining, with the exception of fuel filling pipes which are allowed to be laid through sanitary spaces, provided the pipes used have no detachable joints.

4.5.2.4 The pipes of all the systems and the ventilation ducts shall, where necessary, be fitted with arrangements for blow-down of the working medium or draining of liquid.

4.5.2.5 Pressure pipes are not allowed to be laid above and behind the main switchboards as well as the control panels of essential machinery and equipment.

Such pipes may be carried at a distance not less than 500 mm from the fronts and sides of these switchboards and control panes, provided that at a distance within 1000 mm from switchboards and control panels no detachable joints are used, or the flanged joints have protective casings.

4.5.2.6 On twin-hulled craft, the pipes connecting identical systems of both hulls, when routed along the common upper deck, shall be provided with compensators, where necessary, and protected against damage.

Damage to these pipes shall not involve failure of the systems connected by them.

4.6 BILGE-PUMPING SYSTEM. BALLAST SYSTEM

4.6.1 Pumps.

4.6.1.1 Each self-propelled craft with main engines having total power output of 220 kW and above, installed in a separate hull compartment, shall be provided with at least two power driven bilge pumps one of which shall be a stationary pump connected to the bilge-pumping system.

Sanitary or general service pumps of sufficient capacity may be used as bilge pumps. One of the bilge pumps may be a main engine driven pump or a water ejector.

If fire pumps are used as bilge pumps, the requirement of 6.3, Part X "Fire Protection" shall be met.

4.6.1.2 Each self-propelled craft with main engines having total power output of less than 220 kW, installed in a separate hull compartment, shall be provided with at least two bilge-pumping arrangements; one of these arrangements may be stationary power driven pump or an ejector, while the other arrangement may be a manual pump with a capacity of each pump not less than that specified in Table 4.6.1.2. The use of a portable power pump instead of the stationary one is subject to special consideration by the Register.

On craft having no water fire fighting system, one manual bilge pump may be installed. In this case, compartments may be drained using flexible hose.

Table 4.6.1.2

Hull length, L_{H}, in m	Total bilge pump capacity, in m^3/h	Piping diameters, in mm	
		Main bilge lines	Bilge suctions
$L < 7$	3	25	
$7 \le L < 12$	5	32	
$7 \le L < 15$	5	32	
$15 \le L < 24$	6	40	32

4.6.1.3 On self-propelled craft with engines installed in exposed locations (in cockpit or on transom), pump capacities and internal diameters of the bilge pipes shall not be less than those specified in Table 4.6.1.2.

Also, depending on the craft size, the following requirements shall be met:

.1 if the hull length is less than or equal to 7 m, at least one manual bilge pump which may be a portable pump shall be installed. On agreement with the Register, a non-sinking bailer may be used;

.2 if the hull length is of 7 to 12 m, use shall be made of at least one stationary manual pump operable from the cockpit, with all access ladders and hatches closed;

It is advisable to have on board a secondary pump, permanently installed or portable, of the same capacity;

.3 if the hull length is greater than or equal to 12 m, the craft shall be provided with two pumps one of which shall be a power driven pump.

In this case, one pump shall be operable from the cockpit, with all access ladders and hatches closed.

4.6.1.4 Non-self-propelled craft and berth-connected craft provided with power sources or supplied with power from shore shall be equipped with drainage arrangements as self-propelled craft with main engines of power output less than 220 kW, installed in a separate hull compartment or with engines installed in exposed location (in cockpit or on transom).

4.6.1.5 For non-self-propelled manned craft having no power-driven machinery, it is sufficient to install one or several manual pumps with a total capacity not less than that specified in Table 4.6.1.5.

Table 4.6.1.5

$0{,}8 L \cdot B \cdot D$[1], in m^3	Total pump capacity, in m^3/h
Up to 50	4
More than 50	6

[1] Definitions of *L*, *B*, *D* (length, breadth and depth), in m, are given in Section 1, Part II "Hull". *D* is measured in each particular case up to the freeboard deck level.

4.6.1.6 On multi-hulled craft (catamarans, trimarans), each hull shall be provided with an independent bilge-pumping system complying with the relevant requirements of this Chapter.

4.6.1.7 Centrifugal bilge pumps shall be of self-priming type, or alternatively the system shall be provided with a vacuum arrangement.

4.6.1.8 Each bilge pump required in 4.6.1.1 shall have a capacity Q, in m^3/h, not less than that determined from the formula

$$Q = 5{,}65 \cdot 10^{-3} \cdot d^2 \qquad (4.6.1.8)$$

where d = inner diameter of the main line determined in accordance with 4.6.2.1.

One of the bilge pumps may be replaced by two pumps with a total capacity not less than that specified above.

4.6.1.9 Cockpits may be drained by gravity in accordance with the requirements of Section 10, Part III "Arrangements, Equipment and Outfit".

4.6.2 Piping diameters.

4.6.2.1 The internal diameter d_1, in mm, of the main bilge line and that of bilge suctions directly connected to the pump, except specified in 4.6.2.2, shall be determined by the following formula:

$$d_1 = 1{,}5\sqrt{L(B + D)} + 25 \qquad (4.6.2.1)$$

where L, B, D, see 4.5.1.4.

4.6.2.2 The internal diameter d_0, in mm, of the branch bilge suctions connected to the main bilge line and that of the manual pump suction shall be determined by the formula

$$d_0 = 2{,}0\sqrt{l(B + D)} + 25 \qquad (4.6.2.2)$$

where l = length of the compartment to be drained, as measured at its bottom, in m;

B, D, see 4.6.1.4. In case of multi-hulled craft, B is assumed to be the breadth of one hull.

4.6.2.3 The internal diameter of the main bilge line and bilge suctions determined from formulae 4.6.2.1 and 4.6.2.2 shall not be less than 40 mm. On craft of less than 10 m in length, this value of the internal diameter may be reduced to 20 mm. The internal diameter of the main bilge line and bilge suctions directly connected to the pump shall not, in any case, be less than the bilge pump suction diameter.

4.6.2.4 The cross-sectional area of the pipe connecting the distribution chest with the bilge main shall not be less than the total cross-sectional area of two largest branch bilge suctions connected to the chest, but it need not be greater than the sectional area of the bilge main.

4.6.2.5 The diameter of the emergency bilge suction in the engine room shall not be less than that of the pump suction.

4.6.3 Piping laying.

4.6.3.1 The bilge lines and their branch suctions shall be so arranged as to enable any watertight compartment to be drained by any one of the pumps required in 4.6.1.1, 4.6.1.2, 4.6.1.4, 4.6.1.8.

4.6.3.2 The system shall be arranged so as to prevent the possibility of sea water penetrating inside the craft, or water from one watertight compartment into another, in the event of pipe breaking or any other pipe damage in any other compartment because of collision or grounding. For this purpose, the suction valves of the drainage pipes open ends, connected directly to the chests, shall be of non-return type. In case where only one common piping system for all pumps is available, provision shall be made for control of the required valves serving the suctions from positions above the main deck. Other equivalent arrangements are also allowed.

4.6.3.3 The arrangement of the bilge pipes shall be such as to make it possible to drain the engine rooms through the suctions directly connected to the pump, the other compartments being simultaneously drained by other pumps.

4.6.3.4 The arrangement of the bilge pipes shall be such as to enable one of the pumps running in case when the rest of pumps are inoperative or are used for other purposes.

4.6.3.5 In general, the bilge pipes shall be laid outside the double bottom space. Where the pipe is laid within the double bottom space, the bilge suctions in each watertight compartment shall be fitted with non-return valves.

4.6.3.6 The arrangement and number of the bilge suctions shall be determined in each case depending on the shape and size of the compartment.

The bilge suctions in each compartment shall be arranged in such a manner as to ensure most complete drainage of the compartment with the craft been heeled 5^0 either way.

4.6.3.7 Lengthwise, bilge suctions shall be arranged in the following manner:

on craft operating in upright position – near the aft bulkheads of forward compartments and near the forward bulkheads of aft compartment;

on craft constantly operating with a trim by stern – near the aft bulkheads of compartments.

4.6.3.8 Peaks and steering engine rooms may be drained by their own manual pumps or water ejectors as well as through drain pipes laid into the engine room or the adjacent compartment.

Drain pipes shall have readily accessible self-closing valves or gate valves fitted on the bulkheads on the adjacent compartment side, provided that the gate valves are controlled from the deck, and shall be not less than 39 mm in diameter.

4.6.3.9 Drainage of chain lockers may be carried out by means of manual pumps, water ejectors or by removing water through drain openings into the forepeak.

4.6.4 Drainage of enclosed machinery spaces.

4.6.4.1 The arrangement and number of bilge suctions in the engine and boiler rooms shall comply with 4.6.3.1 to 4.6.3.7. One of the bilge suctions shall be connected directly to an independent bilge pump.

4.6.4.2 Suctions for bilge drainage of machinery spaces shall be fitted with mud boxes or strum boxes, provided they are accessible for cleaning. Pipes between mud boxes and bilges shall be as straight as practicable. The lower ends of these pipes need not be fitted with strum boxes.

4.6.4.3 In all self-propelled craft of design categories **A**, **A1**, **A2** or **B** with main engines having total power output of 220 kW and over, provision shall be made for an emergency bilge drainage of machinery spaces, in addition to bilge suctions required by 4.6.3.1. For this purpose, the largest available sea water power pump shall be fitted with direct suction pipe at the drainage level and also fitted with a non-return stop valve. The diameter of this direct suction shall be equal to that of the pump suction branch.

The capacity of this pump shall exceed that required in 4.6.1.8 by an amount satisfactory to the Register.

The spindles of the non-return stop valves fitted to the suction branches shall extend above the engine room floor plates to a sufficient height and shall bear a notice “For emergency use only”.

Use of fire pumps for emergency drainage of machinery spaces shall be in compliance with 6.3, Part X “Fire Protection”.

For sailing-motor and motor-sailing craft, this requirement is of recommendatory character.

No strum boxes and strainers shall be fitted on the suction for emergency drainage.

4.6.4.5 In craft having an electric propulsion plant, the arrangement shall be such that the bilge wells under the propulsion motors are properly drained and automatic alarms are fitted to give warning at excess of permissible level in the wells.

4.6.5 Ballast system.

4.6.5.1 The ballast system shall be served by at least one pump. The capacity of the ballast pump shall be such as to ensure the speed of water not less than 2 m/s, with the suction pipe diameter taken from Formula (4.6.5.4) for the largest ballast tank.

Each hull of twin-hulled craft shall be provided with an independent ballast system, as appropriate.

4.6.5.2 General service pumps of sufficient capacity, as well as bilge, fire or standby cooling pumps may be used as ballast pumps.

The pumps used for pumping out ballast water from the double-bottom tanks shall be of self-priming type.

Fire pumps may be permitted subject to compliance with 6.3, Part X “Fire Protection”.

4.6.5.3 Ballast tanks shall not, generally, be intended for the carriage of fuel oil.

Possible relaxations from this requirement shall be specially considered by the Register in each particular case.

The standby pump shall not be used for ballasting, nor shall the ballast pump be used as a standby cooling pump or fire pump.

4.6.5.4 The internal diameter, d_B, in mm, of ballast pipe suctions for separate tanks shall be determined by the following formula:

$$d_B = 16\sqrt[3]{v} \qquad (4.6.5.4)$$

where v = ballast tank capacity, in m^3.

The diameter may be adopted by the nearest standard size.

The diameter of the ballast main line shall not be less than the maximum diameter of the suction determined by Formula (4.6.5.4).

4.6.5.5 The arrangement of the suctions shall be such as to ensure pumping of water from any ballast tank, whether the craft is upright or heeled to 5°.

4.7 AIR, OVERFLOW AND SOUNDING PIPES

4.7.1 Air and overflow pipes, overflow tanks.

4.7.1.1 Each tank intended for the storage of liquid and each cofferdam to be filled, as well as the sea chests and ice boxes shall have air pipes meeting the requirements of this Chapter.

Air pipes of ice boxes and sea chests shall have shut-off valves fitted directly on them.

Air pipes of double bottom tanks and tanks adjoining the shell plating, as well as air pipes of sea chests and ice boxes, shall be carried to above the bulkhead deck (main deck).

4.7.1.2 The air pipes of tanks shall be fitted at the highest parts of the tanks and, as a rule, at a place that is at maximum distance from the filling pipe. The number and arrangement of the pipes shall be selected depending on the shape and size of the tank, and shall also preclude the formation of air pockets.

If air pipes of fuel oil tanks are used as overflow (air/overflow) pipes, the requirements of 4.7.1.8 shall be complied with.

The air pipes of tanks carrying liquids of different kinds are not permitted to be laid into a common line.

4.7.1.3 The height of the air pipes measured from the deck to the level to which liquid may have access from below shall not be less than:

in craft of design categories **A** and **A1**: 760 mm – for pipes on the freeboard deck, and 450 mm – for pipes on the decks arranged above;

in craft of design categories **A2** and **B**: 600 mm – for pipes on the freeboard decks, and 380 mm – for pipes on the decks arranged above;

in craft of design categories **C** and **C1**: 450 mm – for pipes on the freeboard deck, and 300 mm – for pipes on the decks arranged above;

in craft of design categories **C2, C3** and **D**: 250 mm.

The air pipes shall be located in places where there is no possibility of their damage.

4.7.1.4 The upper end of each air pipe shall be made as a bend, with its opening faced downwards, or shall have another construction agreed upon with the Register.

Outlets of air pipes situated on the open deck are recommended to have permanently attached automatically operating covers preventing the sea water from penetrating into the tanks, but allowing a free access to air and liquid.

The air pipes of independent lubricating oil tanks not fitted with heating arrangements, may terminate in spaces where the tanks are installed, if precautions are taken that will preclude spillage of oil onto electrical equipment or heated surfaces in case the tank is overflowing.

4.7.1.5 The total cross-sectional area of air pipes in tank filled by gravity shall not be less than the total cross-sectional area of the filling pipe of that tank.

The total cross-sectional area of air pipes in tank filled by the craft's pumps or shore pumps shall not be less than 1,25 times the cross-sectional area of the filling pipe of that tank.

The cross-sectional area of a common air pipe from several tanks shall be at least 1,25 times the cross-sectional area of the common filling pipeline of these tanks.

4.7.1.6 The air pipes of fuel oil and lubricating oil tanks in way of accommodation spaces shall not have detachable connections.

4.7.1.7 Nameplates shall be attached to the upper ends of all air pipes.

4.7.1.8 Fuel oil tanks filled by pumps shall be provided with overflow pipes directing fuel oil to an overflow tank or storage tank the capacity of which shall not be less than that of the overflow tank as stipulated in 4.7.1.15.

The cross-sectional area of an air pipe of a tank fitted with overflow pipe shall not be less than 1/3 of the cross-sectional area of the filling pipe.

Where the air pipes from several tanks fitted with overflow pipes are combined into a common pipe, the sectional area of the common air pipe shall not be less than 1/3 of the sectional area of the common filling pipe of these tanks.

Where air pipes are simultaneously used as overflow pipes, they shall not be connected to the air pipes of overflow tanks.

4.7.1.9 The inner overflow pipe diameter shall be at least 40 mm under all conditions.

The arrangement of air pipes shall preclude the formation of hydraulic seals in the pipes.

4.7.1.10 Where the overflow pipes from several integrated tanks located in different watertight compartments are laid to a common header or pipe, this header or pipe shall be located above the deepest waterline.

4.7.1.11 The overflow pipes of fuel oil and lubricating oil daily and settling tanks shall be laid to tanks located below the tanks mentioned above.

4.7.1.12 Overflow pipes shall be extended to the bottom of the overflow tanks with a minimum clearance. The flow area of the clearance shall not be less than the sectional area of the overflow pipe.

4.7.1.13 Minimum overflow pipe bore shall be 50 mm.

4.7.1.14 A sight glass shall be fitted on vertical sections of the overflow pipes, or an alarm device shall be provided to give warning when the predetermined level is reached in the overflow tank.

Sight glasses on the fuel oil and lubricating oil pipes shall be heat-resistant.

4.7.1.15 The capacity of an overflow tank shall be not less than the maximum permissible throughput of the fueling system within 10 min.

The overflow tank shall be provided with visual and audible alarms actuated whenever the tank filling reaches 75 per cent.

4.7.1.16 The air pipes from crankcases of internal combustion engines shall comply with the requirements of 3.2.2.

4.7.2 Sounding arrangements.

4.7.2.1 Each tank intended for the storage of liquid, cofferdams and void spaces with bilge connections, as well as bilges and bilge wells in spaces which are not readily accessible at all times, shall be provided with sounding pipes for level measurement, generally extended to the exposed decks. Other sounding arrangements of design approved by the Register may be used in tanks.

Sounding pipes shall be as straight as practicable and shall not interfere with taking soundings with a sounding rod.

Sounding pipes of independent tanks are not required to be carried to the exposed deck.

Upper ends of the sounding pipes of fuel oil and lubricating oil tanks shall not be laid to the spaces which may present a risk of ignition of leakages from sounding pipes. The sounding pipes of the fuel tanks must not be laid to accommodation and service spaces.

Other oil- level gauges may be permitted provided they are protected by casings of steel or another fire-resistant material.

Level indicators in the fuel oil and lubricating oil tanks shall comply with the requirements of 4.10.2.3.8.

4.7.2.2 The sounding pipes of fuel oil and lubricating oil tanks are allowed to be laid to positions above the machinery space floor plates, provided that such pipes are fitted with self-closing valves and their height is at least 0,5 m above the floor level. Self-closing test cocks shall be fitted below the above-mentioned self-closing valves. The said pipes shall not be used as air pipes.

4.7.2.3 Provision shall be made under the open ends of sounding pipes for welded-on striking plates or other strengthening to protect the bottom plating from damage by sounding rod.

In case of slotted sounding pipes with closed ends, adequately strong closing plugs shall be provided.

4.7.2.4 The internal diameter of sounding pipes shall not be less than 25 mm.

Nameplates shall be attached to the upper ends of sounding pipes.

4.7.2.5 The ends of sounding pipes carried to the exposed deck shall be fitted with tight plugs.

Plugs and threaded portions of deck sockets shall be of bronze or brass. The use of other material is subject to special consideration by the Register in each case.

The use of closing means of other types is subject to special consideration by the Register in each case.

Self-closing fittings of sounding pipes of the double bottom fuel oil tanks shall be corrosion-resistant and shall not initiate sparks.

If the sounding pipes project above the open deck, they shall be located at such positions where they cannot be damaged, otherwise they shall have appropriate guards.

4.8 EXHAUST GAS SYSTEM

4.8.1 Exhaust gas piping.

4.8.1.1 The exhaust gas pipes shall, as a rule, be laid to the open deck.

4.8.1.2 Where the exhaust gas pipes are laid through the side plating or transom in the vicinity of the waterline or below it, provision shall be made for arrangements precluding the possibility of sea water entering the engine.

Inside the machinery space a loop shall be arranged with its upper part located above the deepest waterline.

4.8.1.3 The exhaust gas pipes shall be laid at a distance not less than 450 mm from the fuel oil tanks.

4.8.1.4 Each main engine shall have an individual exhaust gas pipe. Where required, departures may be allowed, subject to special consideration by the Register.

The exhaust gas pipes of auxiliary engines may be connected to a common exhaust gas pipeline provided that the common exhaust gas pipeline is fitted with reliable devices precluding gases of the common line entering the pipes of the engines not actually in work as well as damage of any of the engines when started.

In craft intended for operation in offshore areas of navigation, the exhaust gas pipes of the main and auxiliary engines may be permitted to be connected to a common exhaust line provided that the foregoing precautions are taken.

4.8.1.5 The gas exhaust pipes of the internal combustion engines shall be generally made of steel.

The exhaust gas pipelines of the engines with "wet" exhaust or when the exhaust gases are cooled by the engine cooling water, may be completely or partly manufactured of plastic pipes or flexible hose.

4.8.1.6 The exhaust gas pipes of the internal combustion engines shall be thermally insulated by means of suitable insulating material or double walls. The temperature of the insulation surface shall not exceed 60 °C.

The material used for thermal insulation shall be noncombustible. In machinery space, the surface of the insulating material shall be oil- and oily vapor-impermeable.

The exhaust gas pipes with "wet" exhaust or double walls cooled by water may not be insulated if the temperature of the pipe surface does not exceed 60 °C.

4.8.1.7 The exhaust gas pipes of engines shall be fitted with thermal compensators.

4.8.1.8 Exhaust gas pipes passing through accommodation spaces or the wheelhouse shall be enclosed by a protective casing inside these spaces. The interspace between the exhaust gas pipes and protective casing shall communicate with the open atmosphere.

4.8.2 Silencers, spark arresters and heat exchangers.

4.8.2.1 The exhaust gas pipes shall be generally fitted with silencers and, whenever necessary, with spark arresters.

4.8.2.2 The silencers and spark arresters shall be so arranged as to permit cleaning or draining of tar and condensate from the nearest pipeline portion, and shall be provided with appropriate handholes or drain cocks and plugs.

4.8.2.3 Where waste heat-exchanging apparatus are installed, arrangements shall be provided to prevent possible ingress of water into the engine due to leakages in the heat exchangers or damage thereof.

4.9 VENTILATION SYSTEM

4.9.1 Ventilation ducts and ventilation heads. Air inlets.

4.9.1.1 Ventilation ducts shall not be laid through watertight bulkheads below the bulkhead deck (main deck).

4.9.1.2 Where trunkways and vertical ducts of ventilation system pass through watertight decks, they shall be watertight and equivalent in strength to adjacent hull structures within a single watertight compartment below the bulkhead deck.

4.9.1.3 Where ventilation ducts pass through the main fire-retarding bulkheads, they shall be fitted with steel fire dampers installed generally on the bulkheads. The fire dampers shall be capable of being locally closed from both sides of the bulkhead.

Places where dampers and their driving gear are installed shall be readily accessible and painted red. Indicators shall be provided to show whether the damper is open or closed. Where the damper is not installed on the bulkhead, the duct between the bulkhead and the damper shall have insulation corresponding to the degree of fire integrity of the bulkhead.

4.9.1.4 Ventilation ducts leading to machinery and other spaces fitted with fire smothering facilities shall have closing arrangements to preclude movement of gas. The inlets and outlets of the ventilation systems of these spaces shall be provided with tight covers or closing arrangements and, where they are arranged in the said spaces, also with actuators for closing them from positions outside the spaces fitted with fire smothering facilities.

4.9.1.5 In places of possible sweating, the ventilation ducts shall be properly insulated. Drain plugs shall be provided for portions of ducts where water is likely to accumulate.

4.9.1.6 Ventilation heads of supply ducts and air inlets of ventilation system shall be so located that the risk of drawing in air contaminated by gas, oil vapors, etc. is minimized and admission of sea water into the ventilation ducts is precluded.

On ice-strengthened craft, the ventilation ducts shall be protected against penetration of snow .

It is recommended to arrange air intakes on both sides of the craft and to provide them with heating arrangements.

4.9.1.7 Provision shall be made for closing all the main air inlets and outlets of ventilation systems of spaces in accordance with 4.9.1.9.

4.9.1.8 Ventilators to spaces below the freeboard deck shall be fitted with strong coamings.

Construction of the coamings shall meet the requirements of Part II “Hull”.

Thickness of the metal coaming shall not be less than the thickness of the deck in way of the coaming.

4.9.1.9 The requirements for the closing arrangements of the air inlets and outlets and for the height of their coamings shall be consistent with 9.2.2 and 9.2.4, Part III “Arrangements, Equipment and Outfit”.

4.9.1.10 Galley ventilation systems shall be separated from ventilation systems serving other spaces.

Exhaust ducts from galley ranges shall be made of steel where they pass through accommodation spaces or spaces containing combustible materials. Each exhaust duct shall be fitted with a readily removable grease trap and with a fire damper located in the lower end of the duct.

4.9.2 Ventilation of machinery spaces.

4.9.2.1 Ventilation of machinery spaces shall be such that under all service conditions including heavy weather a supply of air is maintained which is sufficient for operation of machinery at full load as well as for the safety and comfort of the attending personnel.

The ventilation shall ensure removal of gases heavier than air from the lower zones of those spaces, from below floor plates, from where fuel system equipment and daily tanks are installed.

Provision shall be made for disabling of the artificial ventilation from a readily accessible position outside the machinery space.

4.9.2.2 Enclosed machinery spaces in which carburetor (petrol) engines are installed, shall, in addition to the natural supply ventilation, be fitted with a forced exhaust ventilation ensuring at least 10 air changes per hour, proceeding from the volume of empty spaces.

The forced exhaust ventilation shall be served by a fan of intrinsically safe design. The electric motor shall be of safe type or located outside the exhausted air flow.

The natural ventilation ducts shall have the cross-sectional area:

$$F = 40\,V, \text{ in cm}^2, \quad \text{but not less than } 45 \text{ cm}^2 \qquad (4.9.2.2)$$

where V = volume of empty space, in m^3.

4.9.2.3 Enclosed spaces where carburetor (petrol) engines and petrol tanks or canisters with fuel are installed, shall be provided with a natural supply-exhaust ventilation with separate supply and exhaust ducts.

The ducts shall have cross-sectional area not less than that determined from Formula (4.9.2.2).

4.9.2.4 Spaces for portable canisters with petrol shall be provided with a natural supply-exhaust ventilation ensuring removal of air from the upper zone of the ventilated space.

The inlet air shall be supplied into the lower part of the ventilated space.

The cross-sectional area of the ventilation ducts shall be at least 20 cm^2.

The discharges of the exhaust ducts shall be carried to places where issuing gases do not present a fire hazard.

4.9.3 Ventilation of accumulator battery rooms and boxes.

4.9.3.1 The accumulator battery rooms and boxes shall be provided with an independent ventilation system capable of removing air from the upper part of the ventilated spaces.

The exhaust ducts shall be gastight.

4.9.3.2 The inlet air shall be supplied into the lower part of the ventilated space.

4.9.3.3 The outlets of ventilation ducts shall be so constructed as to preclude penetration of sea water, atmospheric precipitation and solids.

No flame arresting fittings shall be installed.

The discharges of the exhaust ducts shall be carried to places where issuing gases do not present a fire hazard.

4.9.3.4 The boxes of accumulator batteries having a charging capacity not over 0,2 kW may be ventilated through the openings in the lower and upper parts of the box to ensure removal of gases.

4.9.3.5 The rate of air flow, Q, in m^3/s, for the ventilation of an accumulator battery room or box shall not be less than that determined by the formula

$$Q = 3{,}06\,I \cdot n \cdot 10^{-5} \qquad (4.9.3.5)$$

where I = maximum charging current during gas emission, but not less than 0,25 of the maximum current of the charging device, in A;
n = number of battery cells.

4.9.3.6 The cross-sectional area, F, in m^2, of the duct, in case of natural ventilation of accumulator battery rooms and boxes, shall not be less than that determined by the formula:

$$F = 1{,}04\,Q, \quad \text{but not less than } 0{,}004\ \text{m}^2 \qquad (4.9.3.6)$$

where Q = rate of air flow determined by Formula (4.9.3.5).

4.9.3.7 Natural ventilation of the spaces may be used in the following cases:

.1 required amount of air calculated by Formula (4.9.3.5), is less than $2{,}36 \cdot 10^{-2}$ m^2/s;

.2 angle of the duct deflection from the vertical is 45°;

.3 number of bends of the duct does not exceed two;

.4 length of the duct does not exceed 5 m;

.5 operation of the ventilation system does not depend on the direction of the wind;

.6 cross-sectional area of the duct is taken not less than that determined by Formula (4.9.3.6).

Where the rate of air flow determined by Formula (4.9.3.5) is $2{,}36 \times 10^{-2}$ m^3/s and over, the accumulator battery room shall be provided with forced exhaust ventilation.

The internal surfaces of exhaust ducts and fans shall be protected against the action of the electrolyte.

The motors of fans shall not be located in way of gas exhaust.

The construction of fans shall comply with the requirements of Section 3.

4.10 FUEL OIL SYSTEM

4.10.1 Pumps. Piping laying.

4.10.1.1 A power driven fuel oil transfer pump and a standby pump which may be a manual pump shall be provided for fuel oil transfer.

Any suitable pump, including the fuel oil separator pump may be used as a standby pump.

On craft intended for operation in offshore areas of navigation, one pump may be installed.

On craft with daily consumption of fuel oil less than 1000 kg, a manual pump is allowed.

4.10.1.2 Where fuel oil tanks are regularly used also for water ballast, provision shall be made for reliable arrangements disconnecting the ballast system from these tanks when carrying fuel oil and also the fuel oil system when containing water ballast.

4.10.1.3 The fuel oil transfer pumps and separator pumps, besides local control, shall be provided with stopping means operable from always accessible positions outside the spaces where the pumps are installed.

Shut-off valves shall be fitted on the pressure side and suction side of fuel oil pumps.

4.10.1.4 Laying of diesel oil piping.

4.10.1.4.1 The diesel oil pipes, their fittings and joints shall comply with the requirements of 4.2.1, 4.2.2, 4.2.3, 4.2.5.

The fuel oil pipes shall be properly secured and protected against mechanical damage.

4.10.1.4.2 The fuel oil pipelines shall have no communication with other piping systems, shall not be laid above the internal combustion engines, exhaust gas pipes, electrical switchboards and control panels.

In exceptional cases, it is allowed to lay fuel oil pipes above the said equipment, provided that in these positions the pipes have no detachable joints.

4.10.1.4.3 Such pipes may be carried at a distance not less than 500 mm from the fronts and sides of the switchboards and control panels, provided that at a distance of 1000 mm from switchboards and control panels no detachable joints are used or the joints have protective casings, and trays are installed in appropriate positions to prevent the spillage of fuel oil on the equipment or sources of ignition.

4.10.1.4.4 The fuel oil suction pipes from tanks of more than 50 l in capacity, as well as the pipes intended to equalize the level of fuel in tanks, where such tanks are located outside the double bottom, shall be provided with shut-off valves fitted directly on the tanks. These valves shall be capable of being closed from always accessible positions located outside the space containing the tanks.

4.10.1.4.5 For draining water from daily service and settling tanks, these tanks shall be fitted with self-closing valves and pipes connected to drain tanks.

The drain pipes shall be fitted with heat-resistant sight glasses. Where trays are available, open funnels may be used instead of sight glasses.

4.10.1.4.6 Tanks, pumps, filters and other equipment shall be fitted with drip trays where there is a possibility of fuel oil leakage.

Drain pipes from the drip trays shall be laid into the fuel oil drain tanks.

The internal diameter of the drain pipes shall be at least 25 mm.

Drainage of fuel oil into the bilges is not permitted.

On craft intended for operation in offshore areas of navigation, drip trays may be fitted with plugs or local drain pipes with a shut-off devices enabling the fuel oil leaks to be collected in portable tanks.

4.10.1.4.7 The drain tanks shall be fitted with an alarm sensor to give warning when the tank is filled to 80 per cent of its volume.

If the drain pipes from drip trays or tanks fitted in different watertight compartments are laid into common drain rank, structural precautions shall be made to prevent water from one flooded compartment to enter the other compartment via the open ends of drains.

4.10.1.5 Petrol piping.

4.10.1.5.1 Compliance with the requirements of 4.10.1.4.1 and 4.10.1.4.2 is mandatory.

4.10.1.5.2 The fuel oil pipeline shall de accessible for inspection over its entire length. Number of detachable joints shall be kept to a minimum. Pipe joints shall have no gaskets.

4.10.1.5.3 For draining water from daily service and settling tanks, these tanks shall be fitted with self-closing valves and pipes connected to drain tanks.

Drain pipes shall be fitted with heat-resistant sight glasses.

Where drain tanks are unavailable, water from the daily service tanks shall be drained into a portable tank fitted with flame-arresting screen.

In this case, the self-closing valve shall be fitted with a dome nut on the draining end.

4.10.2 Arrangement of fuel oil tanks.

4.10.2.1 Arrangement of fuel oil tanks intended for fuel oil with a flash point not lower than 55 °C (diesel oil).

4.10.2.1.1 In general, the fuel oil tanks shall be integral with the hull and, as far as practicable, located outside the machinery spaces.

Where the fuel oil tanks, other than the double bottom tanks, are arranged adjacent to, or within, the machinery space, their surfaces in the machinery space shall be as small as possible and shall preferably have a common boundary with the double bottom tanks.

Where the fuel oil tanks are arranged within the machinery space, they shall not contain fuel oil with a flash point below 60 °C.

The fuel oil tanks shall not have common walls with the fresh water storage tanks.

4.10.2.1.2 The fuel oil tanks and independent fuel oil tanks shall be placed on oil-tight drip trays.

4.10.2.2 Arrangement of fuel oil tanks intended for fuel oil with a flash point below 43 °C.

4.10.2.2.1 Fuel oil shall be stored only in independent tanks located in a separate compartment isolated from the machinery space and accommodation compartments by a gas-tight bulkhead and provided with an independent natural ventilation which ensures removal of fuel vapors from any point of the compartment.

4.10.2.2.2 Each tank and compartments in which the tank is located shall be fitted with an air pipe laid to the exposed place on the deck.

Air pipes of the compartment and tanks shall be separated.

Outlets of the air pipes shall be fitted with permanently attached heads with double flame-arresting screens and a float. The height of air heads shall meet the requirements of 4.7.1.3.

4.10.2.2.3 The fuel oil tanks located in exposed machinery spaces (compartments), in superstructures as well as in other exposed places shall be protected against the action of sunrays.

4.10.2.2.4 The fuel oil tanks shall be earthed by connection to engine seating or earth plate.

4.10.2.2.5 Enclosed compartment in which independent petrol storage tanks are installed shall be provided with carbon dioxide or aerosol fire extinguishing system.

4.10.2.2.6 Fuel oil tanks delivered complete with outboard engines shall be appropriately secured to avoid displacement thereof and damage to fuel oil pipe or flexible fuel oil hose.

4.10.2.3 Fuel oil tanks.

4.10.2.3.1 Fuel oil tanks shall be made of carbon steel, corrosion resistant steel or aluminium alloys.

Copper-base alloy fittings shall not be installed on aluminium fuel oil tanks.

4.10.2.3.2 The wall thickness of the fuel oil tanks shall not be less than that given in Table 4.10.2.3.2.

Materials used for manufacture of the fuel oil tanks shall comply with the requirements of Part XI “Materials”.

Use of other materials is subject to consideration by the Register in each case.

Table 4.10.2.3.2

Tank capacity, in dm^3	Minimum wall thickness, in mm		
	Carbon steel	Corrosion-resistant steel	Aluminium alloy
< 100	2[1]	1	2
100 – 200	3	1,5	3
200 – 500	4	2	4
500 – 1000	5	3	5

[1] For externally galvanizes tanks 1,5 mm may be allowed.

4.10.2.3.3 Fastenings of the fuel oil tanks made of aluminium alloys shall be manufactured of aluminium alloys or corrosion-resistant steel.

4.10.2.3.4 The inner surfaces of the fuel oil tanks shall not be painted or galvanized. The outer surface of the fuel oil tanks shall be efficiently protected against corrosion.

The fuel oil tanks shall be designed and installed so that no exterior surface will trap water.

4.10.2.3.5 The fuel oil tanks shall be so designed as to withstand s test pressure not less than 0,02 MPa. Whenever necessary, tanks shall be reinforced or have internal bulkheads.

4.10.2.3.6 Wherever possible, all fittings and openings shall be on top of petrol tanks.

Nevertheless, where fittings are installed on the sides, welded pads shall be used for direct mounting of the fittings on the tank side.

4.10.2.3.7 The fuel oil tanks shall have manholes for inspection of the interiors:

150 mm in diameter – for tanks from 50 up to 500 dm^3 in capacity;

350 · 450 mm – for tanks over 500 dm^3 in capacity.

4.10.2.3.8 Each fuel oil tank shall be provided with a means to determine fuel level or quantity.

4.10.2.3.8.1 Diesel oil tanks may be fitted with sounding pipes or column-type sight gauges.

The column-type sight gauges shall have transparent, unbreakable inserts made of artificial material or glasses retaining their properties under effect of fuel.

A self-closing shut-off valve shall be installed between the level indicator and the lower part of the tank. If the level indicator is connected with the tank below the highest possible liquid level, such device shall be also installed in the upper part of the tank.

The use of other level gauges is subject to consideration by the Register in each case.

4.10.2.3.8.2 The petrol tanks shall be provided with a level detector with an indicator installed in the conning station.

The detector shall be of an intrinsically safe design.

4.10.2.3.9 Diesel oil and petrol tanks complying with the requirements of ISO 21487:2006 may be used.

4.10.2.4 The fuel oil tanks shall not be immediately adjacent to accommodation spaces. The air interspace between the fuel oil tank and accommodation space shall be effectively ventilated.

The fuel oil tanks located in machinery space (see 1.2.1, Part X “Fire Protection”) shall be made of steel or equivalent material.

The fuel oil tanks shall not be located in front of the collision bulkhead.

4.10.3 Filling of fuel oil storage tanks and portable canisters.

4.10.3.1 The bunkering of the craft shall be carried out through a permanent pipeline provided with fittings necessary for filling of all the basic fuel oil storage tanks.

On multi-hulled craft, the suction pipes shall ensure the filling of fuel oil tanks of any of the hulls as well as transfer of fuel oil from the tanks of one hull into the tanks of the other.

The end of the filling pipe shall be carried to the tank bottom with a clearance not less than 1/4 of the internal diameter of the pipe.

4.10.3.2 The bunkering point shall be protected by coamings preventing spillage of fuel oil due to leakage from the filling pipe.

The suction pipe shall have a reliable closing arrangements . Where deck sockets are used as fuelling arrangements, they shall have a plug made of copper-base alloys.

4.10.3.3 The filling pipes of tanks located above the double bottom, as well as filling pipes of the double bottom tanks shall be connected to the tanks near the top.

Where this is impracticable, the filling pipes shall be fitted with non-return valves installed directly on the tanks.

When the filling pipe is used as a suction pipe, the non-return valve shall be replaced by a remote-controlled shut-off valve operable from an accessible position outside the space in which the tank is located.

4.10.3.4 The petrol suction pipe shall ensure electrical conductance from the suction socket up to the tanks being filled.

4.10.3.5 The petrol suction pipe shall be fitted with a readily accessible water separator , in the absence of which fuelling shall be performed through a funnel with a water separating gauze (with mesh of 0,5 × 0,5 mm).

4.10.3.6 For filling of fuel oil tanks located in exposed machinery spaces (compartments) provision shall be made for a branch pipe led to the open deck level, provided with a barrier to prevent penetration of fuel oil into the hull. The branch pipe shall be fitted with a closing arrangement made of a metal which preclude spark formation, or of non-combustible material resistant to the action of fuel and which does not absorb it.

4.10.3.7 Portable fuel oil tanks which are delivered complete with outboard engines shall be filled outside the craft.

4.10.4 Fuel oil supply to internal combustion engines.

4.10.4.1 The equipment of fuel oil system shall be capable of supplying fuel oil duly prepared and cleaned to an extent required for the given engine.

4.10.4.2 The system of fuel oil supply to engines installed in machinery spaces or compartments shall be permanently installed.

The daily service tanks are recommended to be fitted with a quick-closing valve remotely operable from a readily accessible position outside the space in which the tank is installed.

4.10.4.3 The system of fuel oil supply to engines (outboard engines) installed on the craft transom may consist of flexible connections (hoses) meeting the requirements of 4.1.6.2.

4.10.4.4 The fuel oil filters fitted in the fuel oil supply lines shall be such that any filter can be cleaned without interrupting the operation of the engine.

4.10.4.5 Fuel oil supply to carburetor (petrol) internal combustion engines.

4.10.4.5.1 Compliance with the requirements of 4.10.1.5, 4.10.4.1, 4.10.4.2, 4.10.4.3, 4.10.4.4. is mandatory.

4.10.4.5.2 The pipeline and fittings shall be located on the engine side opposite to the exhaust manifold.

4.10.4.5.3 The pipeline from the daily service fuel oil tank (or daily service canister which is delivered complete with the outboard engines) to the engine shall be fitted with quick-closing valve remotely operable from an accessible position outside the space/area where the tank or canister is installed.

The valve shall be installed directly on the wall of the tank or the daily service canister.

4.11 LUBRICATING OIL SYSTEM

4.11.1 Lubricating oil pumps of internal combustion engines, gears and couplings.

4.11.1.1 For an installation with one main engine on motor craft of design categories **A, A1, A2** and **B**, provision shall be made for not less than two circulating lubrication pumps, main and standby, of the same capacity. One of these pumps may be driven by the main engine.

The standby pump may be dispensed with, if the craft has a spare pump, provided that it is accessible for mounting under operating conditions.

In sailing-motor and motor-sailing craft the standby pump may not be installed.

4.11.1.2 Where two and more main engines are installed in craft of design categories **A, A1, A2** and **B**, each of them shall have its own lubricating oil pump, with provision for one standby pump driven independently and having a capacity sufficient to ensure operation of each engine.

The standby pump may be dispensed with, if the craft has a spare pump, provided it is accessible for mounting under operating conditions.

In sailing-motor and motor-sailing craft the standby pump may not be installed.

4.11.1.3 Lubricating oil pumps of main gearing, if they are independent of the main engine lubrication system, shall comply with the requirements of 4.11.1.1 and 4.11.1.2 for the main engines.

4.11.2 Lubricating oil supply to engines and gears.

4.11.2.1 The pipes of the lubricating oil system shall not communicate with other piping systems.

4.11.2.2 The circulating lubrication system shall provide for cleaning of oil and along with that, provision shall be made for cleaning of lubricating oil filters without having to stop the engine and the following filters shall be fitted:

.1 magnetic filter generally on the suction side of the pump of the gears;

.2 one coarse filter (strainer) on the suction pipe of the pump; two parallel filters or one switch-over duplex filter or one self-cleaning filter on the pressure pipe of the main engine pump.

The capacity of each filter shall exceed by 10% the maximum capacity of the pump.

4.11.2.3 The lubricating oil system shall be fitted with a pressure gauge indicating pressure of the oil after the filter and before it enters the engine.

A pressure gauge indicating the pressure of oil after the oil cooler or after the filter before it enters the inboard engine shall be placed at the control station.

4.11.2.4 As regards collection of the lubricating oil leakage in a drain tank, the requirements of 4.10.1.4.7 may be applied.

4.11.3 Lubricating oil tanks.

4.11.3.1 The lubricating oil tanks shall be separated from the fresh water tanks.

4.11.3.2 In craft of design categories **A, A1, A2** and **B**, provision shall be made for a spare tank with a capacity sufficient for filling the system with oil to the working condition.

The tank shall be situated outside the double bottom.

In sailing-motor and motor-sailing craft the spare tank may be dispensed with.

4.11.3.3 The suction pipes from the tanks shall be fitted with shut-off valves installed directly on the tanks.

4.11.3.4 For the lubricating oil tanks situated in machinery spaces, the requirements of 4.10.1.4.6 and 2.7.2 shall be met.

4.12 COOLING SYSTEMS OF INTERNAL COMBUSTION ENGINES

4.12.1 Pumps.

4.12.1.1 The water cooling system of main engines in craft of design categories **A**, **A1**, **A2** and **B** shall comply with the following requirements:

4.12.1.1.1 Sea water cooling system of one main engine shall include two pumps, one of which shall be a standby pump. The capacity of the standby pump shall not be less than that of the main pump. At least, one pump shall be driven independently.

The standby pump may not be installed if the craft has a spare pump, provided it is accessible for mounting under operating conditions.

A fresh water cooling system of the main engine shall also comply with the same requirements.

One common independently driven standby pump may be used for both fresh and sea water cooling; the capacity of this pump shall not be less than that of the main pumps; precautions shall be taken to prevent mixing of fresh and sea water.

In sailing-motor and motor-sailing craft the standby pump may be dispensed with;

4.12.1.1.2 One independently driven standby pump ensuring the operation of each engine running at maximum load shall be installed in sea water cooling system of two and more main engines, each served by a separate cooling water pump.

No standby pump may be provided where a spare pump is available, which is accessible for mounting under operating conditions.

A fresh water cooling system shall also comply with the same requirements.

It is permitted to install one common independently driven standby pump for fresh and sea water, the capacity of which shall be such as to ensure fresh or sea water cooling of any engine; precautions shall be taken to prevent mixing of fresh and sea water.

In sailing-motor and motor-sailing craft the standby pump may be dispensed with;

4.12.1.1.3 It is allowed to cool several engines by one independently driven pump. In this case, the capacity of the pump shall be sufficient for simultaneous cooling of all engines when running at maximum load. One standby pump, the capacity of which shall not be less than that of the main pump cooling simultaneously all engines, shall be provided.

The cooling pipe shall be fitted with a water control valve at inlet to each engine;

4.12.1.1.4 In installations with an automation mark in the class notation provision shall be made for separate fresh water and sea water standby pumps, the capacity of which shall not be less than that of the main pumps.

4.12.1.2 The water cooling system of main engines in craft of design categories **C**, **C1** and **C2** shall comply with the following requirements:

4.12.1.2.1 Sea water cooling system of one main engine shall be provided generally with one pumps driven by the main engine; however, provision in this case shall be made for direct sea water cooling of the main engine or for a spare pump available on board, which is accessible for mounting under operating conditions;

4.12.1.2.2 In a sea water cooling system of two and more engines, each served by a separate cooling pump driven by the main engine, the standby sea water cooling is not compulsory.

4.12.1.3 The bilge or other general purpose pumps operated only for clean water may be used as standby cooling pumps.

The use of fire pumps for this purpose is permitted if the requirements contained in Part X “Fire Protection” are complied with.

4.12.2 Piping laying.

4.12.2.1 The water cooling system of the main engines in craft of design categories **A**, **A1**, **A2** and **B** shall be supplied from at least two sea chests: bottom and side or bottom and ice box arranged in engine room and interconnected.

4.12.2.2 The water cooling system of the main engines in craft of design categories **C** and **C1** may be supplied from one sea chest: bottom, side or ice box.

4.12.2.3 The water cooling system of the main engines in craft of design categories **C2**, **C3** and **D** be provided only with bottom sea inlet fittings complying with the requirements of 4.4.3.1.

4.12.2.4 The water cooling system of the main engines installed on transom is allowed to be separately supplied with sea water.

The water cooling system of the auxiliary engines is allowed to be separately supplied with sea water only from bottom sea inlets which shall comply with the requirements of 4.4.3.1.

4.12.2.5 Filters shall be fitted on suction lines of sea water cooling system serving the main and auxiliary engines. Filters shall be provided with a device making it possible to be sure, before the filters are opened, that there is no pressure. Means shall be provided to enable the filters to be cleaned without having to stop the cooling pumps.

4.12.3 Cooling of internal combustion engines.

4.12.3.1 In the fresh water cooling system of the engine, provision shall be made for an expansion tank where the level of water is higher than the maximum level of water in the engine. The expansion tank shall be connected to the suction pipes of the pumps and may be common for the cooling system of several engines.

The tank shall be provided with a device for monitoring the water level.

In the cooling system of engines, the arrangement of the sea water discharge pipes shall be such that the highest cooled spaces of engines, water and oil coolers are always filled with water and formation of stagnant pockets is excluded.

4.12.3.2 In the cooling system of the internal combustion engines, the cooling fresh water may be cooled in water coolers cooled by sea water, by air flow or in the keel cooling systems.

4.12.3.3 The cooling system shall be fitted with thermometers and cooling water temperature control device.

It is recommended that suitable alarms shall be provided to warn of the limit value of the cooling water temperature.

4.12.4 Keel cooling systems of inboard internal combustion engines.

4.12.4.1 For craft of design categories **A**, **A1** and **A2** equipped with one main engine, not less than two sea water coolers, one of which is standby, shall be provided.

For craft equipped with two or more main engines, one standby cooler shall be provided to keep each engine running.

4.12.4.2 Each cooler shall be provided with air discharge arrangement.

Arrangements for drainage of cooling medium from the coolers shall be provided.

4.12.5 Air cooling system.

4.12.5.1 The main internal combustion engines with a direct air cooling system in sailing-motor and motor-sailing craft as well as craft intended for operation in offshore area of navigation shall be provided with an engine driven cooling air blower.

The craft shall be provided with a spare cooling air blower and its drive elements which will make it possible to mount the blower on board under operating conditions.

For auxiliary engines, this requirement is not compulsory.

Use of main engines with a direct air cooling system in craft of design categories **A**, **A1**, **A2**, **B** and **C** is subject to special consideration by the Register in each case.

4.12.5.2 In case of internal combustion engines with direct air cooling or with air cooling of the fresh water heat exchanger, released air shall not cause an inadmissible heating of the machinery space atmosphere.

In general, special ducts shall be provided to lead the exhaust air out to the exposed part of the deck.

4.13 COMPRESSED AIR SYSTEM

4.13.1 Number of air receivers, compressors, amount of starting air and piping laying.

4.13.1.1 Where a craft is provided with main or auxiliary internal combustion engines started by compressed air or by compressed gas from gas bleeding arrangements of the engines, the requirements for the number of starting air receivers, compressors and amount of starting air with consideration for all consumers, piping laying shall comply with those set out in Section 16, Part VIII "Systems and Piping" of the Rules for the Classification and Construction of Sea-Going Ships, in so much as applicable and sufficient unless specified otherwise below.

4.13.1.2 Air receivers shall be equipped with a device for complete moisture removal.

The air receivers shall meet the requirements given in Section 6, Part X "Boilers, Heat Exchangers and Pressure Vessels" of the Rules for the Classification and Construction of Sea-Going Ships, in so much as applicable and sufficient unless specified otherwise below.

4.13.2 Compressed air pipes of pneumatic devices, craft's service consumers, control and automation systems in craft where the engines are not started by compressed air.

4.13.2.1 Where a tyfon is provided on board, the capacity of a special air receiver for the tyfon shall be determined so that the tyfon will be able to work continuously for 2 min, with hourly performance of compressor being not less than required to provide continuous operation of tyfon during 8 min.

If air from the air receiver is consumed also for other purposes, the capacity of the air receiver shall be increased as compared with that designed for tyfon only, with provision for automatic replenishment or signaling means which shall operate as soon as the amount of air in the air receiver is such as required for tyfon only.

4.13.2.2 Where a tyfon is provided on board, it is allowed to install one independently driven compressor with a capacity not less than required to operate the tyfon as specified in 4.13.2.1.

Where a tyfon is not provided on board, the compressor may be attached to the engine or manually driven, provided that air receiver can be filled by shore means.

4.13.2.3 The air receivers shall meet the requirements of 4.13.1.2.

4.14 LIQUEFIED GAS SYSTEMS

4.14.1 General.

4.14.1.1 The requirements of this Chapter apply to fixed liquefied gas installations designed to operate at a pressure of 500 mm water g. and consisting generally of one gas cylinder with a gas mass not more than 11 kg, one or several pressure regulators, distribution network and, maximum, two appliances consuming gas simultaneously. More complicated systems are subject to special consideration by the Register.

4.14.1.2 Installations of approved type, complying with the requirements of this Part of the Rules and manufactured in accordance with the regulations of a competent body shall be used on board craft. Installations which are not fixed installations may be used only when they meet special requirements prescribed by a competent body.

4.14.1.3 Only fuel hydrocarbon liquefied gas termed "propane, butane, propylene, butylene" complying with the requirements of current national standards are allowed to be used on board the craft. Installations working on gas shall in every particular be suitable for use of "propane".

4.14.1.4 It is allowed to use on board the craft liquefied gas installations for domestic purposes only: cooking, and in water- and air heaters consuming not more than 1,5 kg of liquefied gas per hour. Use of liquefied gas for other purposes is subject to special consideration by the Register.

4.14.1.5 Components of the liquefied gas installations shall not be located in machinery spaces.

4.14.1.6 Components of the liquefied gas installations shall not be located within cargo spaces.

4.14.1.7 Gas-consuming appliances separated by the cargo area or integral tank shall not be served by the installation.

4.14.1.8 Openings in deck located at least 3 m from the doors or other closing arrangements of spaces or areas where components of the domestic liquefied gas installations are located shall have coamings of at least 150 mm in height.

4.14.1.9 All the equipment of the domestic liquefied gas installations arranged on board craft, including gas supply lines, shall be reliably secured.

4.14.1.10 A warning inscription: "Gas cylinder. Open the valve while the gas cylinder is being used. Close the valve before the flame dies out" shall be displayed near the gas cylinder.

4.14.2 Liquefied gas cylinders.

Only cylinders complying with the national standards and having filling mass up to 11 kg, are permitted to be installed on board craft.

In special cases, the Register may allow to install cylinders with greater filling mass.

4.14.3 Gas-consuming appliances and spaces for their installation.

4.14.3.1 All gas-consuming appliances installed in craft shall be approved by a competent body.

4.14.3.2 The gas-consuming appliances shall be provided with devices effectively preventing gas leakage in the event of the burner and starter flame-jet failure. For the water- and air heaters such device shall have pilot flame.

Upon agreement with the Register, such device may be dispensed with for appliances installed in spaces above the upper deck and operated only in the presence of attending personnel.

4.14.3.3 The water- and air-heaters shall be fitted with flues designed so as to provide outgoing of the products of combustion outside the craft.

4.14.3.4 The gas-consuming equipment may be arranged in the wheelhouse only when there are no ducts which would make penetration of gas into the interiors of the craft possible.

4.14.3.5 Spaces in which the gas-consuming appliances are installed shall be equipped in accordance with requirements set out in 2.4 and also shall comply with the following requirements:

.1 they shall be arranged not lower than the upper deck level and have natural ventilation ensuring effective removal of the products of combustion and the air exchange and having no shut-off arrangements on ventilation ducts and air gratings.

Installations with cylinders having capacity not more than 3 kg of liquefied gas may be located below the deck in accommodation spaces, provided that the gas appliance is mounted directly on the cylinder or is connected with the cylinder by a flexible gas supply line of no more than 1,5 m in length, and the cylinder is arranged so as to provide free and fast access to the valve which cuts off supply of gas;

.2 they shall have an access to exposed deck and a pivoted side scuttle (window). Pivoted side scuttle (window) may not be provided in galley if the pivoted side scuttle or door opening directly onto the exposed deck are located in an adjacent uninhabited space or corridor;

.3 where a space, even if partially, is located below the upper deck, it shall be provided with forced ventilation and a hood shall be fitted above the gas range;

.4 in the lower part of the heater space, provision shall be made for an air grating with cross-sectional area not less than 0,02 m^2 for each heater;

.5 bulkheads and decks shall be tight; sills of the door openings shall be not less than 150 mm high. Installation of ladders and lifts from these spaces to underlaying spaces is not permitted;

.6 height of the space shall be not less than 2,2 m. Where an exhaust hood which extends beyond the overall dimensions of the range is fitted, the height of the spaces may be reduced to 1,9 m;

.7 a powder or carbon dioxide fire extinguisher shall be installed near the entrance to the space of gas-consuming appliances;

.8 a warning label shall be affixed in a conspicuous position which shall provide instructions for operation and maintenance and safety precautions.

4.14.3.6 The distance from the gas appliances to the bulkheads shall not be less than 75 mm.

4.14.4 Distribution station.

4.14.4.1 The distribution station shall be situated on the open deck in a special locker or in a gastight enclosure of the superstructure with a door which shall be opened from the outside, from the exposed deck.

4.14.4.1.1 Whenever necessary, structural measures shall be taken to preclude elevation of the temperature of the cylinders located at the station above 40 °C.

4.14.4.1.2 Artificial illumination shall not be provided; in exceptional cases, the station shall be illuminated by approved electric safety-type lamps, in this case the switch shall be fitted on the outside of the station.

4.14.4.1.3 Gas leakage shall not present a risk of its penetration into the inner spaces of the craft or its contact with the potential sources of ignition.

4.14.4.1.4 A clearly visible inscription “DANGER. GAS” and a cryptogram (symbol) warning of explosion hazard and prohibiting use of open flame shall be displayed on the outside of the station or on the door.

4.14.4.1.5 The distribution station shall be adequately ventilated via the openings in its upper and lower parts.

4.14.4.1.6 The special locker of the distribution station shall be manufactured of non-combustible material and shall not be located near the bulwark.

4.14.4.2 Depending on the number of the cylinders installed, the distribution station shall comply with the following requirements:

4.14.4.2.1 Where one cylinder connected to the network is installed; in this case, in order to connect a pressure-reducing valve placed on the cylinder head to the liquefied gas pipeline, a rubberized fabric hose with metal clamps to ensure tightness and security of coupling may be used. One spare cylinder may be installed at the station;

4.14.4.2.2 Where two cylinders connected to the network are installed, one of which is used as a daily service cylinder and the other is used as a standby cylinder, the both cylinders shall be connected to the distribution network manifold in accordance to 4.14.4.2.1. In this case, a shut-off valve or cock shall be fitted between each cylinder and manifold, and the station shall be provided with a notice prohibiting simultaneous use of both cylinders. One spare cylinder may be installed at the station.

4.14.4.3 The cylinders installed on board the craft shall bear brands of competent authorities, as well as information on the date of hydraulic tests by proof pressure and on the kind of gas contained.

4.14.4.4 The liquefied gas cylinders shall be installed vertically, with their valves faced upwards, in special housings made of material precluding spark formation and shall be secured to the station structures by means of quick-detaching joints.

4.14.4.5 The distribution station shall not contain equipment which is not associated therewith.

4.14.4.6 Spare and empty cylinders shall be stored in locker or in an enclosed space meeting the requirements of 4.14.4.

4.14.5 Liquefied gas piping and fittings.

4.14.5.1 Liquefied gas piping shall consist of seamless steel or copper pipes with inside diameter not less than 6 mm.

4.14.5.2 The wall thickness of pipes shall comply withy the requirements of columns 2 or 5 of Table 4.2.5.1.

4.14.5.3 The pipe joints shall be welded. Threaded or flanged joints shall be allowed only at connections of instruments, gas-consuming appliances and fittings.

4.14.5.4 Inside the distribution station, a shut-off valve or cock operable from a position outside the space shall be installed on the pipeline, near its way out from the station. If such arrangement is impracticable, a second shut-off valve or cock shall be installed outside the station where the pipeline leaves the station.

4.14.5.5 The pipelines from the distribution station to gas consumers shall be laid on the open deck and protected against mechanical damage.

The liquefied gas pipelines shall not pass through accommodation, service and machinery spaces.

4.14.5.6 Where several gas consumers are available on board the craft, each branch line from the common pipeline to the consumer shall be fitted with shut-off fittings.

4.14.5.7 Pressure-reducing valves fitted in the system shall be designed to provide a pressure of gas delivered to the consuming appliances not higher than 0,005 MPa.

Where a double-stage pressure-reducing valves are used, the intermediate pressure shall be not higher than 0,25 MPa.

The pressure-reducing valve or the first stage of pressure reduction which is a constituent of the double-stage pressure-reducing valves shall be fitted at the distribution station. The valve shall be fitted on the pipeline section between the cylinder and shut-off valve and attached to the station bulkheads or manifold.

4.14.5.8 The pipeline shut-off valves shall be fitted in readily accessible positions.

The shut-off valve shall be provided with an limiting device which allows it to rotate through 90° and with an indicator of "open" and "closed" positions.

4.14.5.9 All the fittings shall be made of bronze, brass or another corrosion-resistant material.

4.14.6 Testing of the liquefied gas installation.

4.14.6.1 The liquefied gas pipes from the cylinders to the pressure-reducing valves shall be tested as follows:

in shop – by hydraulic pressure of 2,5 MPa;

on board – by air pressure of 1,7 MPa.

The liquefied gas pipes from the pressure-reducing valves to gas consumers, after installation on board the craft, shall be tested for tightness by air with an excessive pressure of 0,02 MPa.

4.14.6.2 The whole liquefied gas installation , once mounted on board the craft, shall be tested for tightness while the system is subjected to a normal working pressure. The test shall be carried out with the use of soap solution; no gas seepage shall be observed.

4.14.6.3 The normal operation of the gas-consuming appliances , including the arrangement used to cut off gas supply to the consuming appliance shall be checked.

4.15 AIR HEATING INSTALLATIONS AND SPACE HEATING APPLIANCES

4.15.1 Air heating installations.

4.15.1.1 The air heating installation is an installation intended to heat air, wherein the air is heated while passing through the combustion chamber of the air heater.

4.15.1.2 Air heaters shall not be located in accommodation and service spaces.

The spaces containing air heaters shall be considered as machinery spaces of Category **A**; the air to be heated shall be taken in from outside of the machinery spaces. Air intakes of the air heaters located on exposed areas of the deck shall be protected from penetration of spray and precipitation.

4.15.1.3 Heat exchangers of the air heater combustion chambers shall be tight and tested by a pressure not lower than 0,1 MPa.

4.15.1.4 Ventilation ducts for hot air and pipes for carrying off the combustion products shall be made of steel or of a material equal to steel in fire resistance. No shut-off fittings shall be installed on pipes for carrying off the combustion products.

4.15.1.5 Combustion air shall be supplied by an independent air blower. Before the burner of the air heater is alight, the furnace chamber shall be pre-ventilated with the use of the air blower during at least 5 s.

4.15.1.6 Pipes for air supply to the air heaters shall comply with the requirements of 4.10. The possibility of fuel oil coming into contact with the hot air and outgoing gas pipes shall be precluded.

4.15.1.7 Fuel oil supply to the air heater shall be cut off automatically in case of:

burner flame-jet cut-off;

loss or low head of combustion air;

temperature of the air heated exceeding the pre-determined limit;

electric power loss.

Upon operation of protective devices, the air heater shall be capable of being actuated only locally.

4.15.1.8 Provision shall be made for fuel oil supply, hot air blowers and combustion air supply cutting off from two positions, one of which shall be located outside the machinery space.

4.15.2 Space heating appliances.

4.15.2.1 All space heating appliances shall be so designed and arranged that they cannot cause ignition of equipment, as well as clothes and baggage of people present in the space.

4.15.2.2 The space heating appliances shall be located at a distance at least 50 mm from the craft sides or from the bulkheads. If the sides or bulkheads are lined with wood, veneer or with another combustible material, the areas where the space hating appliances are located shall be protected by thermal insulation of non-combustible material.

With no thermal insulation, the heating appliances shall be located at least 150 mm away from the wooden, veneer or another combustible lining.

PART VI . AUTOMATION

1 GENERAL

1.1 APPLICATION AND BASIC REQUIREMENTS

1.1.1 The requirements of this Part of the Rules apply to automated and remotely controlled machinery installations of the craft for which an automation mark **AUT** to be added to the classification notation is assigned (see 2.2.7, Part I "Classification").

1.1.2 The requirements of this Part shall be complied with where the machinery installation of a craft is adapted to operation without permanent attendance of personnel in machinery spaces.

The requirements of this Part do not cover craft with locally controlled outboard engines.

1.1.3 For craft with electrical propulsion plants, the level of automation to grant the automation mark in the class notation is subject to special consideration by the Register.

1.1.4 The mechanical, electrical and electronic equipment, as well as components of the automation systems and machinery themselves shall meet the requirements of relevant Parts of these Rules.

1.1.5 The requirements of this Part cover the automation equipment according to 1.3.2, as well as the cases when a craft, as a whole, is not assigned the mark **AUT** in the class notation.

1.2 DEFINITIONS AND EXPLANATIONS

1.2.1 For the purpose of this Part of the Rules, the following definitions and explanations have been adopted:

Automated machinery plant means a plant fitted up with automated control of main and auxiliary machinery and their associated systems, remote monitoring, alarm and indication facilities;

Remote automated control system means a control system whereby a desired operating mode of a machinery can be set up from a remote control station with one move of control (e.g. handle) followed by automatic execution of all intermediate operations.

Remote control system means a control system which, when being used for executing intermediate operations, needs an Operator's action to manipulate controls located at the remote control station.

Alarm system means equipment for signaling whenever the controlled parameters reach the preset limit values, or deviations of machinery and associated systems from normal working ranges occur.

Safety system means equipment to automatically influence, in a specific way, the operation of machinery under control in order to prevent an emergency or limit its consequences.

Indication system means equipment providing visual information on the values of certain physical parameters or on change of certain conditions in machinery and systems.

Local control station means a control station fitted with controls, indicators and means of communication, intended for control of a machinery and located in proximity to, or directly on, the machinery.

Automation device means a part of automation system comprising components, which form a structural and functional unity.

Automation component means a structurally independent item (e.g. amplifier, sensor, relay, logic element) used in automation devices and systems.

1.3 SCOPE OF TECHNICAL SUPERVISION

1.3.1 General provisions concerning classification procedure, technical supervision of craft being designed or constructed, manufacture of equipment and components thereof, surveys, as well as requirements for technical documentation on the craft, as a whole, to be submitted to the Register for review and approval may be found in Part I "Classification"of these Rules and in General Regulations for the Classification and Other Activity.

1.3.2 Subject to technical supervision, as applied to a craft, during manufacture and in service are automation components, devices and systems of the following:

.1 main machinery and propellers;

.2 electric power plants;

.3 auxiliary services machinery;

.4 auxiliary boilers;

.5 alarm systems;

.6 other systems as required by the Register.

1.4 TECHNICAL DOCUMENTATION

1.4.1 For each item of automation equipment listed under 1.3.2, the technical documentation to be submitted to the Register shall be as follows:

.1 description of operational principle including technical parameters, scope of automated operations to be executed, operating conditions and other data;

.2 general arrangement and layout;

.3 schematic circuit and functional diagrams;

.4 specification with indication of the materials used and accessories, where all used components and devices with their technical characteristics are shown;

.5 list of monitored parameters for the alarm and safety systems;

.6 test program;

.7 list of spare parts.

1.4.2 The technical documentation pertinent to automation, incorporated into the technical design documentation, shall be submitted to the Register for review prior to craft construction, in the scope stipulated in Part I "Classification".

2 DESIGN OF AUTOMATION EQUIPMENT

2.1 AUTOMATED MAIN MACHINERY

2.1.1 Automated main machinery shall be provided with:

.1 devices for remote automated control from the wheelhouse;

.2 visual alarm to indicate the availability of the main machinery for service;

.3 alarms to indicate malfunction in the control system and the limiting values of monitored parameters;

.4 automatic safety devices activated when the monitored parameters fall beyond the limits of the allowed parameters being of potential menace of accident, as well as an alarm system to give warning signal at operation of safety devices;

.5 a device to transfer control of the main machinery from automatic to manual mode from a local control station regardless of the position of handle at the remote control station.

2.1.2 Hydraulic and pneumatic control systems shall be supplied from two sources. The second source shall be connected automatically upon pressure loss with application of an alarm signal.

See circular 975c

2.1.3 Electric and electronic control systems shall be supplied from both the main and emergency power sources. Power circuits for control systems shall be independent of the power circuits for safety and alarm systems.

2.1.4 In installations with two or more engines driving one shaft, the safety system shall provide for automatic shut-down of the faulty engine so that the rest keep the craft running and maneuvering.

Protection system of main engines, except for overspeed protection , shall be disconnectable, with the signal of disconnection being activated in the wheelhouse and at the control stations of machinery space.

2.1.5 A device, independent of the control and alarm systems, shall be provided for emergency shut-down of the main engine.

2.1.6 Failure of remote control system of the main machinery shall not cause an increase in the craft speed, change in the propeller thrust direction, or inadvertent starting of the main machinery, and also immediate stop of the engine from the remote control station shall be made possible.

2.1.7 If malfunctions occur in power system for the control systems, changeover from one power supply source to another shall be effected manually from the control station, or automatically depending on the system functionallity.

2.1.8 In craft with main machinery having power of 220 kW and less, with attached auxiliaries, the composition of the monitoring, alarm and protection means may be reduced.

2.1.9 For engines with power of 220 kW and less, use of the remote control systems may be allowed.

2.1.10 For auxiliary machinery, which are required to operate under definite service conditions only, provision may be made for control from the wheelhouse with application of alarm signal and indication of starting thereof, if needed.

2.1.11 Pressure and temperature in essential systems of the machinery installation shall be controlled automatically.

2.2 AUTOMATED ELECTRIC POWER PLANTS

2.2.1 The automated electric power plants shall be provided with the control devices ensuring remote starting of generator sets with automatic or remote synchronization, taking over and load sharing.

2.2.2 In ships where electrical power is normally supplied by one generator, in case of its failure and de-energization of the main switchboard, provision shall be made for the following:

.1 automatic starting of stand-by diesel generator and its connection to busbars of the main switchboard within 30 s;

.2 automatic connection, in the necessary sequence, of essential devices ensuring propulsion, without any overloading of the electric power plant.

2.2.3 Indicators shall be provided at the electric power plant control stations to warn that the generator sets are ready to start immediately (automatically).

2.2.4 Where the generator driven by the propulsion plant (shaft generator) and diesel generator are not intended to operate in parallel, the system of connections shall be so interlocked as to prevent their possible switching-on for parallel operation.

2.2.5 Monitored parameters of the automatic electric power plants (except emergency), measuring points, limiting values of parameters and types of automatic protection and parameter indication are given in Table 2.9.7.

2.3 AUTOMATED BOILER PLANTS

2.3.1 The requirements of the present Chapter cover boiler plants with oil-burning installations.

2.3.2 Steam boilers shall be provided with automatic feed water and steam pressure governors.

2.3.3 Provision shall be made for a remote shut-down of the boiler plants from the control station where continuous watch is kept.

2.3.4 As far, as the oil-burning installations are concerned, the oil supply to the burners shall be cut off automatically in the following cases:

.1 absence of flame for not more than 5 s from the moment the oil supply begins;

.2 degradation of parameters of air intended for fuel oil atomization;

.3 insufficient pre-ventilation of the burner furnace.

2.3.5 Starting of boiler plants from cold condition and after being shut down by protection system shall be possible from the local control station only.

2.3.6 Automation system of exhaust gas water heating boilers operating under pressure shall provide for automatic changeover of the device which regulates direction of exhaust gas flow through the boiler or directly into the atmosphere, depending on temperature in the boiler.

2.4 AUTOMATED BILGE PLANTS OF MACHINERY SPACES

2.4.1 Depending on the water level in wells, the automated bilge plants shall put automatically the relevant bilge pumps in operation. Alarm to indicate pump operation shall be provided.

2.4.2 If, after the bilge pumps have been started, the water level in the bilge wells goes on rising or does not fall, an alarm shall be activated.

2.4.3 A separate sensor shall be provided to signal of the highest possible level, which would be independent of the sensors provided to control the bilge pumps.

2.5 AUTOMATED COMPRESSOR PLANTS

2.5.1 Starting air receivers, tyfon, as well as the amount of air to feed automation systems shall be replenished automatically.

For automated compressors, provision shall be also made for starting and stopping thereof from the wheelhouse.

2.5.2 Compressed air system shall be fitted up with automatic drainage devices.

2.5.3 Air compressors shall be automatically started when the pressure in air receivers drops by not more than 30 per cent of the nominal pressure, and shut down when the pressure reaches 97 to 103 per cent of the nominal one.

2.6 AUTOMATED PUMPING UNITS

2.6.1 Automated pump control system shall ensure automatic starting of standby pumps and changeover, as necessary, in systems, in case of pump failure or upon reaching the highest permissible deviations of parameters in essential circulation systems. Along with that, the alarm system shall actuate signal to warn of faulty pump and of standby pump starting.

2.6.2 The starting circuit of pumps having equal output shall make it possible to use each of them as the main one.

2.7 EQUIPMENT ARRANGEMENT IN WHEELHOUSE

2.7.1 Facilities shall be provided to effect remote control of main and auxiliary machinery and propellers.

2.7.2 Provision shall be made for independent emergency stop of main engine from the wheelhouse.

2.7.3 Alarm system shall be provided to warn of troubles to machinery and plants in machinery space. Provision shall be made for indicating means to show speed and direction of propeller rotation, as well as the pitch of CPP.

2.7.4 Provision shall be made for indicating means to show engagement/disengagement position of the coupling of the main machinery.

2.7.5 In the wheelhouse, provision shall be made for the following separate alarms:

"Water in machinery space", "Fire in machinery space", "Alarm system failure".

2.7.6 Control, indication and alarm devices in the wheelhouse shall be located on desks adapted for manipulation by one person.

The visual indicators shall be arranged in such a way as to prevent dazzling of the personnel and to be clearly seen in day-time.

Provision shall be made for dimming of the indicating system lamps.

2.7.7 In boats with open machinery space, open navigating bridge, with main machinery of total power less than 220 kW and outboard engines, the scope and list of the automation system facilities may be reduced, subject to agreement with the Register.

2.8 EQUIPMENT ARRANGEMENT IN MACHINERY SPACES

2.8.1 Local control station of the main machinery shall be provided.

2.8.2 Provision shall be made for a panel for alarms and indicators of parameters, arranged in the vicinity of the control station of the main machinery.

2.8.3 The controls of auxiliarities shall be installed in close proximity to the local control station of the main machinery.

2.8.4 For the main engines with power less than 220 kW, with mechanical remote control system, the local control stations and alarm panels may be dispensed with.

2.9 ALARM, PROTECTION AND INDICATION SYSTEMS OF MACHINERY INSTALLATION

2.9.1 The alarm system of the machinery installation shall give visual and audible signals if operating parameters fall beyond the allowable limits. In this case, the alarm signal shall not be activated when allowable deviations of the operating parameters are caused by maneuvering. Alarm shall be activated in the engine room and in wheelhouse.

2.9.2 Irrespective of the extent of automation and the monitoring order used for the machinery, the alarm system shall give visual and audible warning signals at:

.1 monitored parameters reaching predetermined limit values;

.2 operation of protection devices;

.3 power failure of particular automation systems;

.4 starting of emergency power sources.

The visual signals shall be given as flashing lights. After being accepted (acknowledged) the flashing light shall change to steady light. Canceling of a visual signal shall be only possible after the fault has been cleared.

2.9.3 In the crew's accommodation and service spaces, the engineer's alarm shall be activated for the call of the engineers to machinery space, which is activated manually, or automatically where an alarm system has not been acknowledged.

See circular 975c

2.9.4 For machinery installations with main engines having power less than 220 kW, outboard engines and mechanical remote control system the range of alarm signals may be reduced, subject to agreement with the Register.

2.9.5 The protection systems of automated machinery shall be provided for those parameters only the deviations of which can lead to serious damage, complete failure of the machinery.

2.9.6 The indication system shall be so designed that the readings are displayed in units normally used for parameters, i.e. without recalculation.

2.9.7 Monitored parameters of machinery and systems, measuring points, limiting values of parameters and types of automatic protection and parameter indication shall be found in Table 2.9.7.

2.9.8 The Owner's Manual shall contain information on limiting values of parameters and types of protection and parameter indication.

Table 2.9.7

Nos.	Monitored parameter	Measuring point	Alarm for limiting values of parameters	Automatic protection	Indication of parameters in wheelhouse	Comments
1	2	3	4	5	6	7
1	**Main internal combustion engines**					
1.1	Lubricating oil pressure	At engine inlet	Min.	Engine shut-down	Continuous or on call	–
1.2	Lubricating oil temperature	At engine inlet	Max.	–	Continuous or on call	–
1.3	Lubricating oil pressure drop	Filter	Max.	–	Continuous or on call	–
1.4	Coolant pressure or flow	At engine outlet	Min.	Slow-down	Continuous or on call	–
1.5	Coolant temperature	At engine outlet	Max.	Slow-down	Continuous or on call	–
1.6	Coolant level	Expansion tank	Min.	–	–	For independent tank
1.7	Cooling sea water pressure or flow	Sea water cooling system	Min.	–	Continuous or on call	–
1.8	Exhaust gas temperature	Main pipe	Max.	–	–	–
1.9	Starting air pressure	Before starting valve	Min.	–	–	–
1.10	Control air pressure	Engine control system	Min.	–	–	–
1.11	Fuel oil level	Daily service tank	Min.	–	–	–
1.12	Fuel oil leakage	From high-pressure piping	Presence of fuel oil	–	–	–
1.13	Engine speed	–	Max.	Engine shut-down	Continuous or on call	–
1.14	Power supply to remote automated control, alarm and safety systems	At inlet of systems	Failure of power supply	–	–	–
1.15	Oil pressure in CP-propeller hydraulic system	At filter outlet	Min.	–	Continuous or on call	–
1.16	CP-propeller hydraulic oil level	Header tank	Min.	–	–	–

1	2	3	4	5	6	7
2	**Reduction gear**					
2.1	Lubricating oil pressure	At reduction gear inlet	Min.	Engine shut-down	–	–
2.2	Lubricating oil temperature	In reduction gear	Max.	–	–	–
3	Internal combustion engines for driving generators					
3.1	Lubricating oil pressure	At engine inlet	Min.	Engine shut-down	–	–
3.2	Coolant pressure or flow	At engine inlet	Min.	–	–	–
3.3	Coolant temperature	At engine outlet	Max.	–	–	–
3.4	Engine speed	Limiting governor	Max.	Engine shut-down	–	–
4	**Electric installation**					
4.1	Voltage	Main switchboard	Min., max.	–	–	–
4.2	Insulation resistance	Main switchboard	Min.	–	–	–
5	**Starting compressors**					
5.1	Air temperature	At compressor outlet	Max.	Compressor shut-down	–	–
6	**Tanks**					
6.1	Leakage fuel oil level	Leakage fuel oil tank	Max.	–	–	–
6.2	Fuel oil level	Daily service tanks	Min.	–	–	–
6.4	Domestic waste and sewage water level	Tanks	Max.	–	–	–
7	**Bilge plants**					
7.1	Emergency water level	Bilge wells	Max.	–	–	Alarm signal is activated in wheelhouse
8	**Miscellaneous**					
8.1	Safety system of boiler plant	Feeding unit	Failure	Boiler shut-down	–	–
8.2	Alarm system	Feeding unit	Failure	–	–	–
8.3	Protection system	Feeding unit	Failure	–	–	–

PART VII. ELECTRICAL EQUIPMENT

1 GENERAL

1.1 APPLICATION

1.1.1 The requirements of the present Part of the Rules apply to electrical installations in craft in accordance with 1.2 of the General Regulations which have craft's mains subject to the Register technical supervision, as well as to individual types of electrical equipment in accordance with 1.3.

1.1.2 The requirements of the present Part of the Rules apply to fixed electrical systems and equipment.

Use of portable electrical systems and equipment is subject to special consideration by the Register.

1.1.3 The electrical equipment not specified in 1.3 shall be designed and manufactured in compliance with national standards in such a way that its malfunction does not result in fire or electric shock.

1.1.4 Where the power supply system is used to supply domestic services with a voltage higher than the safety voltage the additional requirements of Section 10 shall be complied with.

1.1.5 Where the power supply system with a voltage higher than the safety voltage is used to supply appliances which can affect the safety of navigation and maneuverability of the craft of design categories **A**, **A1**, **A2**, **B**, **C** or **C1**, the appropriate requirements of Part XI "Electrical Equipment" of the Rules for the Classification and Construction of Sea-Going Ships shall be complied with, and for the craft of design categories **C2**, **C3** and **D**, the requirements of Part IX of the Rules for the Classification and Construction of Inland Navigation Ships (for European Inland Waterways) shall be complied with.

1.1.6 The requirements of the present Part of the Rules do not apply to the electrical equipment for domestic, everyday and processing purposes, except for the requirements of 1.3.3.

1.2 DEFINITIONS AND EXPLANATIONS

1.2.1 For the purpose of the present Part of the Rules, the following definitions and explanations have been adopted:

E m e r g e n c y l i g h t i n g is lighting of the craft's spaces and zones, as well as the survival craft em barkation stations and over the sides by means of luminaires fed from the emergency source of power or from the emergency transitional source of power.

E m e r g e n c y s o u r c e o f e l e c t r i c a l p o w e r is a source of electrical power intended to supply necessary craft's services in case of power failure on the main switchboard.

E m e r g e n c y s w i t c h b o a r d is a switchboard intended to be supplied directly from the emergency or emergency transitional source of electrical power in case of failure of the main source of electrical power, and to supply the emergency services.

S a f e t y v o l t a g e is any voltage not dangerous to the personnel. This condition is considered to be satisfied if the windings of transformers, converters and other devices to step down voltage are electrically separated and if the value of stepped-down voltage across these devices or sources of electrical power does not exceed:

50 V between poles for direct current;

50 V between phases or between phases and the craft's hull for alternating current.

S h a f t g e n e r a t o r s are generators driven by the non-reversible main machinery and supplying the craft's electrical mains or separate consumers.

W i n d - p o w e r e d g e n e r a t o r is a generator driven by the non-reversible machinery using a wind power and supplying one or several accumulator batteries in flotage.

E x t e r n a l s o u r c e o f e l e c t r i c a l p o w e r is a source of electrical power located outside the craft and intended to supply all electrical devices and systems essential for maintaining the craft in ready-for-use condition during lay-up, repair and in other navigational or operational cases, without resorting to the emergency source of electrical power.

M a i n s w i t c h b o a r d is a switchboard intended to be supplied directly from the main and external source of electrical power, and to supply the craft's services.

A c c e s s i b l e is capable of being reached for inspection without the use of special tools.

E a r t h i n g is electrical connection of a part of electrical equipment to be earthed to the craft's hull.

P r o t e c t i o n is permanent protection of one or several insulated conductors by means of insulating tape, rubber and plastic sheaths or thermo-sensible tubes.

L i g h t n i n g p r o t e c t i o n z o n e is the area, within the limits of which the craft's space is substantially immune to direct strokes of lightning.

C r a f t ' s h u l l means all craft's metal parts which have a reliable electrical connection to the outer metal shell plating. For craft with non-conducting hull, it is a special metal arrangement specified in 2.5.2.6.

A i r t e r m i n a t i o n n e t w o r k is the upper part of the lightning protection device intended for the perception of atmospherics.

D i s t r i b u t i o n s y s t e m is a system of components intended for distribution of power in the craft and/or for control, such as contactors, relays, fuses, instruments, pilot lamps.

Solar battery is a special assembly of crystals, which converts luminous energy to electrical power and supplies one or several accumulator batteries in flotage.

Main source of electrical power is a source of electrical power intended to supply all electrical equipment and systems essential for maintaining the craft in normal operational and habitable condition, without resorting to the emergency source of electrical power.

Down conductor is a conductor, which electrically connects the air terminal to the earthing conductor.

1.3 SCOPE OF TECHNICAL SUPERVISION

1.3.1 General provisions applicable to the classification procedures, technical supervision during construction of craft, manufacture of equipment, and to surveys, as well as the requirements for technical documentation are stated in the General Regulations and in Part I "Classification".

1.3.2 The following kinds of equipment, systems and devices are subject to technical supervision on board the craft:

sources of electrical power;
distribution systems;
electric drives of the craft's machinery;
electric lighting;
navigational lights;
alarm systems and internal communication;
cable system;
other items not listed above, at the Register's request.

1.3.3 The electrical equipment for domestic, everyday and processing purposes shall be subject to technical supervision on board the craft only in respect to:

.1 effect exerted by operation of that equipment on the performance of the craft's electric generating plant;

.2 choice of the types and cross-sections of cables and conductors, as well as of the methods of cable laying;

.3 resistance of insulation, earthing and protective devices.

2 GENERAL REQUIREMENTS

2.1 ARRANGEMENT OF ELECTRICAL EQUIPMENT

2.1.1 Electrical equipment shall be installed in such a manner as to provide easy access to controls and to all parts that require maintenance, inspection and replacement.

2.1.2 Electrical equipment in its locations shall be provided with efficient protection against the temperature elevation caused by the external sources of heat in order to avoid excess of the temperature permissible for its safe operation.

2.1.3 The air-cooled electrical equipment shall be so located that cooling air is not taken from spaces wherein the air may be contaminated with substances having a harmful effect on insulation.

2.1.4 Electrical equipment shall be fixed in position in such a manner that the strength and tightness of decks, bulkheads and hull plating is not impaired.

2.1.5 Electrical appliances shall not be attached directly to the walls of fuel tanks. The distance from these appliances to the walls of tanks shall be not less than 75 mm.

2.1.6 Generators, starters and other electrical devices attached to the internal combustion engines shall be located as far from the fuel system as practicable.

2.1.7 The craft shall be provided with an electrical system diagram showing all electrical circuits and arrangement of electrical devices with identification of used conductors, contactors, switches, relays and fuses, as well as description of the symbols used.

2.1.8 The electrical equipment installed in craft's spaces wherein flammable gases are likely to accumulate, shall be of safe-type.

2.1.9 When the enclosures of electrical equipment are made from different material than the structures on which they are installed, care shall be taken, if necessary, to prevent electrolytic corrosion.

2.2 OPERATING CONDITIONS

2.2.1 The rated working ambient air and cooling water temperatures for electrical equipment shall be those specified in Table 2.2.1.

Table 2.2.1

Nos.	Location of equipment	Ambient air and cooling water temperature, in °C			
		Craft of design categories **A**, **A1**, **A2** and **B**		Craft of design categories **C**, **C1**, **C2**, **C3** and **D**, navigating outside the tropical zone	
		Air	Water	Air	Water
1	Machinery and special electrical spaces, galleys	+45…0	+32	+40…0	+25
2	Exposed decks	+45…-25	–	+40…-25	
3	Other spaces	+40…0	–	+40…0	–

Note. Electronic elements and devices designed for mounting in the switchboards, panels or casings shall be capable of reliable performance at an ambient air temperature up to 55 °C.

Temperature up to 70 °C shall not cause failure of the elements, devices and systems.

2.2.2 Electrical equipment shall be capable of reliable performance under the following conditions:

at a relative air humidity of 80 ± 3 per cent and at a temperature of +40 ± 2 °C;

at a relative air humidity of 92 ± 3 per cent and at a temperature of +25 ± 2 °C.

In craft operating under winter conditions, the electrical equipment shall be adapted for use at the temperatures down to – 25 °C.

Where the electrical equipment is installed within environmentally controlled spaces, the ambient temperature, for which the equipment shall be suitable, may be reduced as against the value given in Table 2.2.1 and maintained at a value not less than + 35 °C, provided:

.1 the equipment is not for use for emergency services and is located outside the machinery spaces;

.2 temperature control is achieved by at least two cooling units so arranged that in the event of loss of one cooling unit, the remaining unit(s) is(are) capable of maintaining the design temperature;

.3 the equipment installed in such spaces shall be able to work safely at a temperature of +45 °C until the rated working ambient temperature can be achieved. The cooling equipment shall be rated for +45 °C ambient temperature;

.4 audible and visual alarms shall be provided at a continually manned control station to indicate any malfunction of the cooling units.

2.2.3 Electrical equipment shall be capable of reliable performance at vibrations with frequencies from 2 to 80 Hz, namely: with an amplitude of displacements of ± 1 mm for frequency range of 2 to 13,2 Hz and an acceleration of ± 0,7 g for frequency range of 13,2 to 80 Hz.

Electrical equipment installed on the sources of vibration (diesel engines, compressors, etc.) or in the steering gear compartment shall function reliably at vibrations from 2 to 100 Hz, namely: with an amplitude of displacements of ± 1,6 mm for frequency range of 2 to 25 Hz and an acceleration of ± 4 g for frequency range of 25 to 100 Hz.

Electrical equipment shall also function reliably at shocks having an acceleration of ± 5,0 g and at a frequency of 40 to 80 shocks per minute.

The natural vibration frequencies of seatings, attachments and suspensions of machinery, appliances and other electrical devices shall not be in the range from 2 to 100 Hz.

2.2.4 Permissible variations of supply parameters.

2.2.4.1 The electrical equipment shall remain operative at the voltage and frequency variations from the rated values specified in Table 2.2.4.1

The data of Table 2.2.4.1 shall be ignored if other values of frequency variations from the rated value are specified in some Sections of the present Part of the Rules.

For machinery and devices which shall and can function at the values of variations higher than those specified in Table 2.2.4.1, separate limited power supply systems with such variations are allowed.

Table 2.2.4.1

Parameters	Variations from rated values		
	For long periods	For short periods	
	%	%	time,s
Voltage	+6 … -10	± 20	1,5
Frequency	± 5	± 10	5

Note. When the services are fed from an accumulator battery:

long-period voltage variation within + 30 to – 25 per cent for the equipment fed from the accumulator battery connected to the charging unit;

long-period voltage variation within +20 to – 25 per cent for the equipment which is not connected to the charging unit.

2.3 MATERIALS

2.3.1 Structural materials.

2.3.1.1 The structural parts of electrical equipment shall be fabricated of durable materials, rated at least as having low flame-spread characteristic, resistant to damp air, oil and fuel vapour effects, or reliably protected against such effects.

2.3.1.2 Screws, nuts, hinges and similar items designed to secure enclosures of the electrical equipment installed on the exposed deck and in spaces with increased humidity shall be made of corrosion-resistant materials and/or have effective corrosion-resistant coatings.

2.3.1.3 All current-carrying parts of electrical equipment shall be of copper, copper alloys or other materials of equivalent properties, with the exception of the following:

.1 rheostat elements, which shall be made of mechanically strong materials having high resistivity and capable of withstanding high temperatures;

.2 short-circuit rotor windings of asynchronous and synchronous motors which may be made of aluminium or its alloys resistant to sea conditions;

.3 carbon brushes, cermet contacts and other similar parts when the properties specified so require;

.4 parts of electrical equipment directly connected to the craft's hull used as a return conductor with a single-wire system.

The use of other materials for current-carrying parts is subject to special consideration by the Register in each case.

2.3.2 Insulating materials.

2.3.2.1 Insulating materials of live parts shall have adequate dielectric strength and resistance to creepage currents, moisture and oil, as well as sufficient mechanical strength, or be suitably protected.

The heating temperature of current-carrying parts and their connections shall not exceed the permissible heating temperature of the insulating materials at a rated load.

2.3.2.2 Non-flammable liquids may be used for cooling uninsulated parts of electrical equipment.

The use of flammable oils for this purpose is subject to special consideration by the Register in each case.

2.3.2.3 The insulating materials used for winding insulation in machines, apparatus and other equipment for essential services shall comply with the agreed standards. The use of insulating materials not inferior to Class E is recommended.

2.3.2.4 Conductors used in electrical devices for internal connections shall

have insulation made of materials rated at least as having low flame-spread characteristics and for equipment with increased heating – of non-combustible materials.

2.3.2.5 For the insulating materials used for the manufacture of cables are specified in 9.4.

2.4 STRUCTURAL REQUIREMENTS AND PROTECTION OF ELECTRICAL EQUIPMENT

2.4.1 General.

2.4.1.1 Parts to be replaced in service shall be readily dismountable.

2.4.1.2 Where screw fastenings are used, provision shall be made to exclude self-loosening of screws and nuts or, where dismantling and opening are a frequent occurrence, loss of same.

2.4.1.3 Gaskets used in components of electrical equipment (such as doors, covers, sight holes, packing glands, etc.) shall ensure adequate protection when in service.

The gaskets shall be secured to the covers or casings.

2.4.1.4 Suitable water drainage arrangements shall be provided in electrical equipment where condensation is likely to occur. Channels shall be fitted inside the equipment to provide for condensate drainage from all the equipment components. Windings and live parts shall be so arranged or protected that they are not exposed to the effects of the condensate which may accumulate inside the equipment.

2.4.1.5 Electrical equipment with forced ventilation, designed for installation in lower parts of damp spaces, shall be provided with a ventilation system so as to prevent, as far as possible, suction of moisture and oil vapours inside the equipment.

2.4.1.6 Where measuring instruments with oil, steam or water supply are fitted in the control panel or desk, measures shall be taken to prevent these agents from making contact with live parts in case of damage to the instruments or pipelines.

2.4.2 Internal wiring.

2.4.2.1 Stranded wires shall be used for internal wiring of electrical equipment throughout. The use of solid wires is subject to special consideration by the Register in each case.

2.4.2.2 For internal wiring of switchgear, control panels, other distributing and switching devices, etc., wires of not less than 0,75 mm^2 in cross-sectional area shall be used.

For systems of control, protection, measurement of parameters, signalling and internal communication, the use of wires having a cross-sectional area not less than 0,5 mm^2 is permitted. For electronic and electrical devices for transformation and transmission of low-power signals, wires of less than 0,5 mm^2 in cross-sectional area may be used subject to special consideration by the Register in each case.

2.4.2.3 Current-carrying parts shall be so secured that they will not have to sustain any additional mechanical stresses; such parts shall not be secured by screws fitted directly into insulating material.

2.4.2.4 Stranded cores, cables and wires shall have their ends fitted out to suit the type of terminal used, or shall be provided with lugs.

2.4.2.5 Insulated wires shall be laid up and secured in such a manner that the method used for their securing and arrangement does not lead to reduced insulation resistance and that they are not exposed to damage due to electrodynamic loads, vibrations and shocks.

2.4.2.6 Arrangements shall be made to ensure that the temperatures allowed for insulated wires under normal operating conditions or within the duration of short-circuit current breaking are not exceeded.

2.4.2.7 Insulated wires shall be so connected to terminals or busbars that the wire insulation shall not be exposed to the overheating temperature under rated operating conditions.

2.4.3 Protection of electrical equipment.

2.4.3.1 Depending on location, the use shall be made of electrical equipment in appropriate protective enclosure, or other suitable measures shall be taken to protect the equipment from harmful effects of the environment and to protect the personnel from current injury hazards.

2.4.3.2 The minimum degree of protection of the electrical equipment installed in craft's spaces and zones shall be determined according to Table 2.4.3.2.

Table 2.4.3.2

Nos.	Location of electrical equipment	Characteristics of spaces	Degree of protection
1	Dangerous spaces and areas, refer to 2.7	In which explosive mixtures of vapours, gases and dust with air are likely to occur	Ex
2	Ac Accommodation and general use spaces, as well as corridors having no direct exit to exposed deck	Dry	IP20
3	Spaces having direct exit to exposed deck, machinery spaces	With increased humidity	IP23
4	Galleys, showers, lavatories, toilets, accumulator rooms and lockers, ventilating trunks leading to exposed deck, etc.	Water splash	IP44
5	Exposed decks	Water flooding	IP56
Note. Where the enclosure of equipment does not guarantee the necessary protection, alternative methods of protection or alternative arrangement of equipment shall be applied to ensure the degree of protection stipulated by the Table.			

2.5 PROTECTIVE EARTHING

2.5.1 Metal enclosures of electrical equipment shall be fitted with an earth terminal marked with the symbol "⊥", unless otherwise indicated in the present Part of the Rules.

Provision shall be made for earthing inside and outside the electrical equipment enclosure depending on its purpose.

2.5.2 Parts to be earthed.

2.5.2.1 Metal parts of electrical equipment which are not live, but are likely to be touched under service conditions, except those listed in 2.5.3, shall have a reliable electric bond with a component fitted with an earth terminal (refer also to 2.5.3).

2.5.2.2 Protective earthing is not required for:

.1 electrical equipment supplied with current at safety voltage unless suppression of radio interference is required;

.2 electrical equipment provided with double or reinforced insulation;

.3 metal parts of electrical equipment fastened in an insulating material or passing therethrough and isolated from live parts in such a manner that under normal operating conditions these parts cannot become live or come in contact with earthed parts;

.4 bearing housings especially insulated to guard against circulating currents;

.5 lamp caps and fasteners for luminescent lamps, lamp shades, reflectors and guards supported on lamp holders or lighting fixtures constructed of, or shrouded in non-conducting material;

.6 cable clips, cleats, etc.;

.7 individual consumer under voltage up to 250 V supplied through an isolation transformer;

.8 detachable or openable parts of metal lockers, guards, etc., unless electrical equipment is installed on the detachable (openable) parts or voltage of the electrical equipment installed exceeds 42 V a.c. or 55 V d.c.

2.5.2.3 The secondary windings of all instrument transformers for current and voltage shall be earthed.

2.5.2.4 External earthing conductors shall be accessible for inspection and protected against getting loose and mechanical damage.

2.5.2.5 Earthing of electrical equipment by connection to pipelines, cylinders for compressed gases and tanks for oil products is forbidden.

2.5.2.6 For craft with non-conducting hull, earthing shall be effected with the use of a special copper plate of less than 0,5 m^2 in area and not less than 2 mm thick or a plate made of carbon steel of not less than 1,5 m^2 in area and not less than 6 mm thick attached to the underwater part of the shell plating below the light-draught waterline and used for earthing of all items of equipment installed on board the craft.

Instead of a special earthng plate, metal stem or other metal structures of the craft (e.g. metal shaft strut) immersed in water under all sailing conditions are allowed to be used.

2.5.3 Earthing terminals and conductors.

2.5.3.1 Fixed electrical equipment, metal pipes and outer metal sheaths (braids) of cables used for protection against mechanical damage, metal sheaths of cables and screens of cores used for screening, shall be earthed at both ends. Earthing shall be effected by means of external earthing conductors, earthing core in the feeding cable or with the use of a direct electrical contact between the equipment enclosure and the metal craft's hull.

For cables laid on wood or synthetic material, one earthing connection will be sufficient. In case of alternating current, single-core cables and feeders shall be earthed only in one point.

Reliability of earthing of the electrical equipment and cable sheaths may be regarded as appropriate if parameters given in Table 2.5.3.1-1 are met.

For earthing effected with external earthing conductor, copper conductors shall be used. Conductors made of any other corrosion-resistant material may be also used, provided the resistance of same will not exceed that of the copper conductor required. The cross-sectional area of the copper conductor shall not be less than that specified in Table 2.5.3.1-2.

For earthing effected with a special core of feeding cable, the cross-sectional area of this core shall be equal to the nominal cross-sectional area of the feeding cable core for cables having a cross-sectional area up to 16 mm^2 and at least half the cross-sectional area of the feeding cable core, but not less than 16 mm^2, for cables having a cross-sectional area from 16 to 35 mm^2.

Table 2.5.3.1-1

Type of earthing	Method of earthing		
	With a separate conductor	With a cable core	With a direct contact
	Value of resistance, in Ohm, not more than		
Protective	0,1	0,4	0,1
Shielding	0,02	–	0,02

Table 2.5.3.1-2

Cross-sectional area of a cable core connected to consumer, in mm^2	Cross-sectional area of external earthing conductor, in mm^2	
	solid	stranded
0,5 to 4	4	2,5
4 to 16	Half the cross-sectional area of cable core connected to consumer, in mm^2	
16 to 35	16	16
35 to 120	Half the cross-sectional area of cable core connected to consumer, in mm^2	
Over 120	70	

2.5.3.2 Earthing circuits of the fixed equipment shall be non-disconnectable.

2.5.3.3 Earthing of shields and metal armour of cables shall be effected in one of the following ways:

.1 using a copper earth wire of a cross-sectional area not less than 2,5 mm^2 for cable cores with a cross-sectional area up 25 mm^2 and not less than 4 mm^2 for cable cores with cross sectional area over 25 mm^2;

.2 by adequate attachment of the shields or or metal armour to the craft's hull with the use of a strong clamp which feature good conductivity and is fitted snuggly to the hull;

.3 by means of cable gland rings, provided they feature corrosion resistance, good conductivity and elasticity.

Earthing shall be effected at both cable ends. Cable shields of end branches of circuits may be earthed at the supply end only.

2.5.3.4 The earthing conductors shall be fastened to metal craft's hull or to the earthing strap by means of bolts of not less than 6 mm in diameter. For cables and wires having a cross-sectional area up to 2,5 mm^2 and up to 4 mm^2, it is permitted to use bolts 4 mm and 5 mm in diameter respectively. Such bolts shall not be used for other purposes.

Bolts screwed into material without nuts shall be manufactured of brass or other corrosion-resistant material.

Contact surfaces on the electrical equipment, as well as on the craft's hull, in places where the earthing conductor is fitted thereto, shall be cleaned to bare metal and properly protected against corrosion.

2.5.3.5 Earthing of movable or portable electrical equipment shall be effected with the use of a special core in the flexible feeding cable through contact connection in a plug-and-socket unit. The cross-sectional area of the earthing core shall comply with the requirements of Table 2.5.3.1-2.

2.6 LIGHTNING PROTECTION

2.6.1 General.

2.6.1.1 Craft of design categories **A**, **A1**, **A2**, **B**, **C** or **C1** shall be provided with lightning-protection system with protected zones covering all the equipment that requires lightning protection.

It is recommended that the lightning-protection systems be provided also in craft of design categories **C2** and **C3**.

In craft, where the consequential effects of lightning strokes may cause a fire or explosion, lightning earthing devices shall be provided to preclude consequential sparking.

2.6.1.2 The lightning – protection system shall consist of an air terminal, down conductor and earth bond. No special lightning-protection device need be fitted on metal masts if provision is made for reliable electrical connection of the mast to the metal craft's hull or to earthing point.

2.6.2 Air termination network.

2.6.2.1 In metal craft, the craft's vertical structures: masts, derrick posts, superstructures, etc. may be used as air terminations if provision is made for reliable electrical connection of those structures to the metal craft's hull.

Additional air terminations shall be used only when the craft's structural members do not provide for reliable lightning protection.

2.6.2.2 If electrical equipment is installed on the top of a metal mast, provision shall be made for an air terminal effectively earthed.

2.6.2.3 On each mast or top mast made of non-conducting material, an effectively earthed lightning-protection device shall be provided.

2.6.2.4 The air termination shall be made of a rod having a cross-sectional area not less than 12 mm^2. The rod may be of copper, copper alloys or steel protected against corrosion. Aluminium air terminations shall be used for aluminium masts.

2.6.2.5 The air termination shall be fitted to the mast in such a manner that it projects at least 300 mm above the top of the mast or above any device fitted on its top.

2.6.2.6 A lihtning-protective mast shall be of a height to provide the desired zone of protection in accordance with 2.6.2.6.1, 2.6.2.6.2, or 2.6.2.6.3 respectively.

2.6.2.6.1 For a mast height not exceeding 15 m above the water, the base radius shall be approximately equal to the mast height, *h* (see Figs. 2.6.2.6.1-1 and 2.6.2.6.1-2).

2.6.2.6.2 For mast heights over 15 m, the zone of protection is based on the striking distance of the lightning stroke.

Since the lightning stroke may strike any earthed object within the striking distance of the point from which final breakdown to earth occurs, the zone of protection is defined by a circular arc (see Fig. 2.6.2.6.2).

2.6.2.6.3 The protection zone afforded by any configuration of masts or other elevated, conductive and earthed objects can be determined graphically. Increasing the height of a mast above the striking distance will not increase the protection zone.

The radius of the arc is the striking distance (30 m). The arc passes through the top of the mast and is tangent to the water. If more than one mast is used, the zone of protection is defined by arcs to all masts.

2.6.3 Down conductor.

2.6.3.1 The down conductor shall be made of a rod, strip or multiwire cable having a cross-sectional area not less than 100 mm^2.

2.6.3.2 Down conductors shall run on the outer side of masts and superstructures with a minimum number of bends, which shall be gradual and have as large radius as possible.

2.6.3.3 Down conductors shall not run through dangerous spaces and zones.

2.6.3.4 In craft with non-metal hull, the down conductor of the lightning-protection system shall be laid separately throughout its length (including connection to the earth termination network), without connecting to the busbars of the protective and operation earthing circuits.

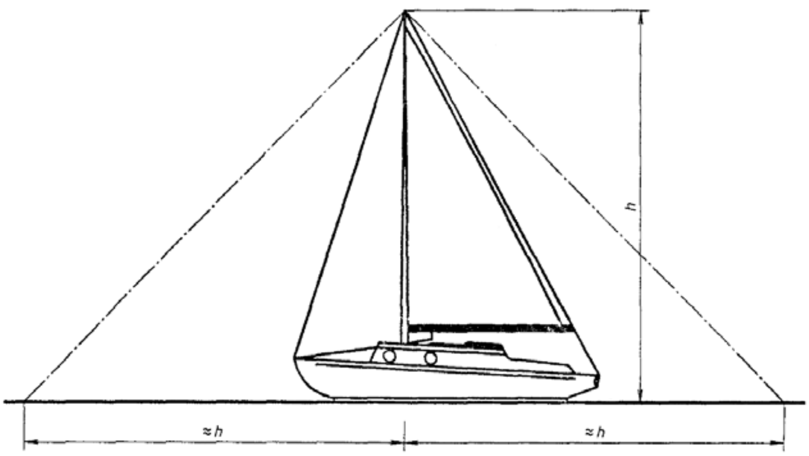


Fig. 2.6.2.6.1-1
Sailing craft with a mast not exceeding 15 m above water

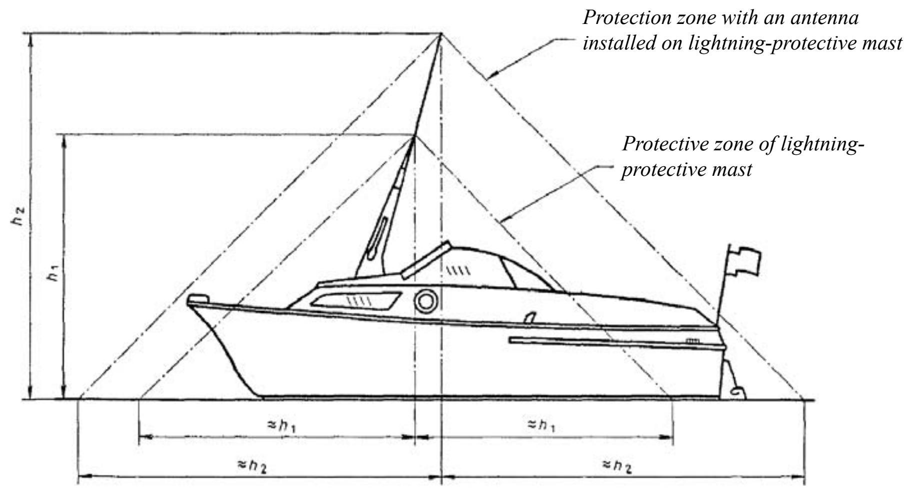


Fig. 2.6.2.6.1-2
Non-sailing craft with a mast not exceeding 15 m above water

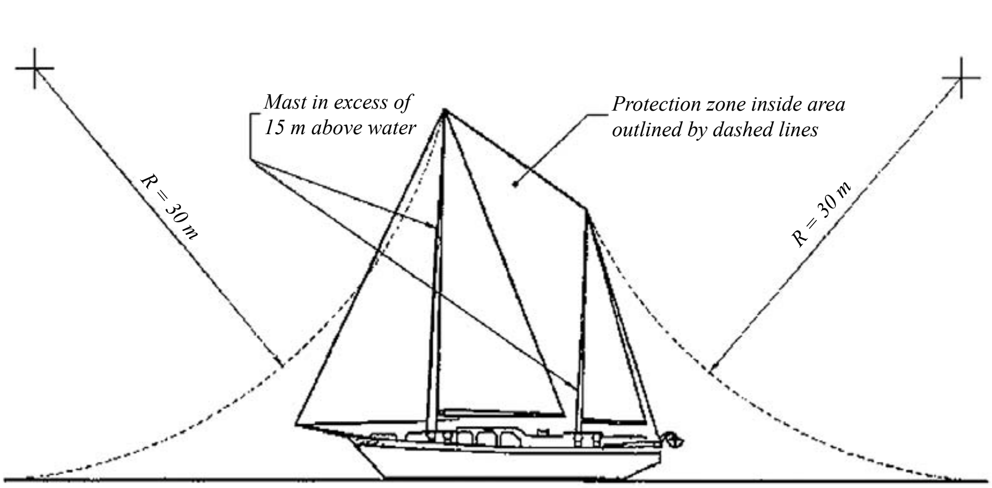


Fig. 2.6.2.6.2
Craft with mast(s) in excess of 15 m above water

2.6.4 Earth termination network.

2.6.4.1 In composite craft, the metal stem or other metal structures immersed in water under any navigation conditions may be used as the craft's earth.

2.6.4.2 Means shall be provided on board the craft to allow for connecting the lightning-protection system or craft's steel hull to the shore-based earth network while the craft is in a dock or on a slipway.

2.6.4.3 In craft with non-conducting hull, means shall be provided to allow for connecting the lightning-protection system to the shore-based earth network while the craft is in a dock or on a slipway.

2.6.4.4 Multihull craft shall provide a lightning earth for each hull.

2.6.5 Connections in lightning-protection system.

2.6.5.1 Connections between the air terminations, down conductor and earth termination network shall be welded or bolted with clamps.

2.6.5.2 Where bolted connections are used, the contacting surface area between the down conductor and air termination shall be not less than 300 mm^2 for copper and copper alloys and not less than 1000 mm^2 for other materials.

The connecting clamps and connecting bolts shall be made of copper, copper alloys or steel protected against corrosion.

2.6.6 Lightning protection earthing devices.

2.6.6.1 Lighting-protective earthing shall be provided for isolated metal structures, movable connections, pipelines, screens of power and communication lines, pipeline entries into dangerous spaces.

2.6.6.2 Metal parts near down conductors shall be earthed if they are not fixed to earthed structures or have no other metal connection to the craft's hull. Facilities or metal parts located at a distance up to 200 mm from the down conductor shall be connected thereto so as to prevent potential consequential sparking.

2.6.6.3 All joints of earthing elements shall be accessible for inspection and protected against mechanical damage.

2.7 SAFE-TYPE ELECTRICAL EQUIPMENT

2.7.1 The requirements of the present Chapter apply to the equipment which is installed in enclosed and semi-enclosed spaces and zones of the craft in which explosive mixtures of vapours, gases or dust with air are likely to occur in dangerous concentrations. The following spaces and zones fall under this category: paint lockers, lantern rooms (for oil lanterns), accumulator battery rooms and spaces which contain tanks, machinery and pipes for flammable liquids having a flash point of 55°C and below.

2.7.2 In dangerous spaces and zones, only safe-type electrical equipment may be installed, the protection of which corresponds to the category and group of the most dangerous gas mixture.

Such electrical equipment shall be of the following safe type:

intrinsically safe *Exi*;
pressurized *Exp*;
flameproof *Exd*;
increased safety *Exe*.

2.7.3 In spaces where explosive mixture of dust or fibre with air may occur, the electrical equipment with the degree of protection not below IP65 shall be installed.

Electrical equipment with the degree of protection IP55 may be permitted where the occurrence of explosive mixture of dust or fibre with air is temporary, resulting from the damage or leakage from processing equipment in operation or ventilation cut-off.

Electrical equipment installed in these spaces shall have such protective enclosure that the temperature of its upper horizontal surfaces or those inclined more than 60 deg. to the horizontal is, under conditions of continuous operation, by 75 °C below the smouldering point of dust accumulated in the space concerned (the smouldering point shall be determined for a dust layer of 5 mm thick).

2.7.4 Lighting fixtures of safe type shall be so installed that a free space around them is not less than 100 mm, excluding the place of fastening.

2.7.5 Any equipment installed in dangerous spaces and zones, except for fire detectors, shall be provided with switches fitted in a safe position outside the dangerous spaces and zones to disconnect live conductors.

2.7.6 Fastening of electrical equipment directly to the walls of tanks intended for flammable liquids is not allowed. In any case, electrical equipment shall be fastened at a distance not less than 75 mm from the tank walls.

2.7.7 In dangerous spaces and zones, only those cables may be laid, which serve the electrical equipment installed in such spaces and zones. The through runs of cables may be permitted in the above spaces and areas provided the requirements of 2.7.8 to 2.7.12 are met.

2.7.8 Cables installed in dangerous spaces and zones shall have:

.1 metal armour or braid covered with a non-metal sheath, or

.2 lead sheath with additional mechanical protection, or

.3 copper or stainless steel sheath (only for cable with mineral insulation).

2.7.9 Cables passing through dangerous spaces and zones shall be protected against mechanical damage.

2.7.10 All shields and metal braids of cables of power circuits for electric motors and lighting systems, which pass through dangerous spaces and zones or supply the electrical equipment installed in these spaces shall be earthed at both ends at least.

2.7.11 Cables of intrinsically safe circuits shall not be used for more than one instrisically safe device and shall be laid separately from other cables.

2.7.12 Cables of portable electrical equipment, except for cables of intrinsically safe circuits, shall not pass through dangerous spaces and zones.

2.8 ELECTROMAGNETIC COMPATIBILITY

2.8.1 General.

2.8.1.1 The present requirements apply to electrical and automation equipment, and also to radio and navigational equipment of craft to ensure electromagnetic compatibility on board.

2.8.1.2 Failure-free performance of the equipment shall be ensured under conditions of interference having the following parameters:

.1 static and variable (50 Hz) magnetic field in accordance with Table 2.8.1.2.1.

Table 2.8.1.2.1

Class of equipment	Intensity, in A/m	
	Static field	Variable field (50 Hz)
1	100	100
2	400	400
3	1000	1000

Installation of equipment is permitted:

class 1- at a distance of 2 m and more from a powerful field source (bus duct, group transformer);

class 2 – at a distance of 1 m and more from a powerful field source;

class 3 – irrespective of the distance from field source of any kind;

.2 harmonic components of voltage in supply circuits in accordance with the higher harmonics diagram for the craft's mains to be found in Fig. 2.8.1.2.2 on a logarithmic scale;

.3 electrostatic discharges with a voltage amplitude of 8 kV;

.4 radio frequency electromagnetic fields within a range of 30 to 500 MHz with a root-mean-square value of field intensity of 10 V/m;

.5 nanosecond voltage pulses with an amplitude of 2 kV for the power supply circuit and of 1 kV for signalling and control cables with a duration of 5/50 ns;

.6 radio frequency interference in conductivity circuits within a range of 0,01 to 50 MHz with a root-mean-square value of voltage of 1 V and with 30 per cent modulation at a frequency of 1 MHz;

.7 microsecond voltage pulses in supply circuits with an amplitude of 1 kV for non-symmetric application of pulses with a duration of 1,2/50 μs.

2.8.1.3 The voltage curve harmonic distortion factor for the power supply circuit shall not exceed 10 per cent and shall be determined by the formula

$$K_U = 1/U_c \sqrt{\sum_{n=2}^{200} U_n^2} \cdot 100\ \% \qquad (2.8.1.3)$$

where U_c = actual circuit voltage;
U_n = n-harmonic component voltage;
n = higher harmonic component order.

The value of K_U is specified for the complete electrical power system of a craft.

Upon a special agreement with the Register, separate busbars with K_U > 10 per cent may be used for power supply to powerful sources of harmonic components of voltage and to electrical equipment not sensitive to such harmonic components, provided that the above busbars are connected to the main busbars through uncouplers (refer to 2.8.2.2).

2.8.1.4 The intensity levels of radio interference from equipment in the power supply circuits shall not exceed the following values within the frequency bands given below:

for equipment installed on exposed deck and navigating bridge;

10 to 150 kHz – 96 to 50 dB;

150 to 350 kHz – 60 to 50 dB;

350 kHz to 30 MHz – 50 dB;

for equipment installed in machinery and other enclosed spaces:

10 to 150 kHz – 120 to 69 dB;

150 to 500 kHz – 79 dB;

500 kHz to 30 MHz – 73 dB.

Artificial mains network and quasi-peak measuring receiver shall be used for measuring the intensity level of radio interference. The receiver bandwidth when measurements are taken within the frequency band from 10 to 150 kHz shall be 200 Hz and within the frequency band from 150 kHz to 30 MHz – 9 kHz.

2.8.1.5 On craft, for which the level of radio interference from power semiconductor converters cannot be

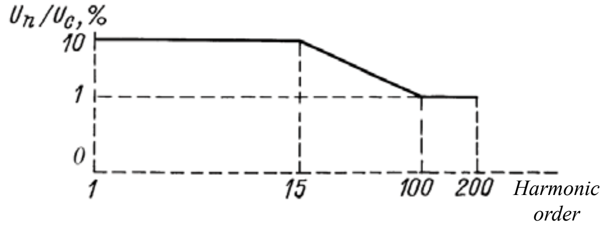


Fig. 2.8.1.2.2
Diagram of higher harmonics components for the craft's mains

limited in accordance with the requirements of 2.8.1.4, the power supply circuits of automation, radio and navigational equipment shall be galvanically isolated from power supply circuits of those converters so that at least 40 dB are attenuated within the frequency band from 0,01 to 30 MHz.

The power supply cables of equipment having the radio interference levels in excess of those specified in 2.8.1.4 shall be laid at least 0,2 m away from cables of other equipment groups where the common cable run is longer than 1 m (see 2.8.2.8).

2.8.1.6 The levels of the radio interference electromagnetic field set up at a distance of 3 m from the equipment shall not exceed the following values within the frequency bands given below:

for equipment installed on exposed deck and navigating bridge:

150 to 300 kHz – 80 to 52 dB;

300 kHz to 30 MHz – 52 to 34 dB;

30 to 2000 MHz – 54 dB, except for the band from 156 to 165 MHz, where the level shall be equal to 24 dB;

for equipment installed in machinery and other enclosed spaces:

150 kHz to 30 MHz – 80 to 50 dB;

30 to 100 MHz – 60 to 54 dB;

100 to 2000 MHz, except for the band from 156 to 165 MHz, where the level shall be equal to 24 dB.

Quasi-peak measuring receiver shall be used to take measurements. The receiver bandwidth within the frequency band from 150 kHz to 30 MHz and from 156 to 165 MHz shall be 9 kHz and within the frequency band from 30 to 156 MHz and from 165 MHz to 1 GHz – 120 kHz.

2.8.2 Measures ensuring electromagnetic compatibility.

2.8.2.1 In order to ensure protection of radio equipment against electromagnetic interference, the requirements of Part VIII “Radio and Navigational Equipment” of the present Rules shall be considered.

2.8.2.2 For the purpose of dividing the supply system of the craft, rotary converters, special transformers and filters shall be used.

2.8.2.3 The power cable screen or metal armour shall be connected to metal casing of relevant equipment and shall be earthed as frequently as possible at each end, as a minimum.

2.8.2.4 The screens of signal cables shall be earthed at one point on the side of the initial signal processing unit. The cable shall have an external insulating sheath.

2.8.2.5 Continuous screening shall be ensured, and for this purpose cable screens shall be connected to equipment enclosures, and it shall also be done in cable branch boxes and distribution boxes, and in way of cable penetrations through bulkheads.

2.8.2.6 Earthing installed for the purpose of inference protection shall have an electric resistance not greater than 0,02 Ohm, minimum length possible, shall be resistant to vibration and corrosion and accessible for inspection.

2.8.2.7 Cable screens shall not be used as return conductors.

2.8.2.8 By the type of signal transmitted, the craft’s cables are subdivided into groups as follows:

.1 coaxial cables of radio receivers and video signals with the signal level from 0,1 μ *V* to 500 mV;

.2 screened or coaxial cables transmitting analogue and digital signals with the signal level from 0,1 to 115 V;

.3 screened cables of telephone and radio broadcasting apparatus with the signal level from 0,1 to 115 V;

.4 unscreened cables located below deck, and screened and located on exposed deck cables of power, lighting, control and signal circuits with the signal level from 10 to 1000 V;

.5 coaxial or screened cables of transmitting aerials of radio transmitters, radar installations, echo sounders and power semiconductor converters with the signal level from 10 to 1000 V.

2.8.2.9 Cables of the same group may be laid in the same cable run provided the interference-sensitive equipment is not influenced by the difference in the levels of signals transmitted.

Where the length of cables laid in parallel is in excess of 1 m, the cables (cable runs) of different groups shall be laid at least 0,1 m apart, and they shall intercross at right angles. The radar installation and echo sounder cables mentioned in 2.8.2.8.5 shall either be double-screened or, if they are coaxial, laid inside a metal pipe. The outer screen shall be earthed along with the main screen of the cable.

Cables of portable echo sounder transducers may have a single screen provided that an allowable electromagnetic compatibility is achieved.

2.8.2.10 When electrical equipment is installed and cables are laid in the vicinity of magnetic compasses and in order to ensure protection against interference from other navigational equipment, the requirements of Part VIII “Radio and Navigational Equipment” of the present Rules shall be considered.

2.8.2.11 On all craft constructed from non-conductive materials, for which radio equipment is required by the Rules, all cables within 9 m from the aerials shall be schieldered or otherwise protected from radio interference , and all the equipment shall be fitted with devices for radio interference suppression (refer to 2.8.1.4).

3 SOURCES OF ELECTRICAL POWER

3.1 MAIN SOURCE OF ELECTRICAL POWER

3.1.1 Craft in which electrical equipment is installed shall be provided with the main source of electrical power with a capacity sufficient to supply all the electrical equipment on board the craft under conditions specified in 3.1.5.

3.1.2 At least one of the following facilities may be used as a main source of electrical power:

.1 generator driven by a propulsion plant engine and generator driven by an individual internal combustion engine;

.2 generator driven by an individual internal combustion engine and one or several accumulator battery(ies) which is(are) floating on the generator;

.3 generator driven by a propulsion plant engine and one or several accumulator battery(ies) which is(are) floating on the generator;

.4 generator driven by the propulsion plant and one or several accumulator battery(ies) which is(are) floating on the generator;

.5 one or several accumulator battery(ies).

For craft of design categories **A**, **A1**, **A2** and **B**, the sources of electrical power specified in 3.1.2.1 to 2.1.2.4 may be used as the main sources. In this case, the capacity of a generator shall be sufficient to supply essential services under running conditions and simultaneously the generator shall be capable of charging the accumulator batteries.

3.1.3 In craft where accumulator battery including such a battery which is floating on a generator is the main source of electrical power, its capacity shall be sufficient to supply the electrical services required within:

24 hrs – for craft of design categories **A**, **A1**, **A2** or **B**;

16 hrs – for craft of design categories **C** or **C1**;

8 hrs – for craft of design categories **C2** or **C3**.

without additional recharging from the craft's charging facilities and with regard to 3.2.14.

3.1.4 Where an accumulator battery is simultaneously used for starting the main internal combustion engines, its capacity shall be sufficient to comply with the requirements of 3.1.5 and 3.2.8.

3.1.5 The number and capacity of the sources of electrical power shall be determined with regard to the following operating conditions of the craft:

.1 running conditions;

.2 maneuvering ;

.3 in case of fire, hole in the craft's hull or other conditions affecting the safety of navigation, with the main source of electrical power in operation;

.4 other operating conditions according to the craft's purpose.

3.2 ACCUMULATOR BATTERIES

3.2.1 Accumulator batteries shall be installed above the bilge level in dry locations, readily accessible, ventilated and not exposed to environmental effects, such as high or low temperature, water splashing and mechanical damage.

3.2.2 Accumulator batteries shall not be installed in close vicinity to fuel tank or fuel filter.

Any metal component of the fuel oil system within 300 mm above the battery top, as installed, shall be electrically insulated.

3.2.3 Accumulator batteries having a capacity over 0,2 kW (66 A·h at 24 V and 135 A·h at 12 V) shall be located in special room or in boxes. This requirement does not apply to unattended accumulator batteries.

3.2.4 Acid and alkaline batteries shall not be located in the same room or box.

The containers and accessories intended for batteries with different electrolytes shall be placed separately.

3.2.5 The battery rooms and boxes shall be adequately ventilated to prevent generation and accumulation of explosive gas-air mixtures.

3.2.6 The accumulator batteries shall be so arranged that at craft inclinations up to 45 deg. electrolyte from vented cells does not leak.

3.2.7 The starting accumulator battery intended for starting engines having power output not more than 75 kW may be used for supplying the craft's lighting system.

3.2.8 Capacity of the starting battery shall ensure six starts of the engine, considering that the duration of each start is at least 5 s, and shall meet the recommendations of the engine manufacturer. If no engine manufacturer's requirements are available, the capacity of the starting battery Q, in A·h, can be determined by the formula

$$Q = kP_{st} \tag{3.2.8}$$

where k = battery capacity factor;
k = 70 for voltage of 12 V;
k = 35 for voltage of 24 V;
P_{st} = rated capacity of starter, in kW.

3.2.9 The procedure of charging of an accumulator battery from the main source shall ensure charging of the battery during not more than 8 hours.

3.2.10 When selecting capacity of acid batteries intended for a service other than starting service, their discharging of not more than 50 per cent of the rated capacity shall be specified. For alkaline batteries, a greater discharging value may be specified in accordance with the battery manufacturer's recommendations.

3.2.11 The starter of the main engine shall be supplied from the starting battery and in an emergency – from another battery having adequate capacity.

In craft with main engine having power output not more than 40 kW, one starting battery which supply also the electrical lighting may be used.

3.2.12 The starting battery shall be located as close to the engine as practicable.

3.2.13 The electrical circuits of the starting battery shall not incorporate protection against over-current.

3.2.14 The accumulator batteries shall not be used for supply of services with a voltage lower that the total voltage of all the battery cells.

3.2.15 It is recommended to use batteries which do not require attendance.

3.3 EMERGENCY ELECTRICAL INSTALLATIONS

3.3.1 In each craft of design categories **A**, **A1**, **A2**, **B**, **C** and **C1** an autonomous emergency source of electrical power shall be provided.

The autonomous emergency source of electrical power shall be located above the damage waterline, as required by the conditions to ensure the reserve of buoyancy in accordance with Part IV "Stability, Reserve of Buoyancy and Freeboard". For craft of design categories **C** and **C1**, it is permitted to install the autonomous emergency source of electrical power in machinery space.

One or several accumulator battery(ies) which is (are) floating on the wind generator or solar battery may be used as the independent emergency source of electrical power.

3.3.2 Where an accumulator battery is used as the emergency source of electrical power, its capacity shall be sufficient to supply the following service during the period of time not less than 25 per cent of that specified in 3.1.3:

.1 emergency lighting of:

stowage places for life-saving appliances, emergency materials, fire-fighting inventory;

stairways, corridors, exits from machinery spaces;

passenger spaces;

machinery space;

wheelhouse;

places for stowing and launching of survival craft;

muster and embarkation stations on deck and over the sides and locations

places for crew crowding in an emergency;

all control stations (desks) as well as spaces for the main and emergency

switchboards;

spaces for the emergency source of electrical power;

steering gear compartment;

near fire pump, emergency bilge pump and at the starting positions of

their motors;

.2 navigation lights;

.3 radio communication means if the craft's own emergency battery is not available;

.4 sound signal means;

.5 internal communication, general alarm and fire detection and alarm facilities.

3.3.3 In craft where the power source specified in 3.1.2.2 to 3.1.2.4, on which the accumulator battery is floating, is the main source of electrical power, the specified battery may be regarded as the emergency source of electrical power.

3.3.4 In craft where an accumulator battery is used as the emergency source of electrical power, installation of an emergency source of electrical power is not required, provided that the capacity of the battery is sufficient to comply with the requirements of 3.3.2.

3.3.5 Where an accumulator battery is the emergency source of electrical power, this battery and the emergency switchboard shall be installed in separate spaces.

3.3.6 In craft where the source specified in 3.1.2.1 is the main source of electrical power, the individually driven generator installed on board in accordance with 3.3.1 may be regarded as the emergency source of electrical power. In this case, provision shall be made for testing of the complete installation, mentioned in 3.1.2.1, together with the automatic starting arrangements of the individual generator prime mover.

3.3.7 An indicator shall be provided in the central control station to show when any accumulator battery, which serves as an emergency source of electrical power, is being discharged.

3.3.8 The emergency sources of electrical power shall be provided only with short-circuit protection. Where a generator driven by an individual internal combustion engine is the emergency source of electrical power, visual and audible alarms shall be fitted in the central control station or watch-keeping location to warn of the generator over-current.

3.3.9 The emergency switchboard shall be located as close as practicable to the emergency source of electrical power.

3.3.10 Where the generator driven by an individual internal combustion engine is the emergency source of electrical power, the emergency switchboard shall be installed in the same place as the generator except where such an arrangement would adversely affect the switchboard operation. All starting arrangements and charging facilities and starter accumulator batteries of the emergency unit shall also be located in this place.

3.3.11 The emergency generator shall be:

.1 driven by an internal combustion engine;

.2 automatically started upon failure of electrical supply from the main source of electrical power and automatically connected to the emergency switchboard . The total time of starting and load take-over by the generator shall not exceed 45 s;

.3 in case the automatic start of the emergency unit stipulated by 3.3.11.2 will not take place within 45 s, a transitional source of emergency electrical power shall be provided, which shall start immediately upon de-energization.

3.3.12 Where an accumulator battery is used as the emergency source of electrical power, it shall:

.1 operate without recharging wile maintaining the voltage variations across the terminals within 12 per cent of the rated voltage throughout the discharge period;

.2 be automatically connected to the emergency switchboard busbars in the event of failure of the main source of electrical power.

3.3.13 The capacity of the battery serving as the transitional source of emergency electrical power shall be sufficient to supply during 30 min, the following services:

.1 lighting and essential navigation lights;

.2 all internal communication and announcing means required in an emergency;

.3 general alarm and fire detection and alarm systems;

.4 daylight signalling lamps, sound signal means (whistles, gongs, etc.).

Services listed under 3.3.12.2, 3.3.12.3 and 3.3.12.4, may not be supplied from the transitional source if they have their own accumulator batteries by which they are supplied during the required period of time.

3.3.14 Under normal service conditions the emergency switchboard shall be supplied from the main switchboard by an interconnector feeder which shall be adequately protected at the main switchboard against over-current and short circuit.

The emergency switchboard shall be fitted with an automatic breaker which shall open automatically upon failure of the main source of electrical power.

Where the main switchboard is supplied from the emergency switchboard the automatic breaker in the emergency switchboard shall be provided, at least, with short-circuit protection.

3.3.15 Cables feeding emergency services shall be so laid that flooding of emergency consuming equipment situated below the bulkhead deck does not discontinue the supply of other consuming equipment located above that deck.

3.3.16 Switchgear of emergency services shall be located above the bulkhead deck.

3.4 POWER SUPPLY FROM EXTERNAL SOURCE OF ELECTRICAL POWER

3.4.1 Where provision is made for the craft's mains to be supplied from an external source of electrical power, an external supply switchboard shall be installed on board.

3.4.2 At the external supply switchboard the following facilities shall be fitted:

.1 terminals for flexible cable connection;

.2 switchgear and protective devices for connection and protection of the permanently laid cable of the main switchboard; where the cable length between the external supply switchboard and the main switchboard is less than 10 m, no protective devices may be fitted;

.3 a voltmeter or pilot lamps to indicate that voltage from the external source exists across the terminals;

.4 an arrangement or facilities for connecting a device to monitor polarity or phase sequence. It is recommended to provide a phase switch;

.5 a terminal for connecting a neutral wire from the external source, an

especially marked terminal for connecting a protective earthing conductor from shore;

.6 a nameplate to indicate distribution system, voltage, type of current and frequency;

.7 an arrangement for mechanical fixation of the end of flexible cable connected to the switchboard and hangers for the cable which shall be placed at the external supply switchboard or in its vicinity.

3.4.3 The external supply switchboard shall be connected to the main switchboard by means of a permanently laid cable.

3.4.4 On craft with electrical installation of low power, it is allowed to install socket outlets used for power supply from the external source of electrical power. The socket outlet with a rated current over 16 A shall have a switch interlocked so that the plug cannot be inserted or withdrawn while the switch is in "ON" position. The socket outlet shall be protected against mechanical damage and flooding by water. The socket outlet shall be so designed as to preclude touching current-carrying parts under all conditions which are likely to be met in service and its spontaneous disconnection.

3.4.5 The Owner's Manual shall contain information on precautions to be taken when connecting/disconnecting power supply from shore. If a craft is powered from a shore supply, the Manual shall include information regarding the hazard caused when the craft sails in the vicinity of the shore supply cables and the necessity of using in this case the relevant notice "SAFETY PRECAUTION".

3.5 ALTERNATIVE SOURCES OF ELECTRICAL POWER

3.5.1 One of both configurations of alternative sources of electrical power indicated below may be used for power supply of the craft's services:

.1 wind-powered generator and one or several accumulator battery(ies) which is(are) floating on the generator;

.2 solar battery and one or several accumulator battery(ies) which is(are) floating on the solar battery.

3.5.2 Where the alternative sources of electrical power are installed on board in addition to the requirements of 3.1 and/or 3.3 for their cooperative use, the systems of electrical power distribution including the wind-powered generator and/or solar battery shall be approved by the Register.

4 DISTRIBUTION OF ELECTRICAL POWER

4.1 GENERAL

4.1.1 Each outgoing electrical circuit in a switchboard shall be provided with a switching and protective device.

4.1.2 Final circuits of electrical lighting of spaces shall not be put under current load in excess of 10 A. These electrical circuits may supply cabin fans and other minor services.

4.2 SYSTEMS OF ELECTRICAL POWER DISTRIBUTION

4.2.1 The following d.c. distribution systems shall be used on board craft:

.1 two-wire insulated system;

.2 two-wire system with negative earthed pole;

.3 three-wire system with a common negative pole.

4.2.2 A single-wire d.c. and a.c. distribution system with the use of the craft's hull as a return conductor is not permitted, except for limited and locally-earthed systems (e.g. starter systems).

4.2.3 The switchgear (main switchboard, emergency switchboard) may be fitted in a desk located in the wheelhouse.

4.2.4 The following services (if available on board) shall be supplied from the main switchboard busbars:

.1 steering gear electric drives (refer also to 5.2.2);

.2 anchor gear electric drives;

.3 fire pump electric drives;

.4 bilge pump electric drives;

.5 section switchboards of lighting;

.6 radio station switchboard;

.7 navigational equipment switchboard;

.8 navigation lights switchboard;

.9 switchboard of integrated control desk;

.10 switchboard of automatic fire detection and alarm station;

.11 electric drives of auxiliaries essential for the operation of main machinery;

.12 switchboards of electric drives for cargo, mooring, lifeboat and other gear, ventilation and heating appliances;

.13 charging facilities of starter accumulator batteries and batteries supplying essential services;

.14 other services not listed above, as required by the Register.

It is permitted to supply services indicated in 4.2.4.4, 4.2.4.6, 4.2.4.7, 4.2.4.8, 4.2.4.10, 4.2.4.11, 4.2.4.13 from the switchboard specified in 4.2.4.9 by separate feeders provided with adequate switching and protective devices.

4.2.5 Final sub-circuits having a current rating in excess of 16 A shall supply not more than one service.

4.2.6 Supply circuits for smaller groups of services shall be specified for a rated current not in exceed of 16 A. These circuits shall not supply simultaneously lighting and heating appliances.

4.3 SWITCHBOARDS

4.3.1 Switchboard design. See circular 975c

4.3.1.1 Frames, front panels and enclosures of main, emergency, section and group switchboards shall be constructed of metal or some other durable non-combustible material.

4.3.1.2 Switchboards shall be of sufficiently rigid structure capable of withstanding the mechanical stresses liable to occur in service or as a result of short circuits.

4.3.1.3 Switchboards shall be at least protected from dripping. This protection is not required if the switchboards shall be located in places where the conditions are such that no vertically falling drops can get onto the switchboard (refer also to 4.3.6.2).

4.3.1.4 Switchboards intended to be installed in places accessible to unauthorized persons shall be fitted with doors to be opened by means of a special key, the same for all the switchboards on board.

4.3.1.5 The design of the switchboard doors shall be such that with the doors opened an access is ensured to all parts which require maintenance, and the live parts located on the doors shall be protected against inadvertent touching.

The opening panels and doors which are used for mounting electrical control gear and measuring instruments shall be securely earthed with at least one flexible bonding.

See circular 975c

4.3.1.6 The generator panels of main switchboard shall be illuminated with luminaires supplied on the generator side before the main circuit-breaker or not less than from two different systems of busbars, where such systems are available.

4.3.1.7 Illumination of the front side of the switchboards shall not interfere with observation and produce a blinding effect.

4.3.1.8 The design of switchboards shall be such that the access is provided to all parts, which require maintenance.

Arrangements shall be provided for doors of switchboards and distribution cabinets to fix them in open position.

Instruments and devices that need observation and maintenance shall be mounted at a height not more than 1,8 m.

4.3.1.9 Each switchgear designed for a voltage of 50 V and over, fitted with switching and protective equipment and without a voltmeter, shall be furnished with a pilot lamp indicating the existence of voltage on busbars.

4.3.2 Busbars and uninsulated conductors.

4.3.2.1 The limiting heating temperature for switchboard busbars and uninsulated conductors at the rated load and short-circuit current or the permissible one-second short-circuit load for copper busbars shall be determined according to national standards.

4.3.2.2 Equalizer busbars shall be designed for at least 50 per cent of the rated current of the largest generator connected to the main switchboard.

4.3.2.3 Where a busbar is in contact with or close to insulated parts, its heat effects shall not cause under operating or short-circuit conditions the temperature rise in excess of that allowable for the insulating material concerned.

4.3.2.4 Busbars and uninsulated conductors in switchboard shall have adequate dynamic and thermal stability when carrying short-circuit currents occurring at relevant points in the circuit. Electrodynamic loads arising in the busbars and uninsulated conductors due to short circuit shall be determined according to national standards.

4.3.2.5 Insulators and other parts designed to support busbars and uninsulated conductors shall be capable of bearing the loads due to short circuits.

4.3.2.6 Busbars shall be connected so as to prevent corrosion in way of connections.

4.3.3 Selection of electrical switching devices.

4.3.3.1 Electrical switching devices shall at least comply with the national standards and shall be so selected that:

.1 under normal service conditions their rated voltages, currents and temperature rise limits are not exceeded;

.2 they are capable of withstanding, without damage or exceeding temperature limits, such over-currents as specified for transient conditions;

.3 their characteristics under short-circuit conditions are consistent with the actual short-circuit power factor, as well as with the behaviour of the sub-transient and transient short-circuit current.

4.3.3.2 The rated breaking capacity of electrical switching devices designed to interrupt the short-circuit currents shall not be less than the prospective short-circuit current at the point of their installation at the moment of interrupting.

4.3.3.3 The rated making capacity of circuit breakers and switches, which may be incorporated in a shorted electric circuit, shall not be less than prospective peak making current at the point of their installation under short- circuit conditions.

4.3.3.4 The electrodynamic stability current of electrical devices not intended for interrupting short-circuit currents shall not be less than the prospective peak current at the point of their installation.

4.3.3.5 The thermal stability current of electrical devices under short-circuit conditions shall be consistent with the prospective short-circuit current at the point of their installation taking into account the duration of short-circuit duration attributed to the discriminative action of protective devices.

4.3.3.6 The use of a circuit breaker with inadequate breaking and/or making capacities relative to the prospective peak short-circuit current at the point of its installation is admissible, provided that it is protected on the generator side with fuses and/or a circuit breaker with at least necessary ratings for short-circuit currents and which is not used as the circuit-breaker of the generator.

The characteristics of the protection arrangement thus composed shall be such that:

.1 while interrupting the prospective peak short-circuit current, the circuit breaker on the load side will not be so damaged as to become unfit for further service;

.2 while making the circuit breaker for the prospective peak short-circuit current, the remaining part of the electrical arrangement is not damaged; in this case, it is allowed for the circuit breaker on the load side not to be immediately fit for further operation.

4.3.3.7 In electric circuits having a load current rating in excess of 320 A, circuit breakers shall be fitted for overcurrent protection. The use of circuit breakers is recommended at the current exceeding 200 A.

4.3.3.8 In d.c. compound generator circuits where the generators are intended for parallel operation, circuit breakers shall have a pole in the equalizing wire mated mechanically with the other poles of the circuit breaker so that it would close before the other poles are connected to the busbars and open after their disconnection.

4.3.4 Arrangement of electrical switching devices and measuring instruments.

4.3.4.1 Devices, measuring and indicating instruments used in connection with generators and other major essential installations shall be fitted on the switchboards associated with the appropriate generators and installations. This requirement may be ignored in case of generators where there is a central control console with switchgear and measuring instruments for several generators.

4.3.4.2 One ammeter and one voltmeter shall be provided for each d.c. generator on the main and emergency switchboards.

4.3.4.3 The following measuring instruments shall be provided for each a.c. generator on the main switchboard and for emergency generator on the emergency switchboard:

.1 an ammeter with a selector switch which enables it to measure the current in each phase;

.2 a voltmeter with a selector switch to permit measurement of phase and line voltages;

.3 a frequency meter (use of one double frequency meter is permissible for generators operated in parallel, with change-over to each generator);

.4 a wattmeter (for output over 50 kVA);

.5 other instruments as required.

4.3.4.4 In craft having a low-power electrical installation, in which the generators are not expected to operate in parallel, one set of instruments as stipulated in 4.3.4.2 and 4.3.4.3 may be installed at the main and emergency switchboards, which would provide a possibility of making measurements at each generator installed.

4.3.4.5 Ammeters shall be installed in the circuits of essential services rated at 20 A and over. These ammeters may be installed on the main switchboard or at control stations. It is allowed to install ammeters with selector switches, but not more than for six services.

4.3.4.6 In the main switchboard, the feeder supplied from the external power source shall be provided with:

.1 switchgear and protective devices;

.2 a voltmeter or a pilot lamp;

.3 phase break protection device;

.4 voltage drop protection device.

4.3.4.7 A change-over arrangement or a separate device for each circuit of isolated system for measuring and indicating the insulation resistance shall be installed on the main and emergency switchboards.

In any case, the hull leakage current due to the operation of the measuring device shall not exceed 30 mA.

Provision shall be made for audible and visual alarms of impermissible reduction of insulation resistance in all circuits under control.

In craft with unattended machinery space, the above alarms shall be also provided in the location where from the craft's control is effected.

4.3.4.8 Measuring instruments shall have scales with a margin of divisions in excess of the rated values of parameters to be measured.

The upper scale limits of the instruments used shall not be less than:

.1 for voltmeters – 120 per cent of the rated voltage;

.2 for ammeters associated with generators not running in parallel – 130 per cent of the rated current;

.3 for ammeters associated with parallel-running generators – 130 per cent of the rated current for load current scale and 15 per cent of the rated current for reverse current scale (the latter refers only to d.c. generators);

.4 for wattmeters associated with generators not running in parallel – 130 per cent of the rated output;

.5 for wattmeters associated with generators running in parallel – 130 per cent for the load power scale and 15 per cent for the reverse power scale;

.6 for frequency meters ± 10 per cent of the rated frequency.

The above scale limits may be changed on agreement with the Register.

4.3.4.9 Voltage, current and power ratings of the electrical propulsion plant and generators shall be clearly marked on the scales of measuring instruments.

4.3.4.10 Breakers shall be fitted and connected to busbars in such a way that none of the movable contacts and protective or control devices associated with the breaker shall be energized in open position.

4.3.4.11 Where breakers with fuses are used in switchboard circuits, the fuses shall be positioned between the busbars and breakers. Other patterns of fuse positioning is allowed only on agreement with the Register.

4.3.4.12 Fuses in switchboards installed on foundation at the floor level shall be located not lower than 150 mm and not higher than 1800 mm above the floor. Live open parts of the switchboards shall be located at a height of not less than 150 mm above the floor level.

Controls of generator apparatus shall be located not lower than 800 mm above the floor. Controls of other apparatus shall be located at least 300 mm above the floor.

4.3.4.13 Fuses shall be so installed in switchboards that they are easily accessible and the replacement of the fuse links is not dangerous for the operating personnel.

4.3.4.14 Screwed-in fuses shall be so fitted that input leads are connected to the lower terminal.

4.3.4.15 The fuses protecting the poles and phases of the same circuit shall be installed alongside each other horizontally or vertically, depending on the fuse design.

The fuses in an a.c. circuit shall be positioned to follow the sequence of phases, from left to right or from top to bottom.

In a d.c. circuit, the positive-pole fuse shall be on the left, at top, or closer to reach.

4.3.4.16 The manual actuators of voltage regulators installed in main or emergency switchboard, shall be positioned close to the measuring instruments associated with relevant generators.

4.3.4.17 The ammeters of d.c. compound generators intended for operation in parallel shall be included in the pole circuit not connected to an equalizing wire.

4.3.4.18 Flexible stranded conductors shall be used for connecting portable or semi-portable instruments.

4.3.4.19 Controls of the electrical switching devices, panels, outgoing circuits on switchboards and measuring instruments shall have their designations marked.

Switching positions of the devices shall be also indicated.

The rated currents of fuses and breakers installed, the settings of circuit breakers and electrical thermal relays shall be indicated as well.

4.3.4.20 Each outgoing circuit in a switchboard shall be provided with an appropriate circuit breaker to disconnect all poles and/or phases. Circuit breakers may be dispensed with in secondary lighting switch boxes provided with a common breaker, and also in the circuits of instruments, interlocking and alarm devices, local lighting of switchboards protected by fuses.

4.3.5 Light signals.

Colours specified in Table 4.3.5 shall be used for light signals. The application for light signals of the ways other than specified in Table 4.3.5 (e.g. letter symbols) is subject to special consideration by the Register in each case.

4.3.6 Arrangement of switchgear.

4.3.6.1 Switchgear shall be installed in locations where the possible concentration of gases, water vapours, dust and acid evaporations is eliminated.

4.3.6.2 If the switchgear with protective enclosure of IP10 type and below is located in a special space, cabinet

Table 4.3.5

Colour	Meaning	Type of signal	Condition
Red	Danger	Flashing	Alarm in dangerous conditions when a prompt response is required
		Steady	General alarm in dangerous conditions as well as in dangerous conditions detected but not yet rectified.
Yellow	Attention	Flashing	Abnormal conditions when a prompt response is not required
		Steady	Intermediate condition between abnormality and safety. Abnormal condition already detected but not yet rectified.
Green	Safety	Flashing	Standby machinery is put into operation
		Steady	Normal conditions of running and operation.
Blue	Information	Steady	Machinery and gear are ready for starting. Energized mains. Everything is O.K.
White	General information.	Steady	Notations relating to automatic operation. Other auxiliary signals.

or recess, then such spaces shall be made of non-combustible material or have a lining of such material.

4.3.6.3 Arrangement of piping and tanks near the switchboards shall conform to the requirements of Part V “Machinery Installations. Machinery. Systems and Piping”.

4.3.6.4 The navigation lights switchboard shall be located in the wheelhouse where it is readily accessible and visible to the personnel on watch.

4.3.6.5 The main switchboard and generating sets are recommended to be located in the same place.

The enclosure within the main boundaries of a machinery space, provided for the engine control room and where the main switchboard is located, is not considered as separating the main switchboard from the generating sets.

Subject to agreement with the Register, the main and emergency switchboards may be located in the wheelhouse.

4.3.6.6 Craft equipped with both direct current (d.c.) and alternating current (a.c.) electrical systems shall have their distribution from either separate switchboards or a common one with a partition provided to separate clearly the d.c. and a.c. sections from each other. Wiring diagrams of the switch board shall be included, with the craft.

4.3.7 Access to switchboards.

4.3.7.1 A passageway of at least 600 mm wide shall be provided in front of the switchboard.

4.3.7.2 A passageway of at least 600 mm wide shall be provided on the rear, lengthwise of the free standing switchboards.

On agreement with the Register, the width of this passageway may be reduced to 500 mm in some places.

4.3.7.3 The space behind the free standing switchboards with live open parts shall be enclosed and fitted with doors.

4.3.7.4 Passageways specified in 4.3.7.1 and 4.3.7.2 are measured from the most protruding parts of the switchboard apparatus and structures to the protruding parts of equipment or hull structures.

5 ELECTRIC DRIVES OF THE CRAFT’S MACHINERY AND EQUIPMENT

5.1 GENERAL

5.1.1 Control stations of drives shall meet the relevant requirements of Section 3, Part V “Machinery Installations. Machinery. Systems and Piping”.

5.1.2 Electrically-driven machinery shall be provided with visual alarm to indicate actuation of the electric drive.

5.1.3 The automatically, remotely and locally controlled equipment shall be so designed that the automatic and remote control is switched off with the changeover to the local control.

The local control shall be independent both of the automatic and remote control.

5.1.4 Starting of the machinery, the electric motors or facilities of which require additional ventilation in normal operation shall be possible only with ventilation in action.

5.2 SWITCHGEAR AND CONTROL GEAR

5.2.1 The switchgear in the electric drive circuits which does not provide for short-circuit protection is to withstand the short-circuit current that may flow at the point of its installation during the time required for protection activation.

5.2.2 Control gear is to provide an opportunity to start an electric motor from a zero position only.

5.2.3 Each electric motor rated at 0,5 kW and over and its control gear shall be provided with a device to isolate the power supply. In this case, where the control gear is mounted on the main or any other switchboard in the same space and its visibility from the place of electric motor installation is ensured, then, for this purpose it is allowed to use the switch mounted on the switchboard.

If the above requirements for control gear arrangement are not met, the following shall be provided:

.1 device interlocking the switch on the switchboard in the off-position;

.2 additional switch near the electric motor;

.3 such installation of fuses in each pole or phase that they are readily removed and replaced by operating personnel

5.3 ELECTRIC DRIVES AND CONTROL OF STEERING GEAR

5.3.1 In addition to the requirements of 6.2, Part IX "Machinery" of the Rules for the Classification and Construction of Sea-Going Ships and of 2.11, Part III "Equipment, Arrangements and Outfit" of these Rules, steering gear shall meet the requirements of the present Part of the Rules.

5.3.2 Each electric or electro-hydraulic steering gear shall be supplied by a separate feeder laid directly from the main switchboard, each feeder being laid in a separate run (refer also to 9.3.1.8).

Where sectionalized collecting busbars are used in the main switchboard, feeders shall be supplied from different sections.

One of the feeders may be supplied through the emergency switchboard.

In case an auxiliary steering gear is provided, it shall be supplied from the emergency source of electrical power.

5.3.3 Starting and stopping of the steering gear electric motors, other than electric motors of rudders with direct electric drive, shall be effected from the steering room and from the wheelhouse.

5.3.4 The starting devices shall ensure automatic restarting of electric motors as soon as the voltage is restored after a discontinuity in power supply.

Where several control stations for electric drives of steering gear are available, a change-over switch shall be provided to ensure functioning of only one control station, at the operator's choice.

5.3.5 The direction of rotation of the rudder wheel or the direction of motion of the control gear handle shall agree with the direction of putting the rudder over.

In the push-button control system, the pushbuttons shall be arranged in such a manner that the switching on of the push-button located to the right causes the rudder blade to move rightward, while the button to the left its motion leftward.

5.3.6 In the steering gear compartment means shall be provided for disconnecting any bridge control system from the steering gear it serves.

5.4 ELECTRIC DRIVES OF ANCHOR AND MOORING MACHINERY

5.4.1 In addition to the requirements of Section 6, Part IX "Machinery" of the Rules for Classification and Construction of Sea-Going Ships, the electric drives of windlasses, anchor and mooring capstans and mooring winches shall meet the requirements of the present Part of the Rules.

5.4.2 When a.c. squirrel-cage electric motors are used, the electric drives of the anchor and mooring machinery shall ensure, after 30-minute operation at rated load, possible stalling of the electric motor at the rated voltage for at least 30 s for the anchor machinery and 15 s for the mooring machinery. For reconnecting stator winding motors this requirements is applicable to operation of the motors with the windings producing maximum starting torque.

The d.c. motors and a.c. wound-rotor electric motors shall withstand the above-stated stalling conditions, but at the torque twice the rated one; in this case, the voltage may be below the rated value.

Following stalling, the temperature rise shall not be over 130 per cent of the permissible value for the insulation used.

5.4.3 In anchor and mooring capstans and mooring winches, at the speed steps intended only for mooring operations, provision shall be made for over-current protection of the electric motor.

5.4.4 The supply of electric drives of anchor capstans or windlasses shall be effected from the main switchboard busbars.

5.5 ELECTRIC DRIVES OF PUMPS

5.5.1 The electric motors of fuel oil and lubricating oil transfer pumps and separators as well as of organic coolant circulation pumps shall be provided with remote disconnecting switches located outside the space wherein these pumps are installed and outside the machinery casings, but in close vicinity of the exits from these spaces.

5.5.2 Disconnecting switches of the electric drives specified in 5.5.1 shall be located in conspicuous positions covered with glass and provided with explanatory inscriptions.

5.5.3 The electric motors of emergency fire pumps shall be provided with remote starting devices located above the bulkhead deck.

The remote starting devices shall be provided with visual alarm to indicate the "on" position of the electric drive.

5.5.4 Remote-controlled fire pumps shall be capable of being also controlled locally.

5.5.5 The electric motors of oily and sewage water transfer and discharge pumps shall be fitted with remote cut-off arrangements located in the vicinity of discharge manifolds, provided no telephone communication is available between the discharge observation position and discharge control position.

5.5.6 Local starting of fire and bilge pumps shall be possible even in the event of failure of their remote control circuits, including protection equipment.

5.6 ELECTRIC DRIVES OF FANS

5.6.1 The electric motors of ventilation fans in machinery space shall be provided with at least two disconnecting switches, one of which shall be located outside the machinery spaces and their casings, but in close vicinity of the exits from these spaces.

It is recommended that these disconnecting switches be positioned together with similar switches referred to in 5.5.1.

5.6.2 The electric motors of ventilation fans in galley shall be provided with cut-off devices located in positions readily accessible from the main deck, but outside the machinery casings.

Electric motors of exhaust ventilation from galley ranges shall be provided with a disconnecting swict located inside the galley, regardless of the number of disconnecting switches.

5.6.3 The electric motors for the general craft's ventilation shall be provided with a switch for remote disconnection of the motors being located in the wheelhouse.

5.6.4 The electric motors in spaces protected by fire-smothering system shall be provided with a disconnecting switch operating automatically when fire extinguishing medium discharged into the space concerned.

6 LIGHTING

6.1 GENERAL

6.1.1 In all craft's spaces, places and zones where illumination is essential for the safety of navigation, control of machinery and gear, habitability and evacuation of passengers and crew, stationary main lighting fixtures shall be provided, which are supplied from the main source of electrical power.

The list of spaces, places and zones where the emergency lighting fixtures shall be fitted in addition to the main ones is given in 3.3.2.1.

6.1.2 Lighting fixtures shall be installed in such a manner as to prevent heating of cables and adjacent materials up to the temperature exceeding the permissible level and that the heat released by them cannot initiate ignition of flammable objects and their components situated in the vicinity of the lighting fixtures.

6.1.3 External-illuminating lighting fixtures shall be so installed as to prevent interference for navigation and for identification of the navigation lights.

6.1.4 Heat resistant wires shall be provided for internal wiring in lighting fixtures.

A bolt for earthing shall be provided on the lighting fixture body. A reliable electric contact shall be ensured between all the metal parts of the lighting fixtures.

6.2 POWER SUPPLY OF MAIN LIGHTING CIRCUITS

6.2.1 The main lighting circuits shall be supplied by feeders from the main switchboard or by separate feeders from separate main lighting switchboards. The main lighting switchboards may supply the electric drives of non-essential services rated up to 0,25 kW and individual cabin heaters rated up to 10 A.

6.2.2 Protective devices of final lighting circuits shall be set to actuate at a current rating nor exceeding 16 A. The total load current of the consumers connected shall not exceed 80 per cent of the rated current of the protective device.

6.2.3 The main lighting of corridors, lounges and passageways leading to the survival craft and to the evacuation areas on deck (if more than one luminaire is available), machinery spaces shall be supplied by at least two independent feeders, with the luminaires arranged in such a manner that even in case of failure of either feeder, as uniform lighting as possible is ensured. These feeders shall be supplied from different group switchboards, which in case of use of sectionalized lighting busbars in the main switchboard shall be supplied from different busbar sections.

6.2.4 Local lighting fixtures in accommodation spaces as well as socket outlets shall be supplied from the lighting switchboard by a separate feeder, other than that intended for supplying the general lighting fixtures.

This requirement does not apply to individual plug-transformers.

6.2.5 When determining the cross-sectional area of a cable, each socket outlet at the voltage of 110 V and over shall be taken as being rated at 100 W. Inn case of portable lighting, a socket outlet at the voltage of 12 V shall be taken as being rated at 15 W and at 24 V – as being rated at 25 W.

6.3 EMERGENCY LIGHTING

6.3.1 The illumination obtained from the emergency lighting fixtures in separate spaces, locations and zones listed in 3.3.2 shall at least be equal to 10 per cent of the general illumination obtained from the main lighting fixtures (refer to 6.6). It is permitted that the illumination from the emergency lighting fixtures shall at least be equal to 5 per cent of the main illumination, if socket outlets fed from the emergency lighting circuit are provided. The illumination shall be sufficient to easily find the way to the escape means (or shall be equal to 0,5 lx).

6.3.2 To obtain the illumination required in 6.3.1, the emergency lighting fixtures with incandescent lamps may be combined with luminescent lamps.

6.3.3 The main lighting fixtures are permitted for use as emergency lighting fixtures if they can also be fed from the emergency sources of electrical power.

6.3.4 The emergency and main lighting circuits shall be, whenever possible, independent of one another. In case, when one of two circuits fails, the other shall function so as to preclude complete loss of illumination of the spaces and passageways and stairways.

6.3.5 Stationary lighting fixtures with built-in accumulators and automatic recharging from the main lighting circuit with a relay switch may be used for emergency lighting.

6.3.6 Each emergency lighting fixture and combined lamp holder (refer to 6.3.3) shall be marked red.

6.4 SWITCHES IN LIGHTING CIRCUITS

6.4.1 Two-pole switches shall be used in all lighting circuits.

In dry accommodation and service spaces, single-pole switches may be used in circuits to switch off individual luminaires or groups of luminaires rated at not more than 6 A and also luminaires designed for safety voltage.

6.4.2 For stationary external-illumination lighting fixtures, provision shall be made for centralized switching-off of all luminaires from the wheelhouse or from other permanently attended station on the upper deck.

6.4.3 The switches of lighting circuits of fire extinction stations and service spaces having high fire risk, bathrooms, showers and other extra humid spaces shall be located outside these spaces.

6.4.4 Local switches of lighting fixtures shall not be used in the emergency lighting circuits.

The use of local switches is permitted in circuits of the emergency lighting fixtures, which under normal conditions serve as main luminaires.

A switch shall be provided for emergency lighting in the wheelhouse,

Emergency lighting fixtures of embarkation stations, which under normal conditions, serve as main lighting fixtures shall switch on automatically if the craft is de-energized.

6.5 SOCKET OUTLETS

6.5.1 Socket outlets for portable lighting fixtures shall be installed at least in the following locations (if the craft is provided with the locations and equipment mentioned):

.1 on deck near the windlass;

.2 in the steering gear compartment;

.3 in the emergency generator set compartment;

.4 in the machinery spaces;

.5 in the wheelhouse.

6.5.2 Socket outlets fed with different voltages shall be so designed as to prevent insertion of a plug intended for a certain voltage into a socket intended for a higher voltage.

The supply voltage shall be indicated on the socket outlet or at the place of its installation.

6.5.3 Socket outlets for portable lighting and other electrical appliances installed on the exposed decks shall be mounted with their face looking downward.

6.5.4 Socket outlets shall not be fitted in machinery spaces below the floor plating, in enclosed fuel and oil separator rooms or in places where approved safe-type equipment is required.

6.5.5 Socket outlets for a rated current over 16 A shall be provided with an interlocked switch preventing plug and socket disconnection or connection in the “on” position of the switch, and a nameplate indicting voltage.

6.5.6 In bath- and wash-rooms it is allowed to install socket outlets with a permissible operating voltage up to 50 V. An exception to this may be socket outlets with isolating transformers for electric shavers or socket outlets protected with the use of automatic switches with differential relay for < 30 mA.

6.5.7 The use of plugs with split pins is not permitted. The plug pins for a current in excess of 10 A shall be cylindrical and solid or hollow.

6.5.8 Sockets and matching plugs for connecting consumers requiring earthing shall have terminals for connecting the earthing cores of the consumer’s cable. When inserting plug into the socket, the earthing part of the plug shall make contact with the earthing part of the socket outlet prior to connection of current-carrying pins.

6.5.9 Socket outlets in IP55 enclosures, as a minimum, shall be designed so as to ensure the protection, no matter whether the plug is inserted into the socket or not.

6.6 ILLUMINATION

6.6.1 The illumination of particular spaces and zones shall comply with the standards specified by the current State Sanitary Rules for the ships of the Russian Federation and by the regulatory documents of the Administrations of other states.

The above requirement does not apply to craft having the main lighting supplied at voltage below 30 V.

6.7 NAVIGATION LIGHTS

6.7.1 The navigation lights switchboard shall be supplied by two feeders:

.1 one feeder from the main switchboard through the emergency switchboard (if any);

.2 the second feeder from the nearest group switchboard, which is not supplied from the emergency switchboard.

6.7.2 In craft, where the main source of electrical power is an accumulator battery and the main switchboard is installed in the wheelhouse, the navigation lights may be controlled directly from the main switchboard.

6.7.3 In craft, where the navigation lights are fed from an accumulator battery floating on a charging facility under the craft's running conditions, the second feeder to supply the navigation lights switchboard may be dispensed with.

6.7.4 The supply circuits of the navigation lights shall be of two-wire type with a double-pole switch for each circuit to be installed in the navigation lights switchboard.

6.7.5 Each navigation lights supply circuit shall be provided with a protection in two wires and with an indicator to show that the navigation light is activated.

The navigation light activation indicator shall be so designed that its failure does not cause malfunction of the navigation light under its control.

The voltage drop at the switchboard supplying navigation lights including the lights functioning alarm system shall not exceed 5 per cent at rated voltage up to 30 V and 3 per cent – at rated voltage above 30 V.

6.7.6 Regardless of the navigation light switching indication referred to in 6.7.5, provision shall be made for an audible and visual alarm operating automatically when any navigation light fails with the switch in the "on" position.

The audible alarm shall be supplied from a source or feeder other than that used for power supply to the navigational lights switchboard, or from an accumulator battery.

In craft, where the possibility exists of controlling the functioning of the navigation lights directly from the wheelhouse, visual alarm may be dispensed with.

6.7.7 Navigation lanterns other than running lights may be supplied from separate distribution boxes or from the nearest lighting switchboard.

The temporarily-hoisted lanterns may be supplied from socket outlets of the lighting circuit.

7 SIGNALLING AND INTERNAL COMMUNICATION

7.1 Craft where a general alarm signal given by voice cannot be heard in all locations manned during voyage shall be provided with an electrical general alarm system that ensures good audibility of signals in all places on board craft.

The internal communication shall, as a minimum, ensure compliance with the requirements of 2.4.17, Part V "Machinery Installations. Machinery. Systems and Piping". The remaining spaces shall be fitted with internal communication on agreement with the Register.

7.2 Sound general alarm devices shall be installed in the following places:

.1 in machinery spaces;

.2 in public spaces , if their floor area is more than 150 m^2;

.3 in corridors of accommodation, service and public spaces;

.4 on exposed decks;

.5 in working spaces.

7.3 The general alarm system shall be supplied from the main and emergency sources of electrical power.

The general alarm system may take its supply from the craft's mains and from a separate accumulator battery automatically activated in the event of the craft's mains voltage loss.

7.4 In circuits supplying the general alarm system, only the short-circuit protection shall be provided. Protective devices shall be fitted in both conductors of the feeder and also in circuits of each sound device. Protection of several sound devices by one common protective device is permitted if in spaces where they are installed good audibility of other sound devices with independent protection is assured.

7.5 The general alarm system shall be activated by means of two-pole self-reset switch installed in the wheelhouse and in a space, if any, intended to keep watch while the craft is in port.

7.6 Sound devices, switches and distribution devices of the general alarm system shall be provided with clearly visible distinctive marking.

8 PROTECTION

8.1 GENERAL

8.1.1 Protective devices shall be adapted to the current characteristics of the equipment under protection so that they activate at impermissible over-current.

8.1.2 Overload protection shall be provided in:

.1 not less than one phase or a positive pole in a two-wire system;

.2 each positive pole in a three-wire system;

.3 not less than two phases in an insulated three-wire three-phase current system;

.4 all phases in a three-phase four-wire system.

8.1.3 Short-circuit protective devices shall be fitted in each insulated pole of a d.c. system or in each phase of an a.c. system. Short-circuit protective devices shall be set to operate at not less than 200 per cent of the rated current of the electrical equipment being protected. Activation of the protective devices may be without time delay or with a time delay necessary for proper discrimination.

The short-circuit protective device may be used for protection of both the consumer itself and its supply cable.

8.1.4 Where cables of reduced cross-sectional area are used in some sections of a supply circuit, additional protection shall be provided for each of such cables unless the preceding protection device is capable of protecting the cable of reduced cross-sectional area.

8.1.5 Protective devices precluding immediate repeated actuation after the activation of the protection shall not be used in supply circuits of the emergency switchboard as well as in supply circuits of emergency consumers.

8.2 PROTECTION OF GENERATORS

8.2.1 Generators not intended for parallel operation shall be provided with over-current and short-circuit protective devices. Fuses may be used as protective devices for generators rated at 30 kW and less.

8.2.2 Generators intended for parallel operation shall be provided at least with the following protective devices:

.1 against overloads;

.2 against short-circuit;

.3 against reverse current and reverse power;

.4 against under voltage.

It is necessary that the devices used for over-current protection of generators are provided with visual and audible alarms operating with a time delay up to 15 min at the current loads from 100 to 110 per cent of the rated current, and capable of switching off the generator being protected with a time delay to suit the generator thermal time constant at current loads from 110 to 150 per cent of the rated current.

It is necessary that for a setting of the protection to operate at 150 per cent of the generator rated current the time delay does not exceed 2 min for an a.c generator and 15 s for a d.c. generator. An over-current exceeding 150 per cent of the generator rated current may be allowed where it is required by operating conditions and is admitted by the generator design.

Overload protection settings and time delays shall be selected to suit the over-current characteristics of the generator prime mover so that the prime mover is capable of developing the necessary output within the time delay adopted. The overload protective devices used for generator shall not preclude immediate re-starting thereof.

8.2.3 Devices automatically and selectively disconnecting non-essential services in the event of the generator over-current shall be provided. Those services may be disconnected in one or several steps depending on the generator over-current capacity.

This requirement may be ignored for craft with electrical installations with sufficient power reserve, if approved by the Register.

8.2.4 The protection of generators intended for parallel operation, against reverse current or reverse power shall be selected to suit characteristics of the driving internal combustion engine. The limits of settings for the protection types specified shall be in accordance with those given in Table 8.2.4.

Table 8.2.4

Kind of current	Limits of reverse current or reverse power protection settings
Alternating	8 to 15% of the generator rated power output, kW
Direct	2 to 15% of the generator rated current, A

Reverse current protection for d.c. generators shall be installed in the pole opposite to that, in which the equalizer lead is connected. The reverse power or reverse current protection shall still be capable of operation when the voltage applied is reduced by 50 per cent, although the reverse current or reverse power may have altered values.

8.2.5 Under voltage protection shall ensure the possibility of a reliable connection of generators to busbars at a voltage of 85 per cent and more of the rated voltage and shall exclude the possibility of generator-to-busbars connection at a voltage less than 35% of the rated voltage. Besides, it shall switch off the generators in case of reduction of voltage across their terminals within 70 to 35 per cent of the rated value.

The under voltage protection shall operate with a time delay for disconnection of generators from busbars in case of voltage reduction and shall operate without a time delay at the attempt to make connection to the generator busbars before the minimum voltage specified above is reached.

8.2.6 It is permitted to use fuses in excitation systems of generators as protective devices for semiconductor elements.

8.3 PROTECTION OF ELECTRIC MOTORS

8.3.1 Outgoing feeders from switchboards supplying electric motors rated at over 0,5 kW shall be provided with means of protection against short-circuit current and over-current, as well as with no-voltage protection if the motor need not be automatically restarted.

The over-current and no-voltage protective devices may be installed in the motor starting arrangements.

8.3.2 The over-current protective devices for continuously running motors shall switch off the motor under protection within the range from 105 to 125 per cent of the rated current.

The over-current protection of electric motors may be replaced by visual and audible alarm which is subject to special consideration by the Register in each case.

8.3.3 Over-current protective devices which operate on the principle of thermal and temperature relays shall not be used in supply circuits of fire pump motors.

The over-current protective devices may be replaced by visual and audible alarm.

8.4 STEERING GEAR PROTECTION

8.4.1 Only short-circuit protection shall be provided for electric motors and control systems of electric or electro-hydraulic steering gear.

Visual and audible alarm shall be provided to warn of the motor over-current and of the failure of any phase of the feeder supplying the motor.

If bimetallic-strip relays are provided to warn of the motor over-current, they shall be selected for the 0,7 rated current of the electric motor.

The protective device of steering gear control circuit shall be at least set at twice the peak current of the control circuit.

8.4.2 Circuit breakers used to protect the d.c. motors against short-circuit, shall be set for release without time delay at a current not less than 300 per cent and not higher than 400 per cent of the rated current of the motor under protection, while those used with a.c. motors shall be set for release without time delay at a current not less than 125 per cent of the peak starting current of the motor under protection.

Where fuses are used as protective devices, the rated current for the fuse links shall be one grade of rating higher than it follows from the values specified for the motor starting currents.

8.4.3 For electric motors used to drive the active means of the craft's steering, short-circuit and over-current protective devices shall be provided.

The over-current protective devices of the above-mentioned motors shall be fitted with visual and audible alarm to warn of the over-current and shall switch off the motor in the over the load range specified in 8.3.2.

The short-circuit protection shall be in compliance with the requirements of 8.4.2.

9 CABLING

9.1 GENERAL

9.1.1 Cables with insulated copper multi-wire cores manufactured of flame- retardant material shall be used in craft, the cross-sectional area of the core being not less than:

.1 1,0 mm^2 for single-core cables separately installed and more than 200 mm long;

.2 0,75 mm^2 for screened multi-core cables.

9.1.2 It is necessary that all the conductors in the craft's electrical systems are appropriately marked in a way enabling their identification:

.1 earthing conductors shall be marked by green with yellow stripes;

.2 all conductors connected to the negative pole shall be marked by blue;

.3 means of identification other than colour for conductors listed in 9.1.2.1 and 9.1.2.2 is permitted if properly identified on the wiring diagram of the electrical system of the craft.

9.2 SELECTION OF CABLES FOR LOADS REQUIRED

9.2.1 Permissible continuous current load for cables at an environment temperature of +30 °C shall be accepted, depending on the limiting temperature of insulation, in accordance with Table 9.2.1 for the type of the insulation chosen.

Table 9.2.1

Nominal cross-sectional area of core, in mm^2	Continuous current load for single- and double-core cables, in A				
	60 °C	70 °C	85 to 90 °C	105 °C	125 °C
0,75	8	10	12	16	20
1	12	14	18	20	25
1,5	16	18	21	25	30
2,5	20	25	30	35	40
4	30	35	40	45	50
6	40	45	50	60	70
10	60	65	70	90	100
16	80	90	100	130	150
25	110	120	140	170	185
35	140	160	185	210	225
50	180	210	230	270	330
70	220	265	285	330	360
95	260	310	330	390	410
120	300	360	400	450	380
150	350	380	430	475	520

9.2.2 The continuous current load for cables at the environment temperature of +60 °C shall be determined with the use of correction factors according to Table 9.2.2.

Table 9.2.2

Limiting temperature of core, in °C	Values of correction factors
70	0,75
85 to 90	0,82
105	0.86
125	0,89

9.2.3 Regardless of selection of cables in accordance with Tables 9.2.1 and 9.2.2, the nominal cross-sectional area *S*, mm^2, depending on the permissible voltage drop adopted, shall not be less than that determined by the following formula:

$$S = 2 \cdot k \cdot P \cdot l \qquad (9.2.3)$$

where k = the permissible voltage drop factor, refer to Table 9.2.3;
P = the maximum power which is taken off in a given electric circuit, in W;
l = cable length from the power supply source to the consumer, in m.

When selecting cross-sectional area of cables, the requirements of the manufacturer of equipment to be connected in individual electric circuits shall be met.

Table 9.2.3

Rated voltage, in V	5 % voltage drop for electric circuits supplying navigation lights	10 % voltage drop for other circuits	3 % voltage drop recommended for all circuits
12	$2{,}4 \cdot 10^{-3}$	$1{,}2 \cdot 10^{-3}$	$4{,}0 \cdot 10^{-3}$
24	$0{,}6 \cdot 10^{-3}$	$0{,}3 \cdot 10^{-3}$	$1{,}0 \cdot 10^{-3}$

9.3 INSTALLATION OF CABLES

9.3.1 Laying of cables.

9.3.1.1 Cables shall be installed in runs, which shall be, as far as possible, straight and accessible. The cable runs shall pass through locations where cables are not exposed to oil, fuel, water and excessive external heating. Cable runs shall be installed not closer than 100 mm to sources of heat.

9.3.1.2 No cables shall be installed at a distance less than 50 mm from the double bottom and from fuel or lubricating oil tanks.

Cables shall be laid at a distance not less than 20 mm from the shell plating, as well as from fireproof, watertight and gastight bulkheads and decks.

9.3.1.3 Metal-sheathed cables may be laid on structures of light metal or be fastened in position by means of cable clips only when reliable anticorrosive protection is used.

9.3.1.4 No cables are recommended to be laid under the flooring of machinery spaces. If such laying is required, cables shall be laid in metallic pipes or closed conduits (refer to 9.3.5).

9.3.1.5 Cables with insulation intended to withstand different permissible temperatures shall be laid in common cable runs in such a manner that the cables are not heated above their permissible temperature.

9.3.1.6 Cables with protective sheaths, the less resistant of which may be exposed to damage, shall not be laid in one common pipe, duct or by some other means of unsupported common installation.

9.3.1.7 Cores in multi-core cables shall not be used for supply and control of essential services not associated with one another.

Multi-core cables shall not be used simultaneously for safety voltage and service voltages exceeding the safety level.

9.3.1.8 When services are supplied through two separate feeders, these feeders shall be laid in different runs spaced horizontally and vertically as far as possible.

9.3.1.9 When cables are laid in ducts or other structures made of combustible materials, the areas where cables are laid shall be protected against ignition by means of suitable fire protection, such as lining, coating or impregnation.

9.3.1.10 Cables shall not be embedded into thermal or acoustic insulation if it is made of combustible materials. Cables shall be separated from such insulation by lining of non-combustible material or shall be laid at a distance of at least 20 mm therefrom.

When laid in thermal or acoustic insulation made of non-combustible materials, cables shall be designed with due regard for the relevant reduction in current rating.

9.3.1.11 Cables laid in refrigerated spaces shall be provided with protective sheath of metal, polychloroprene rubber or of any other material resistant to the effects of a cooling agent.

Where cables are provided with armour, this armour shall be adequately protected against corrosion.

9.3.1.12 Cables in refrigerated spaces shall be laid on perforated panels or bridges and fastened in position in such a manner that a free space is reserved between the cable and the walls of the room. Panels, bridges and cable clips shall be protected against corrosion.

If cables cross the thermal insulation of a refrigerated space, these cables shall run through it at right angle inside an appropriate sleeve sealed at both ends.

9.3.1.13 When laying the cables, minimum internal bending radii shall be maintained in accordance with Table 9.3.1.13.

Table 9.3.1.13

Type of cable		External diameter of cable, in mm	Minimum bending radius of cable
Cable insulation material	Type of cable protective sheath		
Rubber or polyvinylchloride	Armoured with metal tape or wire	Any	10 *d*
	Metal braid	Any	6 *d*
	Lead alloy and armour	Any	6 *d*
	Other sheaths	Up to 9,5	3 *d*
		9,5 to 25,4	4 *d*
		Over 25,4	6 *d*
Ethylene-propylene rubber or cross-linked polyethylene	Semi-conducting and/or metal		10 *d*

9.3.1.14 Cables and earth bonds of resiliently mounted equipment shall be terminated in such a manner that they cannot be damaged in service.

9.3.1.15 Cables laid on exposed parts of the craft and masts shall be protected against direct exposure to sun radiation.

9.3.2 Fastening of cables.

9.3.2.1 Cables shall be properly fastened in position by means of clips, clamps, holders, etc. manufactured of metal or non-combustible or hardly flammable material.

The fastener surface shall be sufficiently wide and without sharp edges.

The fasteners shall be selected in such a manner that the cables are fastened in position without damage to their protective sheaths.

9.3.2.2 Distances between fastening points of the horizontally-laid cables shall not exceed the values given in Table 9.3.2.2.

For vertical runs of cables these distances may be increased by 25 per cent.

Table 9.3.2.2

External diameter of cable, in mm		Distance between fastening points for cables, in mm	
over	up to	without armour	with armour
–	8	200	250
8	13	250	300
13	20	300	350
20	30	350	400
30	–	400	450

9.3.2.3 Cables shall be fastened in such a manner that mechanical strains in cables, if any, are not transmitted to their inlets or terminations.

9.3.2.4 Cable runs and cables laid parallel to shell plating shall be fastened to hull's structure, and not to the plating.

On watertight bulkheads and masts, cables shall be fastened on special supports (trays, bridges, chocks, etc.).

9.3.2.5 Cables running parallel to bulkheads subject to sweating shall be laid on bridges or perforated panels in such a manner that a free space is reserved between cables and bulkheads.

9.3.2.6 Cable runs shall be laid with a minimum number of crossings. Bridges shall be used at places where cables cross each other. An air gap of at least 5 mm shall be left between the bridge and cable run crossing it.

9.3.2.7 For craft constructed from non-conducting materials, it is permitted to accept an equivalent to the requirements for the installation, fastening and sealing of penetrations of cables and cable runs, imposed by the Register upon steel craft, as based on the practice of hull construction from such materials, the properties of the materials used, etc.

9.3.3 Cable penetrating decks and bulkheads.

9.3.3.1 Cable penetrations through watertight, fireproof and gastight bulkheads and decks shall be sealed.

Sealings where cables penetrate the above bulkheads and decks shall not impair their tightness; no force shall be transmitted to cables, resulting from elastic deformations.

9.3.3.2 Where a cable is laid through non-tight bulkheads or structural members less than 6 mm thick, holes for cable passing shall be provided with linings or bushings that will prevent damage to the cable.

Where the above thickness is 6 mm and over, no linings or bushings are required, but the edges of holes shall be rounded.

9.3.3.3 Laying of cables through watertight decks shall be effected by one of the following ways:

.1 in metallic pipes (risers) protruding above the deck to a height of at least 900 mm in locations where mechanical damage is possible and to a height not less than that of the door sill in spaces where there is no risk of such damage;

.2 in common metal sockets or boxes with additional protection of cables by enclosures having the height specified in 9.3.3.3.1. Cable boxes shall be stuffed with sealing compound, while the pipes shall be provided with glands or stuffed with sealing compound.

9.3.4 Sealing compound.

9.3.4.1 To fill the cable boxes in watertight bulkheads and decks, use shall be made of sealing compounds having good adhesion to the inside surfaces of cable boxes and cable sheaths and that will resist to the attack of water and oil products, will not shrink and derange tightness in continuous service under conditions specified in 2.2.1 and 2.2.3.

9.3.4.2 Sealings of cable penetrations through fireproof bulkheads shall withstand a standard fire test specified for the given type of bulkhead in Part V "Fire Protection" of the Rules.

9.3.5 Laying of cables in pipes and conduits.

9.3.5.1 Metallic pipes and conduits wherein cables are laid shall be protected against corrosion on the inside and outside. The inside surface of pipes and conduits shall be even and smooth. Ends of pipes and conduits shall be machined or protected in such a manner that no damage is caused to the cables when they are being pulled in. Cables with lead sheaths not having any additional protective covering shall not be laid in pipes and conduits.

9.3.5.2 Bending radius of a pipe or conduit shall not be less than the permissible radius for the cable of largest diameter laid in this pipe or conduit (refer to 9.3.1.13).

9.3.5.3 The total cross-sectional area of all cables measured on their outside diameters shall not exceed 40 per cent of the inside cross-sectional area of the pipe or conduit.

9.3.5.4 Pipes and conduits shall be mechanically and electrically continuous and securely earthed if the earthing has not been already ensured by the method of pipe and conduit installation.

9.3.5.5 The pipes and conduits shall be installed in such a manner that no water can accumulate therein. Ventilation holes shall be provided in pipes and conduits, if required. These holes, where possible, shall be provided in the highest and lowest points, so that circulation of air is ensured and vapour condensation is prevented. Holes in pipes and conduits are permitted only at places where they do not enhance the explosion or fire hazard.

9.3.5.6 Fore-and- aft installed cable pipes and conduits which can be damaged due to deformation of the craft's hull shall be provided with expansion pieces.

9.3.5.7 If in accordance with 9.3.1.1 use of cables with combustible sheathing is allowed, these cables shall be laid in metaliic pipes.

9.3.5.8 Cables laid vertically in pipes and conduits shall be fastened so that they are not damaged under tension due to gravity.

9.3.6 Connection and tapping of cables.

9.3.6.1 Ends of rubber-insulated cables to be introduced into machines, apparatus, switchgear and other equipment shall have contact, protective and sealing terminations that will ensure a reliable electrical contact, will not permit moisture to penetrate inside the cable and will protect the insulation of cable cores from mechanical damage and effects of air and oil vapours.

At places of connection , rubber-insulated cable cores shall be protected against damage to their insulation (e.g. by chafing, etc.).

9.3.6.2 Protective sheathing of a cable introduced into a device shall enter for at least 10 mm inside.

9.3.6.3 At places of tapping, the cables shall be connected in branch boxes by means of clamps.

9.3.6.4 If during installation of cables it is necessary to make additional connections, these shall be made in suitable junction boxes provided with clamps. The joint as a whole shall be protected against environmental effects.

The applicability of cable joints and methods of cable jointing other than that mentioned above is subject to special consideration be the Register in each case.

9.4 INSULATING MATERIALS

9.4.1 Insulating materials specified in Table 9.4.1 may be used for insulation of cables and conductors.

Table 9.4.1

Insulation symbols	Standard types of insulating materials	Permissible service temperature, in °C[1]
PVC/A	Standard-type polyvinylchloride	60
PVC/D	Heat-resistant polyvinylchloride	75
EPR	Ethylene-propylene rubber	85
XLPE	Cross-linked polyethylene	85
S95	Silicone rubber	95

[1] Wire temperature to determine the permissible sustained load of a cable.

10 ADDITIONAL REQUIREMENTS FOR SYSTEMS AND EQUIPMENT DESIGNED FOR A VOLTAGE EXCEEDING SAFETY VOLTAGE

10.1 GENERAL

10.1.1 The requirements of this Section apply to electrical power equipment and lighting systems with the service voltage in excess of the safety voltage as well as to similar equipment for domestic use.

Electrical devices shall be manufactured so as to ensure normal performance at voltage and frequency variations specified in Table 10.1.1.

Table 10.1.1

Nos.	Parameter	Variations from rated value		
		For long periods	For short periods	
		value, in %		time, in s
1	Voltage from generators	+ 6 – 10	+ 20 – 30	1,5
2	Frequency	± 5	± 10	5

10.2 PROTECTIVE EARTHING

10.2.1 Metal enclosures of electrical equipment operating at a voltage exceeding the safety level and having no double or reinforced insulation shall be fittted with an earth terminal marked with a symbol "⊥".

Provision shall be made for earthing inside or outside the electrical equipment enclosure depending on the use of the equipment

10.2.2 Parts to be earthened.

10.2.2.1 Metal parts of electrical equipment, which are likely to be touched under service conditions and which could be live in the event of damage to the insulation (except for those mentioned under 10.2.2.2) shall be reliably bonded to the part fitted with an earth terminal (refer also to 10.2.3).

10.2.2.2 Protective earthing is not required for:

.1 electrical equipment provided with double or reinforced insulation;

.2 metal parts of electrical equipment fastened in an insulating material or passing therethrough and isolated from live parts in such a manner that under normal operating conditions these parts cannot become live or come in contact with earthed parts;

.3 bearing housings especially insulated to guard against circulating currents;

.4 lamp caps and fasteners for luminescent lamps, lamp shades and reflectors, guards supported on lamp holders or luminaires constructed of, or screwed in, an insulating material;

.5 cable fastenings;

.6 individual consumer under voltage up to 250 V supplied through an isolation transformer.

10.2.2.3 Secondary windings of all current and voltage measuring transformers shall be earthed.

10.2.3 Earthing terminals and conductors.

10.2.3.1 Fixed electrical equipment shall be earthed by means of external earthing conductors or an earthing core in the feeding cable. Where one core of the feeding cable is used for eartinhg, it shall be connected to the earthed part of the equipment, inside its enclosure. Special earhing by means of external conductors need not be provided where the arrangement of equipment ensures a reliable electrical contact between the equipment enclosure and the craft's hull under all service conditions.

For earthing effected with external earthing conductor, use shall be made of copper conductors as well as conductors of any other corrosion-resistant metal, provided that resistance of these conductors does not exceed that of the required copper conductor. The cross-sectional area of the copper earthing conductor shall not be less than that specified in Table 10.2.3.1.

For earhing effected with a special core of the feeding cable, the cross-sectional area of this core shall be equal to the nominal cross-sectional area of the feeding cable core – for cables having a cross-sectional area up to 16 mm^2 and at least half the cross-sectional area of the feeding cable core, but not less than 16 mm^2 – for cables having a cross-sectional area over 16 mm^2.

Table 10.2.3.1

Cross-sectional area of a cable core connected to consumer, in mm^2	Cross-sectional area of an earthing conductor, in mm^2	
	solid	Stranded
Up to and including 2,5	2,5	1,5
From 4 to 120	Half the cross-sectional area of a cable core connected to consumer, but not less than 4	
Over 120	70	70

10.2.3.2 Earthing of movable, loose and portable consumers shall be effected through and earthed jack in the socket outlet or other earthed contact device and a copper earthing core of the feeding flexible cable. The cross-sectional area of the earthing core shall not be less than the nominal cross-sectional area of the feeding flexible cable core for cables up to 16 mm^2 and at least half the cross-sectional area of the feeding flexible cable core, but not less than 16 mm^2, for cables over 16 mm^2.

10.2.3.3 Earthing of the fixed equipment shall be non-disconnectable.

10.2.3.4 Electrical equipment installed in dangerous spaces and zones shall be earthed by means of external earthing conductor irrespective of the way this equipment is secured.

10.3 RESIDUAL-CURRENT DEVICES (RCD)

10.3.1 To protect personnel against current injury and to protect some kinds of electrical equipment against single-phase earth fault residual-current devices shall be used.

10.3.2 The residual-current devices shall be fitted in the supply circuits of socket outlets intended to feed the portable equipment and in the supply circuits of cabin's socket outlets as well as the socket outlets in public and other spaces with the voltage in excess of the safe one (50 V).

10.3.3 The residual-current devices shall be set to operate at zero sequence current within 10 to 30 mA.

10.3.4 For essential electrical equipment, installation of the residual-current devices is not permitted.

10. 4 OWNER'S MANUAL

10.4.1 The Owner's Manual shall contain information on the precautions to be taken when dealing with electrical equipment, including, where appropriate, information required by ISO 13297 "Small craft. Electrical systems – Extra-low-voltage a.c. installations" and ISO 10133 "Small craft. Electrical systems – Extra-low-voltage d.c. installations", for example:

actions to change position of the battery switch when charging accumulator batteries;

procedure for replacing a fuse and other detachable electrical elements;

warnings "SAFETY PRECAUTION" about explosion and fire hazard in relevant spaces which have not been properly pre-ventilated;

warnings "SAFETY PRECAUTIONS" about current injury hazard.

PART VIII. RADIO AND NAVIGATIONAL EQUIPMENT

1 GENERAL

1.1 Requirements of this part of the Rules apply to radio and navigational equipment of small pleasure craft. In respect to everything not specified in this part or specified partially, radio and navigational equipment is regulated by provisions of Part IV "Radio Equipment" and Part V "Navigational Equipment" of the Rules for Equipment of Sea-Going Ships not contradicting provisions of this chapter which constitutes subject of special consideration by the Register.

2 RADIO EQUIPMENTT

2.1 FUNCTIONAL REQUIREMENTS

2.1.1 Installed aboard craft radio equipment shall be capable:

.1of transmitting ship-to-shore distress alerts;

.2 of receiving shore-to-ship distress alerts;

.3 of transmitting and receiving ship-to-ship distress alerts;

.4 of transmitting and receiving on-scene communication;

.5 of transmitting of signals for locating;

.6 receipt of navigational and meteorological warnings and other urgent information on safety of life at sea.

2.2 STRUCTURE OF CRAFT RADIO EQUIPMENT

2.2.1 Depending on sea areas of navigation (GMDSS) and distance from shelter place the small pleasure craft shall have aboard radio equipment according to the requirements of Table 2.2.1.

Radio equipment of the craft of unrestricted area of navigation shall comply with the GMDSS requirement Structure of radio equipment of craft of unrestricted area of navigation constitutes a subject of special consideration by the Register.

2.2.2 Self-propelled craft with capacity of propulsive engine not less than 55 kW and non-self-propelled craft of gross register tonnage of 80 and more designated for operation on the RF inland waterways shall be furnished with VHF radiotelephony station operating in frequency bands 300.025 – 300.225 and 336.025 – 336.500 MHz.

Navigation on inland waterways of other states shall be regulated by relevant rules of Administrations of these states.

2.2.3 Master shall possess information on boundaries of operation areas of coast VHF and MF radio stations en route of expected navigation (Sea Areas A1, A2).

2.2.4 COSPAS-SARSAT system satellite EPIRB shall be free-floating, positioned in easily accessible place and possess an option of manual initiation.

2.2.5 Satellite EPIRB shall be registered in the relevant database and it shall be confirmed by relevant document.

2.2.6 Arials shall be mounted at maximum practicable height. If the antenna is mounted on a mast bearing sails, the ship shall be provided with emergency arial.

2.2.7 Operation instructions for installed aboard radio equipment ensuring radio communications on distress, ur-

Table 2.2.1

GMDSS Sea Areas	A1, A2 and A3[1]	A1 and A2	A1		
Distance from shelter place (no more than)	Unrestricted	150 miles	20 miles	3 miles	200 m
VHF radiotelephony station with DSC encoder	2	1	1	–	–
MF radiotelephony station with DSC encoder[2]	1	1	–	–	–
INMARSAT ship earth station or MF/HF radiotelephony installation with DSC encoder device	1	–	–	–	–
NAVTEX service receiver	1	1	R	–	–
COSPAS-SARSAT system satellite EPIRB	1	1	R	–	–
Radar transponder	1	1	R		–
Two-way VHF radiotelephone apparatus	2	1	1	1[3]	–

[1] Structure of radio equipment of ships of unrestricted area of navigation constitutes a subject of special consideration by the Register.
[2] Not required, if MF/HF radio station with DSC coding device is installed.
[3] Not required, if fixed VHF radiotelephony station is installed.
Remarks:
R – recommended; structure of fitted aboard craft radio equipment shall ensure fulfillment of all functional requirements listed in 2.1.

gency or safety shall be posted in locations of the radio equipment.

2.2.8 Each craft provided with required by this chapter radio equipment and navigating at a distance of more than 3 miles from shelter places shall carry at least one person qualified for distress and safety radiocommunication purposes who shall be a holder of the relevant certificate.

2.2.9 Each craft provided with required by this chapter radio equipment shall possess authorization for its operation – a duly issued license.

2.3 SOURCES OF ELECTRICAL POWER

2.3.1 Each craft shall be provided with at least two sources of electrical power to supply radio equipment: main and reserve.

2.3.2 During all the time of sea voyage continuous power supply shall be ensured sufficient for operation of radio installations and charging reserve source of electrical power.

2.3.3 Reserve source of power supply, independent of main source of power, shall be provided for maintaining radio communications in distress and for the purposes of safety for at least 1 hour in case of failure of the main source of power supply and, if fitted, emergency source of electrical power.

2.3.4 Reserve source of electrical power (radio equipment accumulator battery) shall be positioned as high as practicable with the purpose to exclude its failure in case of flooding.

2.3.5 If reserve source of electrical power consists of rechargeable accumulator battery, means of automatic charging devices shall be provided and be capable of recharging the accumulator battery within 10 hours.

3 NAVIGATIONAL EQUIPMENT

3.1 GENERAL

3.1.1 Depending on design category and distance from shelter place small pleasure craft shall be equipped with navigational equipment as per requirements of Table 3.1.1

3.1.2 Sailing craft of design categories **A**, **A1**, **A2** and **B** at a distance more than 20 miles off shelter place shall be provided with anemometer and clinometer. Multi-hull sailing craft shall be provided with anemometer enabling indication of wind velocity at each steering position.

3.1.3 Categories **A**, **A1**, **A2** and **B** craft at a distance of more than 20 miles off shelter place shall carry International Signal Code, up-to-date nautical charts and nautical publications necessary for the intended voyage. It is allowed to use nautical charts and nautical publications in electronic format.

3.2 MAGNETIC COMPASS

3.2.1 Craft shall be provided with effective magnetic compass, or other heading finding device, and means of correcting heading and bearing (valid deviation table annually re-newed).

3.2.2 Duly corrected magnetic compass or other means shall be independent of main source of electrical power.

Table 3.1.1

Ship design category	**A**	**A1**	**A2**	**B**	**C**	**C1**	**C2**	**C3**	**D**
Distance of shelter place (not more than)	Unrestricted	200 miles	100 miles	50 miles	20 miles	15 miles	6 miles	1 km	200 m
Magnetic compass	1	1	1	1	1	1	1	–	–
Radionavigation system receiver	1	1	1	1	1	–	–	–	–
Radar	1	1	1	1	R	–	–	–	–
Echo sounder	1	1	1	1	R	–	–	–	–
Log[1]	1	1	1	1	–	–	–	–	–
Equipment of the Automatic Identification System (AIS)	R	R	R	R	–	–	–	–	–
Radar reflector[2]	1	1	1	1	1	1	1	–	
Barometer	1	1	1	1					
Daylight signal lantern	1	1	1	1	1	1			

[1] – log may not be fitted, if radio navigation system receiver ensures continuous and reliable measurement of passed distance in the area of intended navigation.

[2] – not required, if ship's effective echoing area is sufficient to enable detection by radar.

Remarks:

P – recommended.

3.2.3 If the craft's hull is metal, means for compensation of magnetic compass deviation shall be provided by coefficients B, C and D, including heeling error (see Standard ISO 1069).

3.2.4 Magnetic compass and its repeater shall be positioned so as to ensure taking express readings of the compass card by a Helmsman at craft's conning position. For craft making nighttime voyages a lighting of the compass card shall be provided.

3.2.5 The craft shall be provided with a bearing device for taking bearings over an arc of the horizon of 360° as far as practicable.

3.3 RADIONAVIGATION SYSTEM RECEIVER

3.3.1 Radionavigation system receiver shall ensure automatic position indication at any time during expected voyage.

3.3.2 Craft position shall be provided automatically from radionavigation system receiver to the craft radio equipment intended for distress alert.

3.3.3 The receiver shall be supplied from main, emergency (if available) and reserve (GMDSS equipment accumulator battery) source of electrical power (see 2.3).

PART IX. LIFE-SAVING APPLIANCES

1 GENERAL

1.1 APPLICATION

1.1.1 The requirements of this Part apply to craft constructed after the present Rules become effective, whose equipment with life-saving appliances and arrangements is subject to survey by the Register, as well as to the life-saving appliances and arrangements intended for installation aboard these craft.

1.1.2 For craft constructed before the present Rules become effective, when life-saving appliances or arrangements on such craft are replaced or such craft undergo repairs, alterations or modifications of a major character which involve replacement of, or any addition to, their life-saving appliances or arrangements, such life-saving appliances or arrangements, in so far as it is reasonable and practicable, shall comply with the applicable requirements of the present Part of the Rules.

However, if survival craft other than an inflatable liferaft is replaced without replacing its launching appliance, or vice versa, the collective life-saving appliance or launching appliance may be of the same type as that replaced.

1.1.3 General provisions for the scope and procedure of supervision of the life-saving appliances or arrangements, their manufacture as well as the requirements for the technical documentation to be submitted to the Register and the instructions for the documents to be issued by the Register to the life-saving appliances or arrangements are set out in Part I "Survey Regulations" and Part II "Life-Saving Appliances" of the Rules for the Equipment of Sea-Going Ships and also in Part I "Classification" of the present Rules.

The inflatable liferafts may be subject to the requirements set out in ISO 9650-1:2005, ISO 9650-2:2005 and ISO 9650-3:2005 harmonized by the Directions for use of the European Directives No. 94/25/EC and No.2003/44/EC.

1.2 DEFINITIONS AND EXPLANATIONS

1.2.1 Definitions and explanations relating to the general terminology of the Rules are given in the General Regulations.

For the purpose of the present Part of the Rules the following definitions and explanations apply:

Standing beacon is a floating mark manufactured in such a way as to be visible at rough sea. It is used to mark the man-over-board position. It is usually kept in the accessible ship's aft to be easily and quickly thrown overboard, where necessary.

Immersion suit is a protective suit made of waterproof material intended for reducing the body heat-loss of a person wearing it in cold water.

Survival craft is a craft capable of sustaining the lives of persons in distress from the time of abandoning the craft.

Lightest sea-going condition is the loading condition with the craft on even keel, without cargo, with 10 per cent stores and fuel remaining with the full number of passengers and crew and their luggage.

Inflatable appliance is an appliance which depends upon non-rigid, gas filled chambers for buoyancy and which is normally kept uninflated until ready for use.

Inflated appliance is an appliance which depends upon non-rigid, gas filled chambers for buoyancy and which is kept inflated and ready foe use at all times.

Detection is the determination of the location of survivors and life-saving appliances.

Positive stability is the ability of a collective life-saving appliance to return to its original position after the removal of a heeling moment.

Embarkation ladder is the ladder provided at embarkation stations of the collective life-saving appliances after their launching.

Retro-reflective material is a material which reflects in the opposite direction a beam of light directed on it.

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

In craft having rounded gunwales, the moulded depth shall be measured to the point of intersection of the moulded lines of the deck and side shell plating, the lines extending as though the gunwales were of angular design.

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

Thermal protective aid is a bag or suit made of waterproof material with low thermal conductivity intended for restoring the body core temperature of the person immersed in cold water.

2 LIFE-SAVING EQUIPMENT

2.1 GENERAL

2.1.1 The present Part of the Rules lays down standards for equipment of craft with life-saving appliances as well as technical requirements which the life-saving appliances and their stowage on board craft shall comply with.

2.1.2 The life-saving appliances shall be manufactured with due account of the requirements of the present Rules in accordance with the current standards and specifications approved by the Register as well as with the requirements of ISO 9650-1:2005, ISO 9650-2:2005 and ISO 9650:3 harmonized by the Directions for use of the European Directives No.94/25/EC and No.2003/4/EC.

2.1.3 The materials which are used for manufacturing of life-saving appliances shall be in compliance with the requirements of Part XIII “Materials” of the Rules for Classification and Construction of Sea-Going Ships, as well as the requirements of ISO 9650-1:2005, ISO 9650-2:2005 and ISO 9650:3 harmonized by the Directions for use of the European Directives No.94/25/EC and No.2003/4/EC.

2.1.4 The life-saving appliances shall comply with the following requirements:

.1 be manufactured of materials approved by the Register;

.2 not be damaged in stowage throughout the air temperature range from – 30 to +65 °C;

.3 operate throughout the seawater temperature from 0 °C (when immersed in seawater – from -1 °C) to +30 °C;

.4 be rot-proof, and not unduly affected by seawater, oil or fungal attack;

.5 be resistant to prolonged exposure to sunlight (be resistant to deterioration);

.6 be of highly visible colour;

.7 be fitted with retro-reflecting material where it will assist in detection in compliance of the requiremnets of the present Section;

.8 retain positive stability and be capable of satisfactory operation in a seaway.

2.1.5 The period of acceptability of life-saving appliances and items of their equipment which are subject to deterioration with age shall be determined. Such life-saving appliances and items of their equipment shall be marked with a means for determining their age or the date by which they must be replaced.

2.1.6 The life-saving appliances shall be marked indelibly.

2.1.7 Upon agreement with the Register, individual craft which, in the course of their voyage, do not proceed more than 20 miles from the nearest land, may be exempted from some requirements of the present Part of the Rules provided that the sheltered nature and conditions of the voyage are such that the application of such requirements is unreasonable or unnecessary.

2.2 GENERAL TECHNICAL REQUIREMENTS FOR EQUIPMENT OF CRAFT WITH LIFE-SAVING APPLIANCES

2.2.1 Craft shall be provided with life-saving appliances depending on design category and service conditions.

2.2.2 Life-saving appliances shall be equipped with radio communication facilities in accordance with the requirements of Part VIII “ Radio and Navigational Equipment”.

2.2.3 Equipment of craft with collective life-saving appliances.

2.2.3.1 Craft of design category **A** shall carry liferafts corresponding to the Type IA as specified in ISO 9650-1:2005 of such carrying capacity and in such a number that in the event of any one liferaft with the greatest capacity being lost or sustaining damage that cannot be repaired on board, there shall be sufficient capacity of the remaining liferafts to accommodate the total number of persons on board. Craft of unrestricted area of navigation which are intended for operation in summer within the winter seasonable zone or area (mark **T0** added to the character of classification) shall carry liferafts complying with SOLAS Convention.

2.2.3.2 Craft of design category **A1** which carry 15 persons and more shall be provided with liferafts according to 2.2.3.1.

2.2.3.3 Craft of design category **A1** which carry less than 15 persons and craft of design category **A2** shall be provided with liferafts according to 2.2.3.1 with aggregate capacity sufficient at least to accommodate total number of the persons on board.

2.2.3.4 Craft of design category **B** shall be provided with liferafts corresponding to Type IB as specified in ISO 9650-1:2005 in number indicated in Table 2.2.3.4.

Craft of design categories **C**, **C1**, **C2** and **C3** shall be provided with liferafts corresponding to Type II as specified in ISO 9650-1:2005 in number indicated in Table 2.2.3.4.

Table 2.2.3.4

Design category of craft	Number of persons provided with survival craft, in %
	Inflatable rafts
B and **C**	100
C1 at $L_H > 6$ m	100[1]
C2, C3 and **D** at $L_H > 6$ m	100[1]
C1 and **C2** at $L_H \leq 6$ m	100[1, 2]
C3 at $L_H \leq 6$ m	100[1, 3]

[1] Use of inflatable appliances not inferior to Type I with a compressed air cylinder for inflation is allowed.
[2] Required when used at the water temperature less than 20 °C, refer also to 2.2.4.5.
[3] Required when used in cold season, refer also to 2.2.4.5.

2.2.3.5 On all craft, other than craft of design category **D** with hull length of 6,0 m and less, places shall be provided for stowage and securing of the survival craft.

The Owner's Manual shall contain information on type, number and locations of the survival craft.

2.2.4 Equipment of craft with personal life-saving appliances.

2.2.4.1 Every craft shall carry lifejackets for the total number of persons on board.

2.2.4.2 On craft intended for the carriage of organized groups of people an extra lifejacket shall be provided.

2.2.4.3 Child lifejackets shall be provided having regard to the likely number and age of the children on board, subject to the condition that each child is provided with a lifejacket.

2.2.4.4 Craft not provided with liferafts and which operate at low water temperatures down to 12 °C shall be provided with immersion suits for every person on board. In areas where prompt aid cannot be anticipated, it is recommended to provide immersion suits when the water temperature is lower than 20 °C.

2.2.4.5 Craft shall be provided with lifebuoys complying with the standards specified in Table 2.2.4.5.

2.2.4.6 Berth-connected craft of 24 m and less in length shall carry two lifebuoys on each deck. When the length of the craft is less than mentioned above, Note 2 to Table 2.2.4.6 shall be taken into account.

2.2.4.7 A life rail of at least 8 mm in diameter shall be mounted around the periphery of the hull of a water bower, in way of the waterline.

2.2.4.8 On craft of design categories **A**, **A1**, **A2**, **B** and **C**, where the crew has to work on deck under heavy storm conditions, safety belts shall be provided: one for each crew member.

2.2.4.9 Any craft shall be provided with a first aid outfit.

2.3 REQUIREMENTS FOR LIFE-SAVING APPLIANCES

2.3.1 Life-saving appliances used on craft in accordance with the requirements of the present Rules shall comply with the requirements of Part II "Life-Saving Appliances" of the Rules for the Equipment of Sea-Going Ships unless provided otherwise in the present Rules.

The inflatable liferafts may be subject to the requirements set out in ISO 9650-1:2005, ISO 9650-2:2005 and 9650-3:2005 harmonized by the Directions for use of the European Directives No.94/25/EC and No.2003/4/EC.

2.3.2 Requirements for a standing beacon.

2.3.2.1 The standing beacon shall be so constructed as to retain stability when its upper part carries a flag (470 × 360 mm, flag colour – orange) and a light at a height of 2 m above the water level.

2.3.2.2 During operation of the craft the standing beacon shall be in ready-for-use (assembled) condition. If the standing beacon is constructed on telescopic principle and extends automatically, the process of extension shall proceed within a time interval not more than 20 s.

2.3.2.3 The standing beacon shall be connected to the lifebuoy be means of a buoyant line.

2.3.2.4 The light shall be provided with an independent source of power and be activated as soon as the lifebuoy and standing beacon are dropped into water.

2.3.3 Requirements for safety belt.

2.3.3.1 The safety belt shall consist of fabric straps and be arranged so that the safety line (sling) wraps around the chest at the armpits level. The safety belt shall be adjustable so that it can be put both on the light clothes and on the warm outer clothes.

2.3.3.2 If the safety belt is made integral with any other item of clothes such as lifejacket, the whole set shall comply also with the requirements of relevant standards for the combined clothes.

2.3.3.3 The width of the main strap(s) of the safety belt that carries (carry) the major load, shall not be less than

Table 2.2.4.5

Type or purpose of craft	Length of craft hull, in m	Number of lifebuoys[1, 2, 3]		
		In all	Including	
			With self-igniting lights	With grabline
Pleasure craft, for carriage of organized groups of people	≤ 24	4	1[4]	At least one on each deck on each side.
Planing craft	≤ 24	2	–	1
Non-self-propelled craft	≤ 24	2	1	1
Craft of other types and purposes	≤ 24	2	1[4]	1

Notes: [1] With reduction in the length of a craft including berth-connected craft, number of the lifebuoys may be reduced: when the length is less than 15 m – down to 2 pcs., when the length is less than 7 m – down to 1pc.

[2] On craft of design category **D** possessing buoyancy in submersed condition, the lifebuoy is not mandatory.

[3] On craft not provided with inflatable rafts as well as on craft not provided with lifebuoys on the one lifebuoy for every two persons basis, provision shall be made for the persons in water to hold on to the craft filled with water, both in normal and capsized position.

[4] On craft of design categories **A**, **A1**, **A2**, **B** and **C** two lifebuoys with self-igniting light shall be provided and one lifebuoy shall be fitted with a standing pole with a flag and a light at the upper part thereof.

38 mm, while the width of supporting straps shall be less than 19 mm.

2.3.3.4 The safety line (sling) shall be designed so that:

.1 it is capable of being manually detached from the safety belt with the use of a snap hook connected either with the safety belt or with the safety line, or

.2 (only for safety belts manufactured prior to 1 January 1994) the safety line is permanently connected to the safety belt. The safety line shall not be longer than 2 m, the distance from the person to the securing point including any gadgets, shall not be more than 2 m, the free end of the safety line (sling) shall be fitted with a snap hook.

2.3.3.5 For easy identification and to speed up the process of putting on the safety belt, the elements which pass over the chest and shoulders are recommended to be of different colour.

2.3.3.6 Yarn used for fabric articles shall consist of bright, continuous multifiber (nylon) or polyether threads having similar breaking characteristics The minimum breaking load of the fabric straps shall be not less than 10 kN per 25 mm of width.

2.3.3.7 The safety belt shall be :

in the form of a twine made of polyamide fibers (nylon) having a diameter not less than 12 mm and sustaining a breaking load of not less than 20,4 kN; or

in the form of a fabric strap made of bright, well-cohesing solid dense-fiber polyamide (nylon) sustaining a breaking load not less than 20,4 kN.

2.3.3.8 In any case, one third of the crew members shall be provided with safety lines of 1 m long or the safety line of 2 m long shall be fitted with a snap hook positioned at the half-length thereof.

2.3.3.9 The snap hooks shall be self-locked. The opening of the snap hook shall be sufficient to receive and enclose entirely a metal cylinder of 12 mm in diameter, and the snap hooks shall withstand a minimum load of 14,7 kN without any destruction or obvious symptoms of deformations or damages.

2.3.3.10 Metal elements being part of the safety belts shall not affect operation of the compass.

2.3.3.11 Provision shall be made for the use of safety belts for children.

2.3.3.12 Construction of the safety belts and their elements is subject to special consideration by the Register.

2.4 STOWAGE OF LIFE-SAVING APPLIANCES ON BOARD CRAFT

2.4.1 The collective life-saving appliances shall be stowed in readily accessible positions where there are no obstacles to muster and embarkation stations. The stowage positions of the collective life-saving appliances shall be safe with regard to potential fire, other vessel allision and also to their damage by wave impacts.

2.4.2 The collective life-saving appliances shall be stowed as far away from the stern counter (in way of vertical portions of the craft side) and the propulsors as practicable.

2.4.3 Liferafts mentioned in 2.2.3 shall be stored, fully equipped, in the manufacturer's containers and shall be stowed so that neither the liferaft nor its stowage arrangements will interfere with the operation of any other life-saving appliance.

2.4.4 Liferafts shall be so distributed that the aggregate capacity of all rafts stowed on each side will be sufficient to accommodate 50 % of the total number of persons on board.

2.4.5 Every liferaft shall de stowed with its painter permanently attached to the craft.

2.4.6 Each liferaft or group of liferafts shall be secured to stowage arrangements by means of hydrostatic release units to ensure that each floats free and inflates automatically.

2.4.7 Liferafts shall be so stowed as to permit manual release of one raft or container at a time from their securing arrangements. The stowage points for the liferafts shall be immediately and readily accessible.

2.4.8 Liferafts shall be so stowed as to be readily transferable from one side of the craft to another or portable from the stowage point to the guard railing in 15 s.

2.4.9 Liferaft may be stowed on the working deck, deckhouse roof or at a special stowage point(s) from which its free floating is ensured and which meets the following requirements:

.1 it is watertight or quick-drained except when it is completely located above the deck level;

.2 its cover can be opened regardless of the water pressure.

2.4.10 Liferaft(s) stored in flexible package (valise), if its(their) mass exceeds 40 kg, may be stowed below the deck near the exit (ladder).

2.4.11 On multihull craft, liferfafts shall so stowed as to be accessible for use with the craft both in upright and capsized condition.

2.4.12 Lifebuoys shall be evenly distributed on both sides of the craft in conspicuous and readily accessible positions. Permanent securing of lifebuoys which does not ensure their free floating when the craft sinks is not allowed.

2.4.13 If the craft's outfit includes two lifebuoys with a lifeline or self-igniting lights/standing beacon, these lifebuoys shall be stowed on the opposite sides of the craft.

2.4.14 Lifebuoy with a sea-anchor or a safety sling (without anchor) with self-igniting light/standing beacon shall be stowed in a position accessible for immediate use by the steersman.

2.4.15 Lifejackets shall be stowed in readily accessible positions so as to ensure maximum ease of their distribution between persons on board and putting on.

2.4.16 Stowage positions shall be provided for lifejackets reserved for crew members on watch.

2.4.17 If lifejackets are intended for groups of persons, an inscription “Lifejackets” shall be provided near the places where lifejackets are stowed.

2.4.18 Child lifejackets shall be stowed separately, and an inscription “Lifejackets for Children” shall be provided at the place where such lifejackets are stowed.

2.4.19 Personal immersion suits and thermal protective aids may be sowed in individual lockers for each member of crew or each passenger or all together for all persons on board – at especially allocated, readily accessible places marked “Thermal protective aids”.

2.4.20 Safety belts shall be stored at places destined for this purpose.

2.4.21 Dinghy.

2.4.21.1 It is recommended that every craft of design category **A, A1, A2, B** and **C** shall carry a light row dinghy with a rigid or inflatable hull.

2.4.21.2 The dinghy shall be clearly marked with the following data: the maximum number of persons of 75 kg in weight the dinghy is capable to carry safely and the name of craft to which the dinghy belongs.

2.4.21.3 The inflatable dinghy shall be checked at regular intervals by the owner/operator for serviceability and be kept in proper condition.

2.4.22 Personal clothes.

The owner and the master of a craft must notify in advance all the persons on board the craft en route of the flowing requirements imposed on the personal clothes:

2.4.22.1 Each crew member shall be provided with clothes suitable for the environmental conditions and each passenger shall be provided with clothes that ensure thermal insulation at the air and water temperatures which prevail in the geographic areas of the craft navigation in the relevant season.

2.4.22.2 On craft intended for navigation in high latitudes, each person on board shall be provided with an immersion suit of a suitable size in order to reduce the likelihood of prompt overcooling of the person when in water.

2.4.22.3 For movement on deck, each person on board shall be provided with nonslip footwear.

2.4.23 Life-saving appliances and arrangements plan.

2.4.23.1 The life-saving appliances and arrangements plan shall be developed and displayed on each craft, except for craft in design category **D**, with a hull length of 6,0 m and less.

2.4.23.2 The life-saving appliances plan may be included into the Owner’s Manual, refer to 2.2.3.5.

2.4.23.3 The plan shall be developed in accordance with the requirements of ISO 17631:2002 “ Ships and Marine Technology. Shipboard Plans for Fire Protection, Life-Saving Appliances and Means of Escape”.

2.4.23.4 The Owner’s Manual shall contain information for rendering first medical aid, e.g. in case of hypothermia (overcooling of body), drowning, burns, injuries, shock suffering, etc.

PART X. FIRE PROTECTION

1 GENERAL

1.1 SCOPE OF APPLICATION

1.1.1 The requirements of the present Part of the Rules apply to craft referred to in Section 1 of the General Regulations within the scope of requirements set forth in the relevant Sections of this Part.

1.1.2 Fire protection of craft where solid fuel is used is subject to special consideration by the Register.

1.2 DEFINITIONS AND EXPLANATIONS

1.2.1 For the purpose of this Part of the Rules, the following definitions and explanations apply:

Automatic fire extinguishing system is fire-extinguishing system automatically activated by a special device when a preset temperature limit is reached.

Petrol is hydrocarbon fuel, or blends thereof, which is liquid at atmospheric pressure and is used in spark-ignition engines. In this context, kerosene is not regarded as petrol.

Exit is any door, hatch or any other aperture which leads to open air either directly or via other sections of the craft.

Diesel fuel is hydrocarbon fuel, or blends thereof, which is liquid at atmospheric pressure and used in compression ignition engines.

Accessible is capable of being reached for inspection, including use of appropriate tools without the removal of permanent craft structure or any item of equipment.

Readily accessible is capable of being reached quickly with opening of closing appliances without the use of any tools.

Escape route is the short-cut from any manned location within the enclosed craft's space to the nearest exit to the exposed deck.

Structural fire protection is a complex of passive means of the structural fire protection intended for:

prevention of fire;

containment of flame and smoke spreading throughout the craft;

creation of conditions for safe evacuation of people from the craft's spaces and

from the craft, as well as for effective fire extinction.

Steel or other equivalent material is a non-combustible material which by itself or due to insulation provided, has structural and fire integrity properties equivalent to steel at the end of applicable fire exposure to the standard fire test (e.g. aluminium alloy with appropriate insulation).

Machinery areas are compartment or space of exposed type or enclosed by a casing, which contains an internal combustion engine.

Machinery spaces are spaces containing main machinery, shafting, boilers, internal combustion engines, electric generators and other main electrical machinery, ventilation and air conditioning installations, steering engines and other similar equipment.

Low flame spread is that the surface thus described will adequately restrict the spread of flame, this being determined in accordance with the provisions of IMO Resolution A.754(18) "Recommendations on Fire Resistance Tests of "A", "B" and "F" Class Divisions" with regard to the provisions of the "International Code for Application of Fire Test Procedures"[1], as adopted by the IMO Maritime Safety Committee by Resolution MSC. 61(67), as amended.

Non – combustible, fire – resisting and fire – retarding divisions are respectively, "A" or "B" class divisions, as defined below. The fire-resisting and fire-retarding divisions shall be subjected to fire test in accordance with the Fire Test Procedures Code.

Non-combustible material is material which neither burns nor gives off flammable vapors in sufficient quantity to selfignition when heated to 750 °C. Any other material shall be regarded as combustible.

Fire-retarding or "B" class divisions are those divisions formed by bulkheads, decks, ceilings or linings which shall comply with the following criteria:

they are fully constructed of non-combustible materials, with the exception that combustible veneers may be permitted (see 2.3.13);

they are constructed as to be capable of preventing the passage of flame to the end of 30 min. of the standard fire test;

they have an insulation value such that the average temperature of the unexposed side will not rise more than 140 °C above the original temperature, nor will the temperature at any one point, including any joint, rise more than 225 °C above the original temperature when either side is exposed to flame, within the time listed below: class "B-15" – during 15 min, class "B-0" – during 0 min.

Fire-resisting or "A" class divisions are those divisions formed by bulkheads or decks which comply with the following criteria:

[1] Hereinafter referred to as "the Fire Test Procedures Code".

they are constructed of steel or other equivalent material;

they are suitably stiffened;

the are capable of preventing the passage of smoke and flame to the end of 60 min. standard fire test;

they are insulated with approved non-combustible materials such that the average temperature of the unexposed side will not rise more than 140 °C above the original temperature, nor will the temperature, at any one point, including any joint, rise more than 180 °C above the original temperature within the time listed below: class "A-60" – during 60 min; class "A-30" – during 30 min; class "A-15" – during 15 min; class "A-0" – during 0 min.

Hazardous area is location where an increased risk of fire actually exists due to:

presence of open flames (stove, heater, permanently installed lamps, etc.);

presence of heat and/or the possibility of electric sparks near flammable liquids/vapors (e.g. in machinery space);

possibility of electric sparks near flammable liquids/vapors (e.g. in fuel spaces with live electrical equipment);

electrical equipment (main switchboard, battery banks).

Galley space is open or enclosed space to accommodate cooking stove.

Fire extinguishing system is a fixed system intended for supply of a fire extinguishing medium to the protected spaces or directly therein and structurally fixed to the craft's hull.

Fire-fighting outfit is portable fire fighting equipment. Among these are fire hoses with connected fittings, fire hose nozzles, portable fire extinguishers, fire blankets, fog applicators, fire buckets.

Standard fire test is test carried out in accordance with the Fire Test Procedures Code.

Fuel space is a specially allocated space on board, containing permanently installed fuel tank or intended for the storage of portable fuel tanks.

Fuel area is an exposed or enclosed area where fuel pipelines, fittings, fuel tanks or an area intended for the storage of portable fuel tank or engine with fuel tank.

Fire extinguishing media are media used for extinguishing fire by filling of a protected space with a medium not sustaining combustion.

Open-flame device is any appliance where direct bodily contact with an open flame is possible.

Room-sealed appliance is a unit having a combustion system in which incoming combustion air and outgoing combustion products pass through sealed ductwork connected to the enclosed combustion chamber and terminating outside the craft.

1.3 SCOPE OF TECHNICAL SUPERVISION

1.3.1 General provisions for the procedures of classification, supervision during craft construction, manufacture of materials and products, classification surveys, as well as the requirements for the technical documentation to be submitted to the Register for review and approval are set out in the General Regulations and in Part I "Classification".

1.3.2 Subject to the Register supervision are:

.1 structural fire protection;

.2 materials the requirements for which, as regards fire hazardous properties thereof, are set by this Part;

.3 fire extinguishing systems;

.4 fire-fighting outfit,

within the scope of requirements specified by this Part of the Rules.

1.4 TECHNICAL DOCUMENTATION

1.4.1 Technical documentation on fire protection of a craft shall be submitted to the Register for review prior to commencement of the craft construction, within the scope given in Part I "Classification".

2 STRUCTURAL FIRE PROTECTION

2.1 GENERAL

2.1.1 In working out measures to prevent origination and spread of fire, particular attention shall be given to the following zones and spaces on board the craft:

machinery spaces, places with high air temperature and areas around the engines;

fuel spaces, places where fuel filling holes are fitted and unprotected fuel pipelines;

areas around the open-flame devices;

galleys and liquefied gas systems;

areas above the heated parts of machinery in order to avoid laying of electric cables under them;

structural fire protection zones with structures adjacent thereto;

main and spare exits from the spaces of the craft.

2.2 REQUIREMENTS FOR LAYOUT

2.2.1 Compartments inside the craft that may contain spillage of flammable liquids shall be accessible for cleaning.

2.2.2 Compartments containing petrol engines or petrol tanks shall be separated from adjacent compartments. This condition is met if the structure fulfils the following requirements:

.1 the boundaries are continuously sealed;

.2 penetrations for cables, piping, etc. are closed by suitable seals;

.3 doors, hatches and similar openings for passage or access are secured in the closed position;

.4 the effectiveness of the boundary joints or sealings is demonstrated either by documentation or by test.

2.2.3 Petrol tanks shall be arranged in compliance with the requirements set out in 4.10.2, Part V "Machinery Installations. Machinery. Systems and Piping".

2.2.4 Passages through compartments shall not be obstructed. Minimum width of the passages shall not be less than 500 mm.

2.3 REQUIREMENT FOR MATERIALS AND DESIGN OF FIRE PROTECTION

2.3.1 The structural fire protection requirements apply to craft of design categories **A, A1, A2, B** and **C.**

2.3.2 The hulls of the craft of design categories **A, A1, A2** and **B** shall be manufactured of non-combustible materials.

Where aluminium alloys and/or combustible materials are used for this purpose, the equivalence of the structural fire protection shall be ensured by an unconditional fulfillment of the requirements of 2.3.4 and 2.3.12. For timber-based materials, the temperature indicated in 2.3.12.1 shall not be higher than 150 °C.

2.3.3 The hulls of the craft of design category C may be manufactured of combustible materials, but the hull structures shall be protected from ignition in all spaces inside the hull, which may be placed into hazardous areas or are intended for crew or passengers, or in which control stations are situated, by properly installed non-combustible insulation and lining so that such structural protection is identical to the B-15 class division.

2.3.4 For the machinery spaces, their casings and spaces intended for the storage of combustible liquids, the structural protection shall be identical to A-30 class in craft of design categories **A**, **A1**, **A2**, **B** and **C**.

2.3.5 At junctions of the metal core of the A-class division, except for A-0 class divisions, with metal decks, sides and hull framing, as well as at penetrations of pipes, cables and ventilation ducts through the metal core of the A-class division, in order to reduce heat transfer, provision shall be made for insulating the nearby structures with non-combustible materials on one or both sides from the A-class division over a length not less than 500 mm. The above-indicated length of insulation may be reduced if the standard fire tests will prove the possibility of smaller insulation length.

2.3.6 A or B – class bulkheads having core of aluminium alloy or other material which fails in fire or is a combustible material, shall have insulation installed on both sides of the core, if they are load-bearing sides and/or ensure floodability of the craft, including enclosures of the buoyancy boxes. A-class decks having core of aluminium alloy or other material which fails in fire or is a combustible material shall be insulated on the underside.

2.3.7 If an A-class division divides two adjacent spaces one of which is entirely empty of combustible medium or this division is the external surface of the hull, superstructures or deckhouses, such a division may be a A-0 class division, provided it is continuous.

2.3.8 Continuous B-class ceilings and linings with the relevant decks and bulkheads shall fully or partially comply with the requirements for insulation and fire integrity of divisions, as required by the respective fire integrity tables.

2.3.9 All B-class bulkheads shall extend from deck to deck and to external plating or to other boundary surfaces. However, if continuous B-class ceilings and/or linings are installed on both sides of the bulkhead, the bulkheads may terminate in such continuous ceiling or lining.

2.3.10 With the exception of baggage rooms and refrigerated stores of service spaces, the insulation materials shall be non-combustible.

Vapor barriers and adhesives, as well as insulation of cooling pipes and their fittings may be combustible, but they shall be kept to a minimum, as far as practicable, while their exposed surfaces shall be low-flame spread.

2.3.11 In spaces where oily products are or may be present, the insulation shall be impermeable to oil and its vapors.

2.3.12 If the hull, superstructures and deckhouses are manufactured of aluminium alloys or non-combustible materials, the following requirements shall be complied with:

.1 "A" or "B"-class divisions made of above-mentioned materials shall be insulated so, that the temperature of the structural core of their specimens does not rise more than 200 °C above the initial temperature at any time during the applicable fire exposure at the standard fire test.

The duration of the standard fire test of "A"-class divisions may be reduced to 30 min;

.2 appropriate measures shall be taken to ensure that the components of columns, stanchions and other structural members made of the above-mentioned materials, which are required to support lifeboat and liferaft stowage, launching and embarkation areas, comply with the temperature rise limitation requirement:

structural core of the "A"-class divisions – at the end of an hour;

structural members required to support the "B"-class divisions – at the end of half an hour;

.3 use of combustible materials for manufacture of structural members, grounds, bulkhead linings, furniture, etc. in the hull, superstructures and deckhouses made of aluminium alloys or non-metal materials shall be limited. The ceilings of corridors and spaces shall be made of non-combustible materials.

2.3.13 The amount of combustible materials used for construction of interior bulkheads, grounds, linings, finishes, furniture and other equipment of control stations, accommodation and domestic service spaces (except for saunas and spaces mentioned in 2.3.10), where the use of such materials is not prohibited by the present Part, shall not be in excess of 45 kg per 1 m^2 of the deck area of each space.

Depending on the type and purpose of the craft, the Register may revise the above limiting amount of such materials.

2.3.14 Stairways and vertical ladders shall be securely fixed and manufactured of steel or another material equal to steel in fire integrity, including steps.

In craft having two or more decks or spacious superstructures, interior stairways shall be surrounded by at least fire-retarding divisions with self-closing doors of a class not inferior than "B-0" class.

2.3.15 Primary deck coverings, if applied within accommodation and service spaces and control stations, shall be of approved material which is neither non-flammable nor will give rise to toxic or explosive hazard at elevated temperatures, this being determined in accordance with the Fire Test Procedures Code.

2.3.16 Paints, varnishes and other finishes used on exposed surfaces inside spaces shall not generate excessive quantity of smoke and toxic vapors, this being determined in accordance with the Fire Test Procedures Code.

2.3.17 In accommodation and service spaces, it is permissible to fit non-combustible bulkheads, linings and ceilings with a combustible covering at most 2 mm thick, except corridors, stairway enclosures as well as control stations where thickness of combustible covering shall not exceed 1,5 mm.

2.3.18 All waste receptacles shall be constructed of non-combustible materials with no openings in sides and bottom.

2.4 PROTECTION OF COOKING AND HEATING APPLIANCES

2.4.1 Materials near cooking or heating appliances.

2.4.1.1 Materials and finishes used in the vicinity of open-flame cooking and heating devices within the ranges defined in Fig. 2.4.1.1 shall comply with the following requirements, taking into account the movement of the burner up to 20° for monohull and sailing craft and 10 ° for multihull and motor craft, where gimbaled stoves are fitted:

.1 free-hanging curtains or other fabrics shall not be fitted in Zone 1 and Zone 2;

.2 exposed materials installed in Zone 1 and Zone 2 shall be of glass, ceramics, aluminium, ferrous metals, or other materials with similar fireproof characteristics;

.3 materials installed in Zone 2 shall be thermally insulated from the supporting substrate to prevent combustion of the substrate, if the surface temperature exceeds 80 °C.

The thermal insulation may be achieved by an air gap or the use of suitable material.

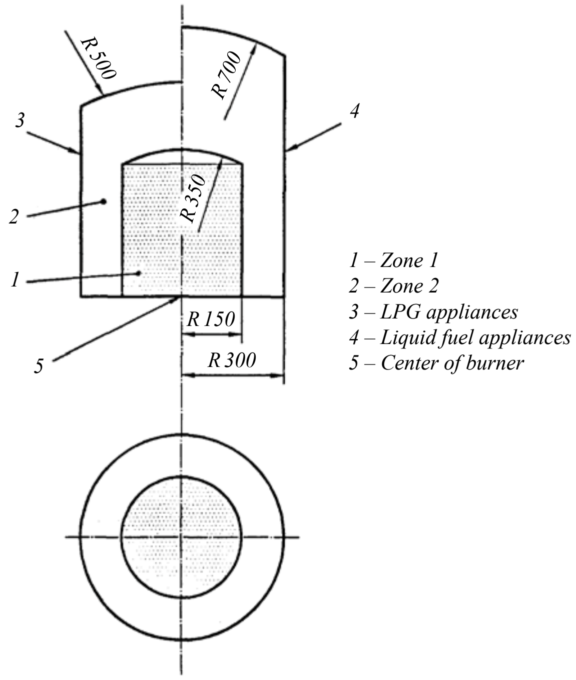


Fig. 2.4.1.1
Areas of special material requirements

2.4.2 General safety provisions.

2.4.2.1 Where flues are installed, they shall be shielded to avoid overheating or damage to adjacent material or to the structure of the craft.

2.4.2.2 For cooking and heating units using fuel which is liquid at atmospheric pressure, the following shall apply:

.1 stoves and heating units shall be securely fastened;

.2 open-flame burners shall be fitted with drip-pan;

.3 where open-flame-type water heaters are installed, adequate ventilation and flue protection shall be provided;

.4 appliances using petrol shall not be installed;

.5 fuel tanks which are not an integral part of the cooking or heating appliance, as well as fuel supplying pipes shall comply with the requirements of 4.10.2, Part V "Machinery Installations. Machinery. Systems and Piping";

.6 fuel tanks which are not an integral part of the cooking or heating appliance shall be installed outside Zone 2, Fig. 2.4.1.1;

.7 a readily accessible shut-off valve shall be installed on the fuel tank. If this is outside the galley, a second valve shall be fitted in the fuel line in the galley space, outside Zone 2, Fig. 2.4.1.1, in a easily accessible position. This requirement may not apply where the tank is located lower than the cooker/heater and there is no possibility of back siphoning. Any valve installed on a tank which is located inside a machinery space shall be remote controlled from a position outside the machinery space;

.8 filler openings for tanks shall be visibly identified to indicate the type of fuel to be used in the system.

2.5 PROTECTION OF MACHINERY SPACES AND FUEL TANKS

2.5.1 The machinery and fuel spaces shall be properly ventilated to prevent the build-up of explosive gases.

2.5.2 Material used for the insulation of machinery spaces shall:

.1 be non-combustible and shall present a surface which does not absorb oily products and their vapors;

.2 have an oxygen index (OI) of at least 21 in accordance with ISO 4589-3:1996 at an ambient temperature of 60 °C.

2.5.3 Electrical equipment installed in spaces containing:

petrol engines and/or petrol tanks;

petrol lines and/or their fittings;

liquefied gas cylinders and/or gas lines;

portable petrol tanks and/or outboard engines with integral petrol tank

shall be designed so as to prevent ignition of the surrounding combustible gases.

2.5.4 Installation of the fuel systems and the installed fuel tanks shall comply with the requirements of Part V "Machinery Installations. Machinery. Systems and Piping".

2.5.5 Fuel tanks.

Fuel tanks, pipelines and their fittings shall be protected and separated or protected from any high temperature source. All the tanks shall be provided with a ventilation system.

The petrol shall be stored in independent tanks which are:

.1 isolated from the machinery space and other sources of ignition;

.2 separated from the accommodation spaces.

Diesel fuel shall be stored in independent tanks.

2.5.6 Fuel with a flash point below 55 °C (petrol and diesel fuel).

2.5.6.1 Arrangement of fuel tanks, their materials and equipment shall comply with the requirements of 4.10.2.2, Part V "Machinery Installations. Machinery. Systems and Piping".

2.5.6.2 Enclosed compartment in which fuel tanks ate located shall be provided with carbon dioxide smothering system or aerosol fire extinguishing system.

2.6 SAUNAS

2.6.1 Sauna shall be insulated against other spaces by "A-60" class divisions except those spaces inside the perimeter. The perimeter of the sauna may include changing rooms, shower/bathrooms and toilets.

2.6.2 Showers or bathrooms with direct access to saunas may be considered as part of them. In such cases, the door between sauna and the shower/bathroom need not comply with fire safety requirements.

2.6.3 The traditional wooden lining on the bulkheads and ceiling are permitted in the sauna. The ceiling above the oven shall be lined with a non-combustible plate with an air gap of at least 30 mm. The distance from the heating surfaces to combustible materials shall be at least 500 mm or the combustible materials shall be protected (e.g. non-combustible plate with an air gap of at least 30 mm).

2.6.4 The traditional wooden benches are permitted to be used in the sauna.

2.6.5 The sauna door shall have no locks and open outwards by pushing.

2.6.6 Electrically heated ovens shall be provided with a timer and meet the requirements of Section 15, Part XI "Electrical Equipment", while cables and wires shall meet the requirements of 16.8 of the same Part.

2.7 LOCAL FURNACE HEATING (FURNACES/FIREPLACES)

2.7.1 The use of local solid fuel-fired furnace heating is allowed on non-self-propelled and berth-connected craft, except for spaces containing fuel oil tanks and/or compressed and liquefied gas cylinders or the fuel oil- and/or liquefied gas-fired equipment.

2.7.2 The brick furnaces/fireplaces shall meet the following requirements:

.1 thickness of the outer brick walls of the combustion chambers shall be not less than 250 mm;

.2 thickness of the outer brick walls of the flues shall be not less than 120 mm;

.3 thickness of the brickwork of the crown shall be not less than 250 mm;

.4 the furnace bottom shall be separated from the combustible deck plating by a brickwork of not less than 250 mm thick;

.5 combustion chamber shall be separated from a combustible deck plating by a brickwork of not less than 350 mm thick;

.6 the brick wall shall have a local thickening of 500 mm at penetrations of the flues through the craft structures;

.7 brick furnaces shall have metal encasements.

2.7.3 Metal heating furnaces without brick lining or water jacket shall not be installed in the craft's spaces.

2.7.4 Heating furnaces shall be placed at a distance of not less than 500 mm from constructions of combustible material. Where such constructions have heat insulation of non-combustible material, the distance shall be at least 250 mm.

In case, where parts of construction abutting on the furnaces are entirely made of non-combustible materials, the minimum distance is not regulated.

2.7.5 The distance from the furnace door to a bulkhead of combustible material shall be at least 1,25 m. Where the bulkhead is made of a non-combustible material or is insulated on surface with steel sheets of 5 mm thick, the distance may be reduced to 1 m.

2.7.6 The distance from the open combustion chamber of the fireplace to a bulkhead of combustible material shall be not less than 2,5 m. Where the bulkhead is made of a non-combustible material or is insulated on surface with steel sheets of 5 mm thick, the distance may be reduced to 2 m.

2.7.7 In front of furnace door and ash hole and the open combustion chamber of the fireplace, provision shall be made for steel plates placed on the floor or for a surface of non-combustible material extending for at least 500 mm from the front wall of the furnace/fireplace.

2.7.8 The furnaces/fireplaces shall be arranged so that, even in case of their overheating, no combustion danger arises for any equipment and outfit. They shall not be installed close to hold bulkheads.

2.7.9 The chimneys of the furnaces/fireplaces shall be so arranged that they rise by 0,5 m above the highest superstructure.

The penetrations of the chimneys through the bulkheads and decks shall be so insulated that the temperature in the point of their contact does not exceed 60 °C.

The distance from the chimney or flue to combustible construction shall be at least 350 mm.

Chimneys shall be made of steel with casings forming a ventilation space or they shall be insulated by a heat-insulating material.

The chimneys shall be securely fixed and fitted with spark traps.

3 FIRE-EXTINGUISHING EQUIPMENT AND OUTFIT

3.1 GENERAL

3.1.1 Provisions shall be made for the craft to be equipped with fire-fighting equipment, according to the craft size and installed engines, and to the presence of open-flame heating devices.

3.2 CLASSIFICATION OF FIRES ACCORDING TO ISO 3941:1977

3.2.1 Class A: fires involving solid materials, usually of organic nature, in which combustion normally takes place with the formation of glowing embers.

Class B: fires involving liquids or liquefiable solids.

Class C: fires involving gases.

Class D: fires involving metals.

3.3 ARRANGEMENT OF EQUIPMENT

3.3.1 The craft spaces shall be equipped with either:

portable fire extinguishers in accordance with the requirements of Section 4, or

fixed fire extinguishing systems in accordance with the requirements of Section 5 plus portable fire extinguishers in accordance with the requirements of Section 4.

3.4 EQUIPMENT OF GALLEY SPACE

3.4.1 The galley shall be provided by one or more portable fire extinguishers and a fire blanket in accordance with the requirements of Section 4, or by a watermist system.

3.5 EQUIPMENT OF MACHINERY SPACE

3.5.1 Protection of machinery space and fuel tanks.

The protection of machinery space and fuel tanks shall be achieved according to the requirements of Table 3.5.1.

3.5.2 Extinguishing medium and capacity.

The fire extinguisher shall be suitable for extinguishing a machinery room fire.

Table 3.5.1

Protection of machinery spaces and fuel tanks

<table>
<tr><th>Type</th><th>Type of craft and position of engine</th><th>Type and rating of engine</th><th>Protection achieved by</th></tr>
<tr><td rowspan="4">Craft without machinery space</td><td rowspan="2">Open craft with inboard engine(s) or part thereof above cockpit sole and nearly vertical casing</td><td>Petrol engine of less than 120 kW rating</td><td rowspan="2">Fixed fire- fighting system complying with the requirements of Section 5 or portable fire extinguisher sized and suited to flood the machinery space through a fire port in the engine casing</td></tr>
<tr><td>Diesel engine</td></tr>
<tr><td colspan="2">Open craft with transom-mounted petrol outboard motor(s) and portable fuel tank stowage in the open atmosphere</td><td>According to provisions given in 4.3.7.
No special requirements for a single outboard engine < 25 kW.</td></tr>
<tr><td colspan="2">Open craft with transom-mounted petrol outboard motor(s), and more than one portable fuel tank per engine, stowed in open atmosphere</td><td rowspan="2">Fixed fire-fighting system to protect fuel space complying with the requirements of Section 5, or portable fire extinguisher sized and suited to flood the fuel space or to cover totally the tank space.</td></tr>
<tr><td>All craft</td><td colspan="2">Petrol tanks are installed in enclosed space</td></tr>
<tr><td rowspan="3">Craft with machinery space</td><td rowspan="3">Engine below cockpit level or inside craft</td><td>Petrol engine</td><td>Fixed fire-fighting system complying with the requirements of Section 5.</td></tr>
<tr><td>Diesel engine/engines of less than or equal to 120 kW combined rating.</td><td>Fixed fire-fighting system complying with the requirements of Section 5,
or portable fire extinguisher of a type and size suitable to flood the machinery space through a fire port in the engine casing.</td></tr>
<tr><td>Diesel engine/engines of more than 120 kW combined rating</td><td>Fixed fire-fighting system complying with the requirements of Section 5.</td></tr>
</table>

The extinguishing capacity of the portable extinguisher shall be sufficient for the volume of the engine room.

A discharge opening shall be provided so that the extinguishing medium can be discharged into the machinery space without opening the primary entrance or access hatch.

3.5.3 Fire port.

The fire port shall be:

identified;

sized to accept the discharge nozzle of the appropriate fire extinguisher;

open or openable to provide ready access for discharge of the medium into the machinery space;

located so that the required size of extinguisher can be operated in a position that will allow complete discharge of the extinguishing medium.

3.6 OTHER ENCLOSED SPACES

3.6.1 Other enclosed spaces shall be adapted to supply of extinguishing medium, except where they are designed for the storage of fuel or other flammable goods when they shall be protected as specified in 3.5.1 for spaces containing main and auxiliary engines with a total combined capacity of less than or equal to 120 kW.

3.7 OPEN DECK

3.7.1 The protection of the open deck area on craft of 15 m and less in length as well as on all craft without power plant may be achieved by fire buckets.

3.7.2 The protection of the open deck area on craft of more than 15 m in length shall be achieved by a water hose system complying with the requirements of Section 6 and by fire buckets.

3.7.3 The type, number and stowage of buckets mentioned in 3.7.1 and 3.7.2 shall be taken according to 10.1.1.4.

4 PORTABLE FIRE EXTINGUISHERS

4.1 APPLICATION

4.1.1 This Section specifies the requirements for type, size, number, location and storage of portable fire extinguishers on board. This Section is not intended to regulate the technical requirements for the extinguishers themselves, which are subject to national regulations.

4.2 GENERAL

4.2.1 Any portable fire extinguisher shall be readily accessible and available for use.

4.2.2 If the portable fire extinguisher is located where it is exposed to splashed or sprayed water, the extinguisher nozzle and triggering device shall be shielded, unless the extinguisher is certified or listed for marine service.

4.2.3 The extinguisher may be stowed in a special locker or other protected or enclosed space. The locker or the opening part of the enclosed-space door shall carry the appropriate symbol indicating that the locker contains a fire extinguisher.

4.2.4 Portable carbon dioxide extinguishers may only be located in a space where energized electrical equipment is located (e.g. electric motor space, battery space, switchboard).

4.3 TYPE, CAPACITY AND NUMBER OF PORTABLE FIRE EXTINGUISHERS

4.3.1 The craft shall be protected by portable fire extinguishers of type approved by the Register in the manner described in 4.3.2 to 4.3.8.

4.3.2 The number of portable fire extinguishers shall be determined according to the requirements of 4.3.6 to 4.3.8.

4.3.3 The craft shall carry Class A and B –rated portable fire extinguishers rated not less than 5A/34B.

4.3.4 An individual carbon dioxide extinguisher shall have a maximum capacity of 2 kg. In each hazardous area (space) there shall be only one carbon dioxide extinguisher.

4.3.5 Where carbon dioxide extinguishers are installed, except for open areas, a notice warning of precautions to be taken in using the extinguisher shall be affixed in the immediate vicinity of such an extinguisher or to the extinguisher itself in accordance with 8.4.

4.3.6 Craft fitted with open-flame device shall carry either:

.1 one or more portable fire extinguisher(s) with a minimum combined capacity of 8A/68B; or

.2 one fire blanket of a size sufficient to protect the galley cooker and a portable fire extinguisher with a minimum capacity of 5A/34B.

4.3.7 Craft with an outboard motor of more than 25 kW shall carry one or more portable fire extinguisher(s) with a minimum combined capacity 8A/68B.

4.3.8 The craft shall be provided with portable fire extinguishers with regard to the requirements for the location thereof:

.1 one portable extinguisher with a minimum capacity of 5A/34B shall be located within 1 m from the main helm position for craft with length less than 10,0 m;

.2 one portable extinguisher with a minimum capacity of 5A/34B shall be located within 2 m from the main helm position for craft with length of 10,0 m and more;

.3 one portable extinguisher with minimum capacity of 8A/68B shall be located within 2 m from any open-flame device and so situated that it is accessible in the event of fire. For the galley cookers, two extinguishers or one extinguisher and fire blanket according to 4.3.6 so located that they are accessible in the event of fire;

.4 one portable extinguisher with minimum capacity of 4A/34B or 8A/68B depending on the power output of installed internal combustion engines, with regard to 4.3.7, shall be located outside the machinery space but not more than 2,0 m from the fire port mentioned in 3.5.3;

.5 one portable extinguisher with minimum capacity of 4A/34B shall be located within 5 m from any manned location for craft with length less than 10,0 m;

.6 one portable extinguisher with minimum capacity of 4A/34B shall be located within (L_H / 3) from any manned location, measured in the horizontal projection, for craft with length of 10,0 m and more;

.7 one portable extinguisher with minimum capacity of 5A/34B shall be located within each 20,0 m^2 of the protected space area for craft with length of 10,0 m and more. If a protected section (area or group of cabins not separated into areas) of the craft is protected by an automatic system, only one portable fire extinguisher with minimum capacity of 5A/34B shall be carried in that section.

5 FIRE EXTINGUISHING SYSTEMS

This Section specifies requirements for fire extinguishing systems, manually or automatically put into operation, capable of extinguishing Class A and B fires.

5.1 GENERAL

5.1.1 Manual systems.

A fixed fire extinguishing system put into operation manually shall be activated from the wheel house. If that position is more than 5 m away from the space to be protected, a means of additional local activation shall be provided near that space.

5.1.2 Automatic systems.

A fixed system that is automatically activated shall comply with the requirements of 5.2.

5.1.3 Manual/automatic combined systems.

The arrangement of a combined manual/automatic system shall be such that the operator can manually override the automatic mode. The system shall comply with the requirements of 5.2.

5.1.4 Gas fire extinguishing systems.

The equipment of a fixed gas fire extinguishing system shall be located in a separate enclosed space and in such a manner that no parts of the system are situated and pass through crew's quarters.

Enclosed space in which such system is located, may have open, closeable and sealed openings for the following purposes:

penetration of cables and pipelines;

access for maintenance of the system equipment.

5.2 INSTALLATION

5.2.1 General.

The components of a fixed system shall be securely fastened to the craft hull to withstand motions, shocks and vibrations during normal running conditions specified by the craft design.

5.2.2 Manual release control systems.

The release control shall be visible or its location clearly labeled and the protected space identified.

The release device shall be readily accessible and operable.

5.2.3 Pipes of fire extinguishing systems.

5.2.3.1 The pipelines and fittings of the fire extinguishing systems and their fastening parts shall be manufactured of steel, copper, copper-nickel alloys as well as of bimetals, one of the layers in which comprises the mentioned material.

5.2.3.2 If non-metal materials are used for manufacture of any system components mentioned in 5.2.3.1, their fire integrity shall not be inferior to that of steel.

5.2.3.3 Brazing used for joining the pipes in the system shall have the melting temperature of the solder of not less than 600 °C.

5.2.3.4 The number and location of discharge nozzles shall ensure effective extinguishing of fires within the protected space.

5.2.4 Discharge and control.

A visual indication of the discharge of extinguishing medium shall be provided.

5.2.4.1 A warning audible alarm shall sound prior to the extinguishing medium being released.

5.2.4.2 If more than one fire extinguishing system is installed in a hazardous space, than each system shall be capable of individually protecting the space, unless they are simultaneously discharged.

5.3 CARBON DIOXIDE SMOTHERING SYSTEM

5.3.1 The supply of 85 per cent of the rated amount of carbon dioxide shall be ensured as follows:

.1 within not more than 2 min for machinery spaces and other spaces where fuel oil is used or other flammable liquids are carried;

.2 within not more that 10 min for spaces where no fuel oil or other flammable liquids are carried or used.

5.3.2 Carbon dioxide shall be stored in cylinders and tanks of an approved type.

5.3.3 The number of cylinders for storing liquid carbon dioxide shall be determined depending on the filling ratio (amount of carbon dioxide per 1 liter of cylinder capacity).

5.3.4 The equipment of carbon dioxide smothering station shall meet the requirements of 5.1.4, 5.2.1 and 5.2.2, as well as 5.3.4.1 to 5.3.4.8.

5.3.4.1 The carbon dioxide smothering stations other than those for machinery spaces shall be arranged in spaces located on open decks or directly below them and having an access from the open deck. The carbon dioxide smothering stations for machinery spaces may not have a direct exit to the open deck only in case where provision is made for remote release of the fire extinguishing medium from the wheel house or other spaces having a direct exit to the open deck.

5.3.4.2 Cylinders shall be placed vertically in rows on pads which may be made of wood.

5.3.4.3 The carbon dioxide smothering station shall have arrangements for weighing the cylinders or measuring the level of the liquid therein.

5.3.4.4 Each cylinder shall be marked with an ordinal number.

5.3.4.5 Doors of the stations shall be properly marked, open outwards and kept permanently locked . The lock shall have two keys, one of which shall be kept in a closed case with a glazed wall located near the lock and the other – in the wheel house.

5.3.4.6 A schematic plan of the smothering system showing the controls and spaces protected, as well as instructions for starting and operating the system shall be displayed in a conspicuous position within the station.

5.3.4.7 The station shall have natural and electric lighting supplied from the craft's mains and from an emergency source.

5.3.4.8 The carbon dioxide smothering stations shall be provided with an independent exhaust and supply ventilation. Inlets of exhaust ducts shall be located in the lower part of the station.

5.3.5 Valves of cylinders shall meet the following requirements:

.1 they shall have protective devices. Protective diaphragms shall break at a pressure rise in the cylinder up to $(1{,}3 \pm 0{,}1)\,P$, in MPa, where P = design pressure in the cylinder. For valves with slotted diaphragms, which are fitted in addition to protective diaphragms, the breaking pressure of the slotted diaphragms shall be at least 1 MPa more than the highest value of the protective diaphragm breaking pressure. There shall be provided a checking device to indicate that the protective device has activated;

.2 the valve-opening device shall be of a lever type and shall ensure full opening of the valve by turning the lever to an angle not more than 90°. The device shall permit the valves to be opened individually or by groups;

.3 the cylinder valves shall be fitted with scarfed pipes cut short at 5 to 15 mm from the cylinder bottom. The inside diameter of the pipes and pipes connecting cylinder valves with the manifold shall not be less than 10 mm.

5.3.6 Gas from the protective devices of cylinder valves shall be discharged to the atmosphere beyond the boundaries of the station through a separate pipe provided with an audible alarm at the outlet.

5.3.7 The pipe connecting the cylinder with the manifold shall be seamless and made of red copper. The use of special flexible hoses manufactured of approved materials is allowed.

A non-return valve shall be fitted on the pipe. The valve shall be installed at the manifold inlet in such a way as to preclude accumulation of water above it. A drainage arrangement of the manifolds shall provide their complete draining.

5.3.8 The distributing manifold of the carbon dioxide smothering station shall be fitted with a pressure gauge graduated to a value at least 1 MPa in excess of the hydraulic test pressure of the carbon dioxide cylinders. The value of the pressure gauge scale division shall not exceed 0,5 MPa.

5.3.9 Sealing materials for valves and flexible hoses shall remain usable at low temperatures down to -30 °C.

5.3.10 The total cross-sectional area of collecting manifolds and cross-sectional area of the distributing manifold shall be not more than the sum of cross-sections of the simultaneously opening cylinder valves for the largest (by volume) protected space.

5.3.11 The cross-sectional area of distributing pipes for individual protected spaces shall be not more than the total cross-sectional area of the simultaneously opening cylinder valves for the space concerned.

5.3.12 Each pipe to individual protected space shall be fitted with individual shut-off devices. Wall thickness of the pipes shall be determined in accordance with the requirements of 4.2.5.3, Part V "Machinery Installations. Machinery. Systems and Piping".

5.3.13 The total sectional area of the outlets of the nozzles in the protected space shall not exceed 85 per cent of the total cross-section of the distributing piping.

5.3.14 Perforated pipes may be used instead of nozzles in silencers, exhaust-gas boilers and smoke stacks. The total area of pipe perforations shall be by 10 per cent less than the pipe cross-section.

5.3.15 Release controls of the system at the fire extinction station shall ensure simultaneous opening of cylinder valves.

5.3.16 Fixed carbon dioxide smothering systems shall be provided with alarm to warn of gas release in accordance with 5.2.5.3.

5.3.17 Closing of all openings through which air can enter and/or the fire smothering gas can escape shall be provided in the spaces protected by the carbon dioxide smothering system. Controls for closing the openings shall be arranged outside the protected spaces or at places not likely be cut off by the fire in the protected space.

5.3.18 A notice of an established standard bearing the description of the alarm signal and actions to be taken when the alarm sounds shall be displayed at each entrance to and exit from the space to which carbon dioxide can be released.

5.3.19 In sound cases, local stations may be allowed for certain protected spaces.

Carbon dioxide cylinders for protection of silencers of internal combustion engines, smoke stacks and other enclosed spaces may be installed inside the machinery spaces.

5.4 AEROSOL FIRE EXTINGUISHING SYSTEM

5.4.1 General

5.4.1.1 The fire extinguishing aerosol generators used in the aerosol fire extinguishing system shall be of a type approved by the Register.

5.4.1.2 The aerosol fire extinguishing system shall include:

generators of fire extinguishing aerosol;

remote control device;

predischarge alarms;

cables.

5.4.1.3 The following measures shall be taken at system activation:

automatic activation of the emergency alarm systems in the protected

space in accordance with the requirements of 5.2.4.1;

automatic disconnection of ventilation in the protected space.

5.4.1.4 For machinery and other spaces where fuel oil or flammable liquids are used, the generator's operating mode shall not exceed 2 min.

5.4.1.5 Arrangement of generators in the protected space shall ensure even distribution of fire extinguishing aerosol. If there are stagnant zones formed by the equipment and boundaries, the fire extinguishing aerosol shall be fed directly to the stagnant zones.

5.4.1.6 When generators are installed, they shall be oriented so that the jets of fire extinguishing aerosol do not exert thermal effect on escape routes, craft's equipment, cables, emergency lighting, warning alarm system, fuel oil and lubricating oil tanks and pipes.

5.4.2 Fire extinguishing aerosol generators.

5.4.2.1 The fire extinguishing aerosol generator shall consist of a casing, which contains an aerosol generating agent, starting device, electrical connector, devices for securing to the craft's structures. The casing of the generator shall be fitted with an arrangement (nozzle) for the release of the aerosol.

5.4.2.2 Each type of generator shall be provided with information about the distance (along the aerosol jet axis) from the exit of the jet out of the generator to the boundary of thermal zone with a temperature of + 70 °C.

5.4.2.3 Time from the start-up of the generator until its operating duty shall not exceed 10 s.

The duration of the operation duty shall not be less than 20 s.

5.4.2.4 The casing of the generator , its foundation and details for securing it to the foundation shall be made of non-combustible materials.

5.4.2.5 The generators shall be fitted with an arrangement for automatic (spontaneous) starting, if the ambient temperature exceeds 250 °C.

5.4.3 The aerosol fire extinguishing remote control device.

5.4.3.1 The remote control device shall comply with the requirements of Section 2, Part VII "Electrical Equipment".

5.4.3.2 The remote control device shall enable simultaneous distant starting of all generators in the protected space.

5.4.3.3 If several spaces are protected by the fire extinguishing system, the remote control device shall enable individual start-up of the generators in each space.

5.4.3.4 There shall be two sources of power supply – main and auxiliary – for the remote control device.

5.4.3.5 The remote control device shall ensure automatic monitoring of the running order of starting circuits (e.g. disconnection, contact-to-frame fault, etc.) and signaling of the fault on the front panel.

5.4.4 Local stations of the aerosol fire extinguishing.

5.4.4.1 In sound cases, local stations with one or two generators and the starting arrangement located near entrance to the space (without remote control device) may be fitted.

5.4.5 Cabling.

5.4.5.1 Cabling shall comply with the requirements of Section 8, Part VII "Electrical Equipment".

5.4.5.2 Starting cables shall be shielded and the shield shall be grounded.

5.5 WATER FIRE MAIN SYSTEM

5.5.1 General.

5.5.1.1 For fire fighting purpose, along with special fire pumps, sanitary, bilge and other pumps may be used, the capacity and head of which shall be not less than the design values for fire pumps.

5.5.1.2 On self-propelled craft having power output 120 kW and over, and non-self propelled craft provided with their own fixed sources of power output of 120 kW and over shall be provided with a fixed water fire main system with a power-driven fire pump. Such a pump, along with its piping and water intake may be located in machinery space.

5.5.1.3 On agreement with the Register, the fixed water main system may not be installed on craft with a crew consisting maximum of 3 members and/or with hull length of 15 m and less.

5.5.1.4 Craft not mentioned in 5.5.1.2 and 5.5.1.3 shall be provided with appropriate fixed manually operated pumps or motor pumps which together with their piping and water intakes shall be located outside the machinery space.

5.5.1.5 For berth-connected craft permanently moored to shore, as an alternative means of fire extinguishing, water to the water fire main system may be delivered by the shore-based system with a capacity and head not less than the design values for the fire pumps. In this case, systems shall be connected with due regard for the craft displacements.

5.5.1.6 The capacity of a fire pump of a fixed water fire main system shall be sufficient to ensure simultaneous operation of two fire nozzles with the largest nozzle size adopted for the craft concerned at a pressure at the farthest hydrant being 0,2 MPa.

Other water fire main systems shall be designed as to be capable of delivering at least one jet of water to any part of the craft, at a pressure at the farthest hydrant being 2 MPa.

5.5.1.7 If other fire extinguishing systems using water supplied by fire pumps are installed on board the craft (pressure water-spraying system, drenching system, etc.), the capacity of the pump of the water fire main system shall be sufficient for delivery of water to any part of the craft and for parallel operation of one of the above systems that requires the largest quantity of water.

5.5.1.8 Where a power-driven pump is used, the fire main shall be fitted with at least one fire hydrant which shall be placed on the deck , and with one fire hydrant fitted on the discharge line in the vicinity of the fire pump (between the pump and shut-off valve).

5.5.1.9 If the manual pumps and power pumps are connected to a common fire main, they shall be provided with a non-return shut-off valve fitted on discharge side.

5.5.2 Requirements for fire pumps.

5.5.2.1 Fire pumps shall have an independent mechanical drive.

The Register may allow use of main-engine-driven pumps, provided that the propulsion plant is designed to provide the fire pump operation when the craft is not under way and disconnection of the pump when the ship is under way.

On agreement with the Register, a V-belt drive from the main engine to the pump may used, provided that transmission of torque is ensured even when one of the belts is broken.

5.5.2.2 The fire pump may be used for other purposes requiring only short-time consumption of water (e.g. flushing out of decks, hawse pipes, etc.).

The Register may allow the use of the fire pump for other services (bilge pumping, emergency drainage of motor compartment), provided that the simultaneous operation of them is ensured and the requirements of these Rules for the services are met.

5.5.2.3 Pumps and pipes intended for fire fighting purposes may neither be used for pumping of petroleum products, oil or other flammable liquids nor as ballast pumps for tanks used for alternate carriage of fuel oil and ballast water.

5.5.2.4 Pumps that are likely to develop in the fire line a pressure exceeding the permissible value shall be provided with bypass valves to discharge water from the delivery to the suction pipe.

The fire pump shall be fitted with a pressure gauge installed on the delivery pipe ahead of the bypass valves.

The by-pass valves shall be set to operate at a pressure exceeding the working pressure in the fire line by no more than 10 per cent.

5.5.2.5 The fixed fire pump and its sea valve shall be located below the light-draught waterline.

On agreement with the Register, the pump may be installed above the waterline, provided efficient self-priming means are available.

5.5.3 Piping.

5.5.3.1 The diameters of the water fire main and water service pipes shall be such that the water velocity at any pipe sections is not more than 4 m/s.

5.5.3.2 Where heating of the craft's spaces is provided, the water fire main sections passing through unheated spaces and spaces located on open deck shall be provided with shut-off fittings for their isolation from the pipes running through heated spaces as well as with water drainage arrangements.

5.5.3.3 Each fire pump shall be fitted with shut-off valves on suction and discharge pipes. The use of slide valves on suction pipes is allowed.

Non-return shut-off valves shall be provided on discharge pipes of centrifugal pumps.

5.5.3.4 Pipes of the water fire main system shall be steel seamless pipes.

5.5.3.5 Fittings shall be of steel, bronze, copper or, on agreement with the Register, of other materials.

5.5.4 Fire hydrants.

5.5.4.1 Each fire hydrant shall be fitted with shut-off valve and a standard quick-acting coupling. Hydrants fitted on open decks shall also have quick-acting plugs.

5.5.4.2 Fire hydrants shall be so arranged on board the craft as to ensure delivery of at least one water jet to any part of the craft through standard fire hoses not more than 10 m long.

5.5.4.3 Fire hydrants shall be placed:

on open decks – in way of exits;

inside the spaces – in corridors and lobbies, engine and boiler rooms.

Fire hydrants shall be placed at a distance of not more than 1,35 m from decks or floorings.

5.5.4.4 All fire hydrants shall be painted red and numbered.

5.5.5 Fire hoses and nozzles.

5.5.5.1 Fire hoses approved by the competent bodies shall be used on board craft.

5.5.5.2 Fire hoses shall meet the following requirements:

.1 they shall have a length equal, approximately, to 2/3 of the craft length, but not more than 15 m;

.2 they shall be made of approved materials resistant to wear and destruction by microorganisms (rotting);

.3 the diameters of the hoses and couplings shall be compatible with the diameters of standard fire nozzles coupled thereto, as well as with the diameters of the craft's fire hydrants.

5.5.5.3 The number of the fire hoses shall be equal to that of fire hydrants installed on board.

5.5.5.4 Each fire hose in assembly with a fire nozzle shall be stowed on reels or in baskets in the immediate vicinity of the fire hydrant for which it is intended. On open decks, fire hoses shall be kept in properly marked ventilated lockers.

5.5.5.5 Fire nozzles shall be of dual-purpose type capable of producing both a solid jet and a sprayed jet.

5.5.5.6 The standard nozzle size shall be equal to at least 6 mm.

5.5.6 Tests for strength and tightness.

The water fire main system shall be tested for strength in a workshop and for tightness after installation on board in compliance with the requirements of Table 5.5.6.

Table 5.5.6

Pipes and fittings	Test hydraulic pressure, in MPa	
	In workshop	On board craft
Pipes from sea valves to pumps	–	0,2
Pipes from pumps to fire hydrants	$1,5p^1$	In action in assembly with the system
Fittings	$1,5p$ but not less than 0,2 MPa	

N o t e . p = working pressure in the system;
[1] in case the test is intended to be conducted with that pressure after installation on board, the test in workshop may be omitted.

6 OPERATION

6.1 The fixed system shall be capable of operating at environmental temperatures corresponding to the operating conditions specified by the design.

6.2 Operating instructions shall be provided for each system. If the extinguishing medium is an asphyxiant, these shall include directions on the necessity and how to ventilate the space prior to entering for damage assessment and subsequent restarting of the engine, as well as on how to help people who accidentally sustained asphyxiation in fire extinguishing.

7 DESIGN AMOUNT OF EXTINGUISHING MEDIUM

7.1 GENERAL

7.1.1 The design amount of the extinguishing medium shall be based on the net volume of the space with the deduction of the volumes occupied by the equipment. The deducted items do not include furniture and equipment into which the extinguishing medium can penetrate.

7.1.2 If the design volume of the space is 10,0 m^3 and less the design amount of the extinguishing medium shall be increased by 10 per cent. When the volume of the space exceeds 20,0 m^3, no reduction is required. The intermediate values are determined by linear interpolation.

7.2 DESIGN AMOUNT OF CARBON DIOXIDE OF A FIXED FIRE SMOTHERING SYSTEM

7.2.1 The amount of carbon dioxide, in kg, shall be determined by the following formula:

$$G = 1,79\,V\varphi \qquad (7.2.1)$$

where V = design volume of protected space, in m^3;
φ = factor equal to:
0,3 – for machinery spaces, the design volume of which is determined with regard to the full volume of casings;
0,35 – for machinery spaces, the design volume of which is determined without any regard to the volume of casing from the level at which the horizontal area of the casings is equal to, or less than, 40 % of the horizontal cross-sectional area of the machinery space.
For machinery spaces, such value of the factor φ shall be taken which results in a greater value of G.

7.3 DESIGN AMOUNT OF AEROSOL GENERATING AGENT OF AEROSOL FIRE EXTINGUISHING SYSTEM

7.3.1 The design mass of the aerosol generating agent, in kg, shall be determined by the formula

$$G = \left(V + \sum_{j=1}^{n} V_{arj} \cdot P_{arj} \cdot Pa^{-1}\right) \cdot k \cdot q \qquad (7.3.1)$$

where V = design volume of the protected space, in m^3;
V_{arj} = volume of the j-th air receiver, in m^3, refer to 4.13.1, Part V "Machinery Installations. Machinery. Systems and Piping";
n = number of air receivers in the protected space;
j = serial number of air receiver;
P_{arj} = working pressure in the j-th air receiver, in MPa;
P_a = atmospheric pressure, in MPa;
q = normative fire extinguishing capacity of aerosol, in kg/m^3;
k = safety factor equal to 1,5.

7.3.2 The normative fire extinguishing concentration of aerosol depends on the type of generator and generally shall not exceed 0,2 kg/m^3.

7.3.3 The design number of generators, in pcs, shall be determined by formula

$$N = G/m \tag{7.3.3}$$

where G = design mass of aerosol generating agent, in kg;
m = mass of a charge in one generator, in kg.

8 DISPLAYED INFORMATION

8.1 Where a space which is regarded as been sealed from adjacent spaces is protected by a fixed system, the following information shall be displayed near the release device:

CAUTION	ВНИМАНИЕ
BEFORE DISCHARGING SHUT DOWN ENGINES AND BLOWERS	ПЕРЕД ПУСКОМ ВЫКЛЮЧИТЕ ДВИГАТЕЛИ И КОМПРЕССОРЫ

Background: Yellow

8.2 Where a space, which is protected by a fixed system, cannot be regarded as being sealed from adjacent spaces, the following information shall be displayed near the release device:

CAUTION	ВНИМАНИЕ
BEFORE DISCHARGING SHUT DOWN ENGINES AND BLOWERS	ПЕРЕД ПУСКОМ ВЫКЛЮЧИТЕ ДВИГАТЕЛИ И КОМПРЕССОРЫ
LEAVE ACCOMMODATION	ПОКИНУТЬ ПОМЕЩЕНИЕ

Background: Yellow

8.3 The following information shall be displayed at any entrance to the protected space, if the extinguishing medium is an asphyxiant:

WARNING	ОСТОРОЖНО
ENGINE COMPARTMENT HAS FIXED EXTINGUISHING SYSTEM TO AVOID ASPHYX1AT10N	МАШИННОЕ ПОМЕЩЕНИЕ ОБОРУДОВАНО СТАЦИОНАРНОЙ СИСТЕМОЙ ГАЗОВОГО ПОЖАРОТУШЕНИЯ
LEAVE THE AREA BEFORE DISCHARGE	ПЕРЕД ВЫПУСКОМ ПОКИНУТЬ ПОМЕЩЕНИЕ
AFTER DISCHARGE VENTILATE BEFORE ENTERING	ПО ЗАВЕРШЕНИИ ВЫПУСКА ПЕРЕД ВХОДОМ ПРОВЕНТИЛИРОВАТЬ

Background: Yellow or orange.

8.4 The following information shall be displayed near or on any CO_2 portable fire extinguisher:

WARNING	ОСТОРОЖНО
THIS EXTINGUISHER USES **CO_2** AS AN EXTINGUISHING MEDIUM IT SHALL BE USED ONLY TO FIGHT ELECTRIC OR GALLEY FIRES	ОГНЕТУШИТЕЛЬ СОДЕРЖИТ ТУШАЩЕЕ ВЕЩЕСТВО **CO_2** ДОПУСКАЕТСЯ ПРИМЕНЯТЬ ТОЛЬКО ДЛЯ ТУШЕНИЯ ЭЛЕКТРООБОРУДОВАНИЯ ИЛИ ПОЖАРА В КАМБУЗЕ
TO AVOID ASPHYXIATION AFTER DISCHARGE LEAVE THE AREA IMMEDIATELY AND VENTILATE BEFORE ENTERING	**ИЗБЕГАЙТЕ ОТРАВЛЕНИЯ ГАЗОМ** ПРИ ВЫПУСКЕ НЕМЕДЛЕННО ПОКИНЬТЕ ПОМЕЩЕНИЕ И ПРОВЕНТИЛИРУЙТЕ ПЕРЕД ВХОДОМ

Background: Yellow or orange

9 TESTS OF OPEN-FLAME DEVICES

9.1 Tests are conducted immediately on board at the standard location specified for the device.

For conducting the test, each of the open-flame burners shall be covered by a metal plate of diameter 200 mm and a thickness of 3 mm ± 0,2 mm. The flames shall burn simultaneously in all burners for 10 min, the controls being set to a maximum. At the end of the burning period, the surface temperature of any material around the open-flame device shall be measured in order to verify compliance with the requirements of 2.4.

10 OWNER'S MANUAL

10.1 FIRE-FIGHTING EQUIPMENT

10.1.1 The following instructions and information shall be included in the Owner's Manual.

10.1.1.1 Portable fire extinguishers.

The craft, when in service, shall be equipped with portable fire extinguishers of the following types and extinguishing capacities, in the following number and in the following locations:

No. 1: extinguishing capacity not less than.................
location...
No. 2: extinguishing capacity not less than.................
location...
No. 3: extinguishing capacity not less than.................
location...
No. *n*: extinguishing capacity not less than.................
location...

10.1.1.2 Fire blanket.

A fire blanket shall be placed in the following location: (Description of position).

10.1.1.3 Servicing of fire-fighting equipment.

The craft owner/operator shall:

have fire-fighting equipment checked at the intervals indicated on the equipment;

replace portable fire extinguishers, if expired or discharged,

by devices of identical fire-fighting capacity; and

have fixed systems refilled or replaced when expired or discharged.

10.1.1.4 Fire bucket.

The craft shall be provided by at least one fire bucket of a capacity not less than 10,0 l for every 6,0 m of the craft length or part thereof. The fire buckets shall be provided with a hemp lanyard attached and stowed in a readily accessible position. The buckets shall be painted red and bear inscription "FIRE".

10.2 GENERAL

10.2.1 Craft with a hull length up to 15 m shall have Instructions on maintenance and performance of all fire-fighting equipment and systems which shall be installed on board craft in an accessible position, complete with related parts and in good order.

10.2.2 Craft with a hull length of 15 m and over shall have a General Arrangement Booklet. The content of the Booklet for the operator and crew shall indicate:

location of control stations;

location of fire-resisting and fire-retarding divisions;

spaces equipped with fixed fire-fighting systems with an indication of the location of fittings ant their control positions;

location of fire hydrants and nozzles;

arrangement of fire-fighting equipment;

ventilation control positions and location of dampers with indication of the group of protected spaces;

brief description of the performance of fire-fighting systems and structural features of fire protection.

10.2.3 As far as practicable, symbols used in the Booklet shall comply with the IMO Resolution A.952(23) "Graphical Symbols for Use in Fire Plans".

10.2.4 Information contained in the Booklet shall be in national language, English or French.

10.2.5 Prior to use on board craft, a copy of the Booklet shall be submitted to the RS Surveyor for review and approval. The approved copy shall be kept on board in an accessible place.

10.2.6 The Booklets shall be timely updated regarding any amendments and these amendments shall be duly recorded.

10.2.7 Locations of the appropriate fire-fighting equipment shall be clearly identified.

PART XI. MATERIALS

1 GENERAL

1.1 APPLICATION

1.1.1 The requirements of this Part of the Rules apply to materials and products being subject to the Register's survey in manufacturing in compliance with the requirements of other parts of the Rules.

The requirements relative to selecting and using materials and products are set forth in the relevant parts of the Rules.

The requirements for a scope of surveys and tests during initial survey of the manufacture of materials and products, and also in carrying out the Register's technical supervision during their manufacture are set forth in Part III "Technical Supervision during Manufacture of Materials" of the Rules for Technical Supervision during Construction of Ships and Manufacture of Materials and Products for Ships.

1.1.2 In addition to meeting the requirements of this Part, materials and products shall meet the requirements of the relevant parts of the Rules.

1.1.3 The materials used for building pleasure craft shall also meet the requirements of ISO 12215-1:2000, ISO 12215-2:2000 and ISO 12215-3:2000.

1.1.4 The materials used for construction of the craft's hulls of design categories **A**, **A1**, **A2** and **B** shall meet the requirements set forth in Part XIII "Materials" and in Section 7 of Part XVI "Hull Structure and Strength of Glass-Reinforced Plastic Ships and Boats" of the Rules for the Classification and Construction of Sea-Going Ships. The use of other materials is subject to special consideration by the Register.

1.1.5 The materials used for construction of reinforced concrete craft shall meet the requirements of the Rules for the Construction of Hulls of Sea-Going Ships and Floating Facilities Using Reinforced Concrete issued by the Register.

1.1.6 The materials which are, as part of a structure or product due to their operational conditions, subject to the requirements not provided in this Part, as well as the materials not regulated by this Part with the chemical composition, mechanical properties and performance not considered by the Register for a particular application, shall be specially considered by the Register.

The materials produced in compliance with international or national standards or according to specifications, or other technical documentation may be permitted by the Register for a specific application provided the Register's requirements are met. In this case the standards, specifications or other technical documentation are recognized by the Register by their entering in the Register's appropriate document and/or by stamping.

The Register may permit delivering materials and products according to standards, specifications or special technical documentation only. Given the distinctions between the above documentation and the Rules, the tests of materials and their assessment shall be carried out considering the most exacting requirements.

1.1.7 The materials and products below to be surveyed by the Register shall be supplied with Register's certificates and be produced by the manufacturers holding a Recognition Certificate for Manufacturer (refer to Part III "Technical Supervision during Manufacture of Materials" of the Rules for Technical Supervision during Construction of Ships and Manufacture of Materials and Products for Ships):

.1 rolled products of shipbuilding steel;

.2 rolled steel for Class I and Class II boilers and pressure vessels;

.3 steel pipes for boilers, pressure vessels and Class I and Class II piping;

.4 steel forgings and castings;

.5 iron castings;

.6 castings of non-ferrous and light alloys;

.7 semi-finished products of non-ferrous and light alloys;

.8 chain cables and ropes;

.9 chain steel

.10 slabs, blooms and billets for rolled products of hull structural and boiler steel if produced at a manufacturer lacking the rolling.

1.1.8 The materials and products subject to survey by the Register, which are listed below (refer to 1.1.1) may be supplied with manufacturer's certificates provided the works have the quality system recognized by an authorized body or the Register and holds a Type Approval Certificate for the types of products manufactured:

.1 materials for reinforced plastic structures;

.2 laminated textiles;

.3 retro-reflective materials;

.4 foam plastics;

.5 corrosion-resistant coatings;

.6 plastic fittings and pipes.

1.2 DEFINITIONS AND EXPLANATIONS

1.2.1 The definitions and explanations relating to the general terminology are given in General Regulations.

The definitions and explanations relating to the terminology used in this Part of the Rules are given in Part XIII "Materials" of the Rules for the Classification and Construction of Sea-Going Ships.

1.3 SURVEY

1.3.1 The general provisions specifying the scope and procedure of survey are set forth in 1.3, Part XIII "Materials" of the Rules for the Classification and Construction of Sea-Going Ships.

1.4 MARKING AND DOCUMENTATION

1.4.1 The provisions specifying the presence of marking and a procedure for issuing documents are set forth in 1.4, Part XIII "Materials" of the Rules for the Classification and Construction of Sea-Going Ships.

1.5 LABORATORIES ENGAGED IN TESTING

1.5.1 The provisions of this Chapter cover the laboratories engaged in testing the materials to be surveyed by the Register.

1.5.2 The laboratories mentioned in 1.5.1 shall meet the requirements set forth in 1.5, Part XIII "Materials" of the Rules for the Classification and Construction of Sea-Going Ships.

2 STEEL AND CAST IRON

2.1 The materials used for constructing pleasure craft shall meet the requirements of Section 3, Part XIII "Materials" of the Rules for the Classification and Construction of Sea-Going Ships. The use of other materials is subject to special consideration by the Register.

3 ALUMINIUM ALLOYS

3.1 Wrought aluminium alloys meeting the requirements of Section 5, Part XIII "Materials" of the Rules for the Classification and Construction of Sea-Going Ships shall be used for the hull structures of the pleasure craft intended for operation at sea and within saline firths or marine salinas. The materials produced in compliance with national or international standards may be used for other craft taking into account the specified in 1.1.6.

4 COPPER ALLOYS

4.1 Copper alloys amenable to plastic working and having the mechanical properties and the chemical composition meeting the requirements of the relevant standards or specifications approved by the Register shall be used for manufacturing the craft's arrangement and equipment components, and also holders and fasteners (rivets, screw nails, screws, etc.).

4.2 The copper alloys recommended in Section 2, Part XIII "Materials" of the Rules for the Classification and Construction of Sea-Going Ships shall be used for casting arrangement and equipment components (propellers inclusive).

5 WOOD

5.1 GENERAL

5.1.1 The types of wood and plywood/veneer specified in Tables 5.1-1 and 5.1-2 considering the characteristics conformity to the requirements of national and international standards and ISO 12215-3:2000 shall be used for fabricating hull structures and equipment for the pleasure craft.

The use of other types of wood, plywood/veneer or veneer sheet is subject to special consideration by the Register.

Table 5.1-1

Wood properties

Nos.	Trade name	Rotting resistance	Impreg-nation	Glueing	Average density, in kg/m^3	Bending strength, in MPa	Tensile strength, in MPa	Compression strength, in MPa	Modulus of elasticity for bending, in MPa
1	Birch	Н	Л	Л	650	120	137	43	15000
2	Black alder	Н	Л	Л	550	90	90	40	9000
3	Beech	Н	Л	Л	690	120	135	60	14000
4	Oak	Т	В	Л	670	95	90	52	11000
5	Oak	Т	В	Л	720	110	90	60	13000
6	Ash	Н	Л	Л	680	120	130	52	13400
7	Ulmus	Н	Д	Л	680	80	80	56	11000
8	Elm	Н	Д	Л	680	80	80	56	11000
9	Norway spruce	Д	Л	Л	450	68	84	40	10000
10	European larch	Д	Д	Л	590	93	107	53	12000
11	Fir	Н	Л	Л	470	68	80	43	10000
12	Common pine	Д	Л	Л	520	82	104	47	12000
13	Hard pine	Д	Д	Д	670	102		50	12000
14	Douglas fir	Д	Д	Л	510	82	105	47	12000
15	Peroba	Т	В	Д	700	108		63	12500
16	Entandropdragma angolense	Д	Д	Л	550	78		48	10000
17	Entandropdragma cyllindricun	Д	Д	Л	640	69	85	57	9800
18	Entandropdragma, Utile	Т	Д	Л	630	100	110	58	11000
19	Guarea, Bosse	Т	В	Л	600	94	52		11000
20	African mahogany	Д	В	Л	500	75	75	43	9500
21	American mahogany	Т	В	Л	540	82	90	45	9500
22	Teak	В	В	В	670	100	115	60	13000
23	Aucoumea	Н			430	72	58	39	3000
24	Macore	В	В	Л	620	103	85	53	11000
25	Agba	Т	Д	Л	490	62	52	40	6500
26	Afromosia	В	В	Л	700	120	60		11600
27	Idicbo	Т	Д	Л	550	74	42		8000
28	Meranti	Т	Д	Л	560	105	129	53	12000
29	Yang	Д	Д	Л	760	125	140	70	16000
30	Red cedar	Т	Д	Л	390	53	50	32	7500
31	Iroko, Kampala	В	Д		620	95	79	55	11000
32	Balsa[1]	Н			160	19	40	10	2600

[1] Material for three-lyered laminate core.

N o t e s : 1. The rotting resistance of wood is determined according to a four-step scale:
Н = non-resistant;
Д = moderate resistance;
Т = resistant;
В = high resistance.
2. The rate of wood impregnating is determined according to a three-step scale:
Л = readily impregnated;
Д = rather readily impregnated;
В = hardly impregnated.
3. The degree of wood bonding with synthetic resin adhesives is determined according to a three-step scale:
Л = readily glued forming a sound bond;
Д = rather readily glued forming a bond;
В = hardly glued forming a sound bond.

Table 5.1-2

Application of wood species for hull

No. in Table 5.1-1	Keel	Deadwood	Stem and stern frame	Stringers	Floors	Frame		Planking			Beams	Knees		Deck stringers	Deckhouse sides	Plywood or veneer	
						Glued	Bent	Below waterline	Above waterline	Decks		Vertical	Horizontal			Ordinary	Moulded
1	–	–	–	–	–	–	–	–	–	–	–	C	C	–	–	B	B
2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	B	–
3	–	–	–	–	–	–	B	–	–	–	–	C	C	–	–	B	–
4	B+	B	B	B	B	B+	A	B	C	–	B+	B	A	B	B	–	–
5	B+	B	B	B	B	B+	A	B	B	–	B+	B	A	B	B	–	–
6	–	–	–	–	–	–	B	–	–	–	B	–	–	–	–	–	–
7	B++	B	B	C	–	–	–	–	–	–	–	–	–	–	–	–	
8	–	–	–	B	–	–	A+	–	–	–	–	C	C	–	–	–	–
9	–	–	–	C	–	–	–	–	C	B	B++	–	–	–	–	–	–
10	C++	–	–	B	–	B++	–	B	C	–	B++	–	–	–	–	–	–
11	–	–	–	C	–	–	–	–	C	–	C++	–	–	–	–	–	–
12	C++	C	C	B	–	–	–	B	B	B	B++	–	–	C	–	C	–
13	–	–	–	B	–	–	–	A	B	B	B++	–	–	–	–	–	–
14	C++	C	C	B	–	–	–	B	B	B	B++	–	–	C	–	–	–
15	–	–	–	–	–	–	–	B	B	A	–	B	B	B	–	–	–
16	–	–	–	–	–	–	–	B	B	B	–	–	–	–	–	–	–
17	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	B	–
18	–	–	–	–	–	–	–	B	B	B	–	–	–	–	–	A	B
19	–	–	–	–	–	–	B	–	–	–	–	–	–	–	–	A	B
20	C++	C	C	C	C	B++	–	C	B	B	B++	–	–	C	B	A	A
21	B+	B	B	–	B	–	–	B	B	–	B++	–	–	B	A	A	A
22	A+	A	A	A	A	A+	–	A	A	A	A+	A	A	A	A	–	–
23	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	B	–
24	–	–	–	–	–	–	–	–	B	B	B	–	–	B	B	A	B
25	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	B	–
26	B+	B	B	B	B	B+	B	B	B	B	B	B	B	B	B	A	B
27	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	A	B
28	C+	C	C	–	B	–	–	B	C	–	B+	B	B	–	B	A	B
29	C+	C	C	–	C	C	–	B	C	–	–	–	–	–	–	–	–
30	–	–	–	–	–	–	–	C	C	–	–	–	–	–	–	B	A
31	–	–	–	B	A	A	–	A	A	A	–	–	–	A	–	–	–

N o t e s : 1. The suitability of wood is determined according to a three-step scale:
A = most preferred;
B = fit;
C = may be used.

2. The wood species marked "+" are used for keels, frames and beams both in a natural form and as the glued of layers. The wood species marked "++" may be used as the glued of layers only.

3. The average density in Table refers to the wood dried down to a moisture content of 15 to 20 %.

5.2 BALSA

5.2.1 Balsa timber sliced crosswise may be used for multilayer structures of decks, superstructure and deckhouse sides. The moisture content of that timber shall be within 12 per cent. The material bounding a balsa core shall have adequate strength to react a load and the glue used shall be based on polyester resin. Balsa shall have shear strength not less than specified in Table 5.2.1.

Table 5.2.1

Specific density, in kg/m^3	Shear strength, in MPa
95	1,10
130	1,80
175	2,00

5.3 REQUIREMENTS FOR SOLID TIMBER

5.3.1 Timber shall be properly seasoned, be free from a pith, sapwood, rot, insect attacks, delaminations, longitudinal cracks and other defects which may impair material workability. In general timber shall also have no knots.

5.3.2 The timber used for components in laying down the craft shall be reasonably seasoned and where a risk of excessive drying up is real, be impregnated with hot linseed oil or paint oil immediately after installation to prevent splitting.

5.3.3 Material intended for hull sheathing and deck planking shall generally be straight-grained and quarter sawn for deck planking.

5.3.4 Prior to use, timber shall be stored under dry conditions at a moisture content within 20 per cent. Excessive drying up of timber during construction shall be prevented.

5.3.5 A moisture content of materials to be glued shall make up about 15 per cent. If resorcinol resin adhesives are used, the moisture content is recommended to maintain slightly above that value, and slightly below that value for phenolic and urea-formaldehyde resins. The material to be used for laminated parts is recommended for forced drying to the moisture content of about 15 per cent.

5.3.6 A moisture content in hull sheathing and deck planking which shall be encapsulated using synthetic resins shall be as low as practicable to prevent its impact on the bond resistance of the sheathing.

5.4 REQUIREMENTS FOR PLYWOOD AND VENEER

5.4.1 Plywood/veneer intended for the shell or deck shall be produced of good quality components used for both external and internal layers. Timber used for manufacturing plywood/veneer components shall be hard and durable, and production technology shall ensure plywood/veneer resistance to water effect. Plywood/veneer produced of less hard species may be acceptable provided their decay resistance is improved with relevant means.

Plywood/veneer sheets shall be stored in a horizontal position on a plane surface in a dry space properly ventilated at a humidity of no more than 15 per cent.

Plywood/veneer without Register's certificates shall not be used for craft's hull structures. Veneer layers shall be bonded with phenolic type (water and heat-resistant) adhesives recognized by the Register. Timber species fit for plywood/veneer manufacturing are recommended in Tables 5.1-1 and 5.1-2. Use of other species shall be approved by the Register.

Other plywood/veneer used for members inside the hull may be produced of less durable timber species treated with wood preservatives.

5.5 WOOD IMPREGNATION

5.5.1 The surfaces of structural components like frames, beams, longitudinals and floors to be butted shall be impregnated with antifungal agents and means preventing teredo attacks. These means shall also be used for impregnating all surfaces of structural components manufactured of the species given in Table 5.1-1 and marked as H (non-resistant) or Д (moderate resistance).

It is recommended to impregnate all the surfaces of components manufactured even of the species marked as T (resistant) and B (high resistance).

One of two groups of antifungal agents and means preventing teredo attacks is recommended for use:

water solution of chrome-copper or chrome-copper-arsenic salts;

metalloorganic and organic solutions of zinc and copper, as well as pentachlorophenol in organic solutions.

Selecting antifungal agents, it should be considered their effect on surface preservatives (paints or lamination) if used to coat the shell.

Use of the other types of preservatives is subject to special consideration by the Register.

6 PLASTICS AND MATERIALS OF ORGANIC ORIGIN

6.1 Plastics and materials of organic origin used for constructing pleasure craft shall meet the requirements set forth in Section 6, Part XIII "Materials" of the Rules for the Classification and Construction of Sea-Going Ships taking into account the required mechanical characteristics specified in 7.2. Use of other materials is subject to special consideration by the Register.

6.2 The required mechanical characteristics:

.1 tensile strength of a fabric strip of 5 cm wide shall be no less than 1471,5 N/5 cm (for motor craft);

.2 breaking strength for tear shall be no less than 73,58 N (for motor craft);

.3 rubber-textile adhesion strength shall be no less than 24,53 N/cm (fot motor craft).

7 METAL FASTENERS

7.1 Metals to be used for fasteners are:

copper;

gunmetal;

plated steel;

silicon bronze;

aluminium bronze;

stainless steel;

monel.

7.2 Steel fasteners shall be galvanized in a hot bath.

Small screws and screw nails, for which hot galvanizing is unacceptable, may be coated with zinc by electroplating provided the coating thickness will be no less than 24 μm.

7.3 Stainless steel fasteners shall be made of austenitic steel.

7.4 Brass fasteners for structural purposes are not allowed.

Aluminium bronze may be used for large bolts where higher strength is required.

7.5 Provisions shall be made to isolate aluminium alloys from wood and incompatible metals. Paints containing lead, mercury or copper shall not be used in combination with those alloys.

PART XII. MEANS FOR THE PREVENTION OF POLLUTION FROM CRAFT

1 GENERAL

1.1 APPLICATION

1.1.1 The requirements of the present Part apply to the craft specified in Section 1 of the General Regulations within the scope defined by provisions of relevant Sections of the present Part and cover the craft the designs of which are submitted to the Register for review after the date when these Rules came into force.

The requirements of this Part apply to craft in service within the scope defined in the General Regulations.

1.2 DEFINITIONS AND EXPLANATIONS

1.2.1 Definitions and explanations relating to the general terminology of the Rules are given in the General Regulations and in Part I "Classification" of these Rules.

For the purpose of this Part of the Rules the following definitions and explanations have been adopted:

Administration is the Government of the State under whose authority the craft is operating. With respect to a craft entitled to fly a flag of any State, the Administration is the Government of this State.

Gross tonnage is the gross tonnage of a craft determined in accordance with the provisions of Annex 1 to the International Convention on Tonnage Measurement, 1969, or in accordance with the provisions of another Convention which will come into force in lieu of the above Convention.

International voyage is a voyage from a country to a port, yard, offshore terminal which are under jurisdiction of another country, or conversely.

Reception facilities are floating or stationary structures for the reception of all kinds of pollution substances from ships for subsequent discharge to treatment plants, utilization, etc.

Discharge, in relation to harmful substances or effluents containing such substances, is any release howsoever caused from a craft into aquatic environment and includes any escape, disposal, spilling, leaking, pumping, emitting or emptying.

Discharge does not include:

dumping within the meaning of the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, concluded in London in November 1972, namely:

any intentional disposal of wastes and other matter from craft into aquatic environment:

with the aim to secure safety of craft and people on board or the safety of life at sea; or

due to damage of craft or its equipment if all reasonable precautions have been taken before and after the occurance of the damage for the purpose of preventing or minimazing the discharge;

release of harmful substances for the purposes of legitimate scientific research into pollution abatement or control.

Craft is a boat of any type specified in 1.2 of the "General Regulations".

Organization is the International Maritime Organization (IMO).

Tank is an enclosed space which is formed by permanent structure of a boat and which is designed for the carriage of liquid in bulk.

Number of persons on board is crew, passengers and special personnel , which the craft is certified to carry.

Main machinery is the machinery using fuel oil as the working fluid and being a part of the craft's propulsion plant.

Auxiliary machinery is the machinery using fuel oil as the working fluid, necessary for supply of the craft with electric power and other kinds of power as well as functioning of the craft's systems and arrangements.

1.3 TECHNICAL DOCUMENTATION

1.3.1 Documentation specified in 3.1.13.1 and 3.1.13.2, Part I "Classification" of these Rules shall be submitted to the Register as part of the documentation relating to all craft designs.

Documentation specified in 3.1.13.3 and 3.1.13.4, Part I "Classification" shall be submitted to the Register as part of the documentation relating to designs of craft with design category **A**, **A1**, **A2**, **B**, **C** and **C1** or intended to carry 10 and more persons on board.

2 CRAFT'S CONSTRUCTION, EQUIPMENT AND ARRANGEMENTS FOR THE PREVENTION OF POLLUTION BY OIL

2.1 GENERAL

2.1.1 For the purpose of this Section of the Rules, craft specified in 1.2 of the General Regulations are subdivided into following categories:

Category 1 – craft with permanently installed main machinery;

Category 2 – craft fitted with outboard engines only, placed outside the craft's hull , used as the main ones with attached machineries which fully ensure their operability.

Crafts having other equipment which use oil as the working fluid, shall be treated as Category 2 craft.

2.1.2 Every necessary measure shall be taken to ensure collection, retention on board and discharge to reception facilities of oily waste generated on board the craft.

Permanently installed internal combustion engines or equipment using fuel oil as the working fluid, when installed on open deck or outside enclosed compartment of the craft, shall be housed in a watertight case, container, etc., fitted with arrangements for collection of leakage fuel oil and lubricating oil from the above-mentioned equipment and means shall be provided to discharge the same to special tanks/containers.

Drip trays shall be installed under the fittings of the fuel oil and lubricating oil tanks.

The drip trays shall be effective under conditions of heel, as a minimum, up to 30°, for sailing single-hull boats and 20° for other boats and a trim up to 10°.

Oily waste from the drip trays shall be discharged to special tanks/containers.

2.1.3 Construction of the systems, arrangement of piping and hydraulic tests of the fittings and piping shall comply with the requirements of Part V "Machinery Installations. Machinery. Systems and Piping".

Electrical systems shall comply with the requirements of Part VII "Electrical Equipment".

2.2 DEFINITIONS AND EXPLANATIONS

2.2.1 For the purpose of this Section of the Rules the following definitions and explanations have been adopted:

Parts per million (ppm) are parts of oil per million parts of water by volume.

Oily bilge water is mixture of water with any oil content resulting from operation of a craft.

Oily waste is oil residues (sludge) and oily bilge water.

Oil is petroleum in any form including crude oil, fuel oil, lubricating oil, oil residues, oil refuse and refined products.

Oil fuel is any oil used as fuel in connection with main and auxiliary machinery of the craft in which such oil is carried.

Oils ludge is part of oil, which due to its consistence is not liable to conventional pumping or processing and requires special methods and devices for its disposal from the boat.

Oil residues are separated sludge, exhausted lubricating oil, oil from bilge water separators, leakages of fuel and lubricating oil.

Exhausted oil is exhausted lubricating oil, hydraulic oil and other hydrocarbon based liquid which is not suitable for use in machinery due to deterioration and contamination.

Separateds ludge is sludge resulting from purification of fuel and lubricating oil.

15 ppm bilge separator is any combination of a separator, filter/coalescer, and also a single unit designed to produce an effluent with oil content not exceeding 15 ppm.

Oil-containing bilge water tank is a tank for accumulating oily bilge water.

Oil residues holding tank is separated sludge tanks, tanks for collecting fuel and lubricating oil leakages, tanks for collecting exhausted oil.

Sludge tanks are tanks for accumulating separated sludge.

2.3 COLLECTION AND STORAGE OF OILY WASTES

2.3.1 Craft mentioned in 2.1.1 shall be provided with tanks for collecting and stroring oily wastes on board.

2.3.1.1 The Category 1 craft of 15 m and more in length having propulsion plants with sterntube arrangements which allow inward water leakages under normal operating conditions shall be provided with oily bilge water holding tanks for collecting and storing oily bilge waters, the capacity of which shall be not less than 10 per cent of the maximum amount of the fuel store on board, and with respect to high-speed craft the capacity shall be not less than 7 per cent of the above amount.

In case of twin- or triple-shaft propulsion plant with sterntube arrangements the design amount of oily bilge waters collected shall be increased by 15 or 25 per cent, respectively.

2.3.1.2 The Category 1 craft with propulsion plant without sterntube arrangement mentioned in 2.3.1.1 shall be provided with holding tanks for collecting oil residues in accordance with the requirements of 2.3.1.3.

2.3.1.3 In Category 1 craft the main and auxiliary machinery shall be fitted with drip trays or coamings intended for collecting leakages of fuel and lubricating oil there from and means shall be provided to discharge the oil residues from these to fixed or portable holding tanks/containers.

In Category 2 craft, the aforesaid is applied as far as it is reasonable and practicable.

2.3.1.4 Where 15 ppm filtering equipment is unavailable, tanks mentioned in 2.3.1.1 may be used for collecting oil residues such as leakages of fuel and lubricating oil.

2.3.2 Capacity of the oil-residues holding tanks V_{or}, l, shall be not less than 10 *l* or calculated by the following formula, whichever is the greater:

$$V_{or} = 0{,}005\,C \cdot T \quad (2.3.2)$$

where C = the daily fuel consumption, in l;
T = the duration of voyage between ports where oil residues may be discharged to reception facilities (where the duration of voyage is not known it shall be adopted equal to 3 days).

2.3.3 Where it is necessary to store exhausted oil on board, a particular tank for collecting exhausted oil shall be provided on board, the capacity of which shall be not less than 150 per cent of the total amount of lubricating and other oils used on board, including oils from crankcases of all internal combustion engines and all machinery installed, as well as oils contained in hydraulic fluid installations.

2.3.4 In case where total amount of oils from crankcases of all internal combustion engines and all machinery installed on board together with hydraulic fluid installations is 300 l and more the tank for collecting exhausted oil shall be of permanently fixed type.

2.3.5 The appropriate procedures/instructions for collection and storage on board of oily wastes and subsequent discharging them to reception facilities shall be documented and stated in the Owner's Manual.

2.3.6 In craft of less than 15 m in length, the oily bilge waters are allowed to be accumulated in bilges of machinery spaces/compartments with subsequent discharge to reception facilities.

This accumulated oily bilge waters shall be accounted for in the stability calculations with due regard for the free surface thereof.

2.3.7 Any craft shall be fitted with 15 ppm bilge separator when necessary endurance cannot be achieved due to insufficient capacity of the holding tanks/machinery bilges for collecting oily bilge water.

With the availability of the bilge separator the craft shall be fitted with an oil residues holding tank.

2.3.8 Where a permanently fixed oil residues holding tank is available, the system for discharging oil residues to reception facilities shall be provided with a special pump meeting the requirements of 2.3.15.

2.3.9 The tanks for collection and storage of oil residues shall be manufactured of metal.

2.3.10 The construction of the permanently fixed tanks shall meet the requirements of Part II "Hull".

The walls of portable containers shall be not less than 1,0 mm thick for steel and 1,5 mm for aluminum and its alloys.

The portable tanks/containers manufactured of non-metallic materials are subject to special consideration by the Register.

2.3.11 The inner surfaces of the bottom and vertical walls of the permanently fixed container for collecting oil residues, except for the built-in oil residues holding tanks, shall be smooth (external framing). In this case, the bottom shall be inclined towards the inlet.

2.3.12 Arrangement of the holding tanks in machinery space/compartments, their systems and equipment shall meet the requirements of Part V "Machinery Installations. Machinery. Systems and Piping".

2.3.13 The fixed holding tanks shall be provided with:

.1 a manhole for inspection and cleaning;

.2 a venting pipe with flame arrester;

.3 visual and audible alarm operating in the wheel house or central control station what are applicable, in case of 80 per cent filling of the tank;

.4 equipment for heating if the tank is located in a place where negative temperature is possible during the craft's operation;

.5 a level gauge.

2.3.14 Instead of a fixed holding tank the installation of a portable holding tank (tanks) is allowed provided that its capacity not more than 25 l. The portable holding containers for collecting oily residues shall be of leak-tight construction with a design volume of filling being 85 per cent of the total capacity.

2.3.15 The pump shall be a self-priming displacement with suitable means for protection against dry running and shall have characteristics allowing transfer of oil residues generated on board. The pump shall be suitable for transfer of high-viscosity oil residues, if these are available.

The discharge side of the pump shall be connected only to the transfer line intended for discharge to reception facilities or to incineration equipment, as appropriate.

2.3.16 The calculation of the capacity of oil-containing bilge water holding tanks and oil residues holding tanks with regard to the intended area of navigation and service conditions of the craft shall be submitted to the Register.

2.4 COLLECTING, PIPING AND DISCHARGE ARRANGEMENTS FOR OILY WASTES

2.4.1 Every craft referred to in 2.3.1.1 shall be provided with arrangement for collecting machinery bilge waters into holding tanks used for collecting oily bilge water.

The arrangement for collecting bilge waters shall consist of permanently installed pump, piping and fittings designed specially for this purpose.

2.4.2 Every craft, for the purpose of discharging oily bilge waters and oil residues from the permanently fixed holding tanks and machinery bilges to reception facilities, shall be provided with a pipeline fitted with standard discharge connection (see Fig. 2.4.2-2) or deck fitting similar to that shown in Fig. 2.4.2-1, fitted with threaded plug with a gasket to ensure watertightness of the connection. In this case, the boat shall be provided with an appropriate adapter for connection to reception facilities fitted with standard discharge connection with flanges (see Fig. 2.4.2-2). The inner diameter of the pipeline shall be not less than 30 mm. For craft operating in the inland waterways of EC countries, a quick-release connection according to EN 1305:1996 may be used.

2.4.3 Starting and stopping of the pumping-out means discharging oily wastes to reception facilities shall be effected manually. Provision shall be made for sealing end fittings of the pipeline for discharging oily wastes to reception facilities.

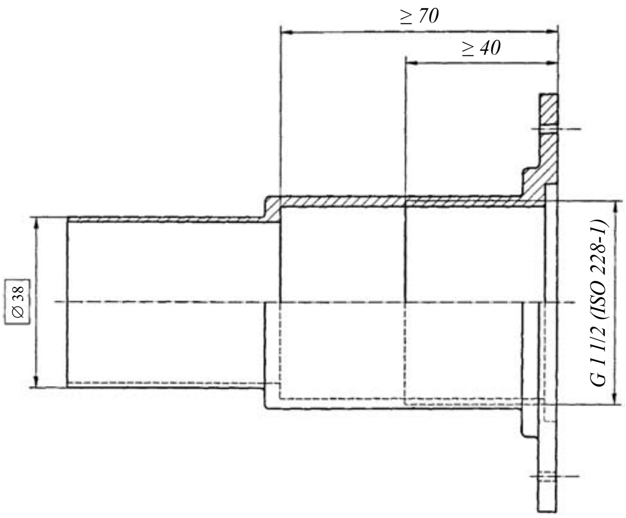


Fig. 2.4.2-1
Deck fitting in accordance with ISO 8099-2000

The pipeline may be located in a place convenient for connection of hoses to provide discharge of oily wastes at both sides of the boat, and shall have distinguishing nameplates.

The arrangement for discharging oily wastes to reception facilities shall be provided with pumping-out means. In case, when this is unreasonable and impracticable from constructional considerations, oily wastes shall discharged by the arrangements of the reception facilities.

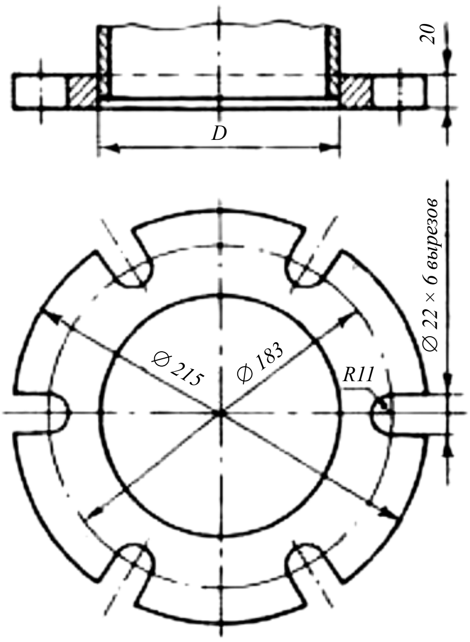


Fig. 2.4. 2 -2
Flange of the standard discharge connection

N o t e . The flange shall be of steel or other equivalent material having a flat face. The flange together with a gasket of oil-proof material shall be designed for a working pressure of 0,6 MPa. The flange is connected by six bolts of suitable length and of 20 mm in diameter each.

3 MEANS FOR THE PREVENTION OF POLLUTION BY SEWAGE

3.1 GENERAL

3.1.1 Where sewage is mixed with wastes or other contaminated waters to which other provisions of this Part apply, in addition to the requirements of this Section, the requirements of other Sections shall be complied with.

3.1.2 Craft which operate with crew members and/or passengers on board, except craft specified in 3.1.3, shall be provided with:

a holding tank for collecting sewage waters and domestic waste waters (if applicable)

pipelines for collecting sewage into holding tank (tanks) and a piping system with standard discharge connections shown in Fig. 3.5.7-2 for discharging sewage to reception facilities.

3.1.3 Upon agreement with the Register, craft intended for independent navigation with duration of not more than 8 hours and with not more than 6 persons on board, except craft specified in 3.2.2, in lieu of equipment specified in 3.1.2, may be provided with, as a minimum, a standard portable biotoilet located in a separate space.

3.1.4 In addition to the equipment referred to in 3.1.2, craft may be provided with a sewage waters and domestic waste waters treatment plant or with a system for comminution and disinfection of sewage waters and domestic waste waters, complying with the requirements of 3.9 and 3.10.

3.1.5 Design of the system, arrangement of the pipelines and hydraulic tests of the fittings and pipelines for collecting and discharging sewage waters and domestic waters shall meet the requirements of Part V "Machinery Installations. Machinery. Systems and Piping".

The electrical systems shall meet the requirements of Part VII "Electrical Equipment".

3.2 APPLICATION

3.2.1 The requirements of this Section of the Rules cover the craft's equipment and arrangements intended for the prevention of pollution by sewage and apply in full measure to all craft, unless expressly specified otherwise in these Rules.

3.2.2 The requirements of this Section of the Rules for small pleasure craft with hull length of 6 m or less (launch and dinghy (boat) the definitions of which are given in the General Regulations for Small Pleasure Craft) apply as far as it is reasonable and practicable depending on the service conditions of the craft and number of persons on board.

3.3 DEFINITIONS AND EXPLANATIONS

3.3.1 For the purpose of this Section, the flowing definitions and explanations have been adopted:

Holding tank is a tank used for the collection and storage of untreated sewage, activated sludge and pulp from the sewage treatment plant.

Sewage is:

drainage and other wastes from any form of toilets and urinals;

drainage from laboratories and medical premises (dispensaries, etc.) via wash basins, wash tubs and scuppers located in such spaces;

drainage from spaces containing living animals;

drainage from scuppers located in the spaces mentioned above;

other waste waters when mixed with the drainages defined above.

Sewage treatment plant is a plant in which sewage and, if appropriate, sanitary and domestic waste waters are treated and disinfected.

Sewage comminution and disinfection system is a plant in which sewage is disinfected and the solid particles contained therein are comminuted.

Domestic waste waters are:

drainage from wash basins, showers and wash tubs;

drainage from sinks and equipment of galleys.

3.4 SCOPE OF TECHNICAL SUPERVISION

3.4.1 Subject to technical supervision of the Register during manufacture are:

.1 sewage treatment plants including their associated piping, pumps, electrical equipment, metering devices, disinfection devices, control, regulation and monitoring devices;

.2 sewage comminution and disinfection systems;

.3 holding tanks including their associated equipment, control, regulation and monitoring devices.

3.4.2 Subject to technical supervision of the Register during installation on board are:

.1 sewage treatment plants;

.2 sewage comminution and disinfection systems;

.3 holding tanks;

.4 equipment and piping system for discharge of sewage.

3.4.3 In addition to the documentation specified in 3.1.12, Part I "Classification", the following documentation on equipment and arrangements shall be submitted to the Register for review:

.1 drawings of container for collecting sewage;

.2 diagram of piping system for discharging sewage to reception facilities;

.3 documentation on sewage treatment plant:

technical description and operating principle;

general view drawings;

calculation of the plant capacity;

diagram of the plant's piping system with indication of supporting mechanisms; principal electric diagram;

diagrams of control, regulation, monitoring, alarm and protection;

test program for the plant;

.4 drawings and diagrams of sewage comminution and disinfection systems.

3.5 SEWAGE SYSTEMS

3.5.1 General.

The system shall be capable of reliable performance at environment temperatures from 0 up to + 45 °C and sustain in dried condition the environment temperatures from -25 up to +45 °C.

Design of the systems, arrangement of piping and hydraulic test of the fittings and piping of sewage collection and discharge systems shall meet the requirements of Part V "Machinery Installations. Machinery. Systems and Piping".

The electrical systems shall meet the requirements of Part VII "Electrical Equipment".

3.5.2 Materials.

The systems shall be manufactured of materials resistant to the effect of the following:

sewage;

fresh and sea water;

disinfectants, deodorants and antifreeze solutions recommended by the system Manufacturer;

household cleaning agents recommended by the system Manufacturer;

chemical compounds in solid, liquid or gaseous form likely to be generated by the operation of the system.

3.5.3 Construction and installation of sewage collecting systems.

3.5.3.1 The system shall be capable of reliable operation when the craft is heeled at least 20° to eiher side and trimmed 10 ° by bow or stern.

3.5.3.2 The equipment of toilets shall be fitted with devices preventing the penetration of odor from untreated sewage into the craft's spaces.

3.5.3.3 When the holding tank is filled to 90 per cent, sewage shall not seep :

outside the carft under conditions of heel up to 30° either way with respect to a single-hull sailing craft or to 20° with respect to another craft;

inward the craft with the maximum expected heel and trim, that is 45°, with respect to a single-hull sailing craft and 30° with respect to a motor craft or a multi-hull sailing craft.

3.5.3.4 Pipelines or deck fittings for discharge shall be located in places convenient for connection to reception facilities.

3.5.3.5 The holding tank shall be provided with visual indication operating in case of 80 per cent filling of the tank.

3.5.3.6 The holding tank of more than 40 l in capacity shall be provided with a suitable access hole fitted with watertight cover for flushing, cleaning and maintenance .

3.5.3.7 Holding tanks shall not have common bulkheads with drinking/washing water tanks.

3.5.3.8 Flexible connections and pipelines shall be reliably secured in position to prevent their damage by abrasion or vibration.

3.5.3.9 Holding tanks and pipe connections shall be accessible for examination and maintenance.

3.5.4 Venting systems for fixed holding tanks.

The venting system for fixed holding tanks shall provide for venting of gases within the system to the exterior of the craft at heel angles up to 20° at 90 per cent of tank capacity.

3.5.4.1 Fixed holding tanks of less than 400 l capacity.

The minimum inner diameter of the vent pipe shall be 19 mm or not less than 16 mm if the tank is fitted with an automatic (vacuum operated) or manual relief valve with a minimum total sectional area of 1100 mm^2.

3.5.4.2 Fixed holding tanks of 400 l capacity and greater.

The minimum inner diameter of a vent pipe shall be 38 mm, or, if multiple vent pipes are used, their inner diameter shall be at least 19 mm; and the combined cross-sectional flow area shall be at least equivalent to that of a single vent pulp with an area of 1100 mm^2.

Vent pipes with inner diameter not less than 16 mm may be used if the tank is fitted with an automatic (vacuum operated) or manual relief valve having the minimum total sectional area of at least 1100 mm^2.

If a manual relief valve is fitted, an appropriate sign/inscription displayed in the vicinity of the discharge manifolds shall show the need for opening of the valve prior to beginning of discharge.

3.5.4.3 Inner diameter of fittings.

The inner diameter of fittings used to connect the vent pipeline shall not be less than 75 per cent of the inner diameter of the discharge pipeline.

3.5.4.4 Operability of the venting system.

The design and construction of the venting system shall ensure its operability under the environmental conditions specified in 3.5.1 and 3.5.3.1. The venting pipeline shall be capable of resisting, without damage, a negative pressure of 50 kPa.

3.5.4.5 Flow area.

The minimum flow area and equivalent flow resistance of any filters installed in the venting system shall not be less than the smallest cross-section area in either the venting pipe or its fittings.

3.5.5 Pipelines and/or flexible joints (hoses).

Pipeline or flexible joints (hoses) between the toilet and holding tank as well as between the tank and pump-out deck fitting/discharge pipeline shall be as short as practicable and its inner surface shall:

be smooth, without convolutions to permit free flow of sewage;

have an inner diameter in conformity with the toilet Manufacturer's recommendations;

or have an inner diameter of 38 mm if no recommendations are provided.

3.5.6 Overboard discharge of sewage in the areas, where discharge is allowed.

Systems capable of direct overboard discharge of sewage/ domestic waste waters (if appropriate) to the areas, where discharge is allowed, shall be fitted with a valve located immediately adjacent to shell plating.

Provision shall be made for sealing the valve in the closed position.

Starting and stopping of the discharge shall be effected manually.

Every valve used for direct overboard discharge shall satisfy the requirements of Part V "Machinery Installations. Machinery. Systems and Piping" and ensure leak-proofness in the closed position.

3.5.7 Sewage discharge to reception facilities.

3.5.7.1 Every craft having fixed holding tanks for discharge of sewage and domestic waste waters (if appropriate) to reception facilities shall be provided with a pipeline fitted with international standard discharge connections with flanges (see Fig. 3.5.7.1-2) or with a pump-out deck fitting similar to that shown in Fig. 3.5.7.1-1, fitted with a threaded plug with a gasket to ensure watertightness of the connection.

To enable connection to the reception facilities fitted with the standard discharge connection with flanges (Fig. 3.5.7.1-2), the craft shall be provided with an appropriate adapter. For craft operating in inland waterways of the EC countries, a quick-release connection according to EN 1306:1996 may be used.

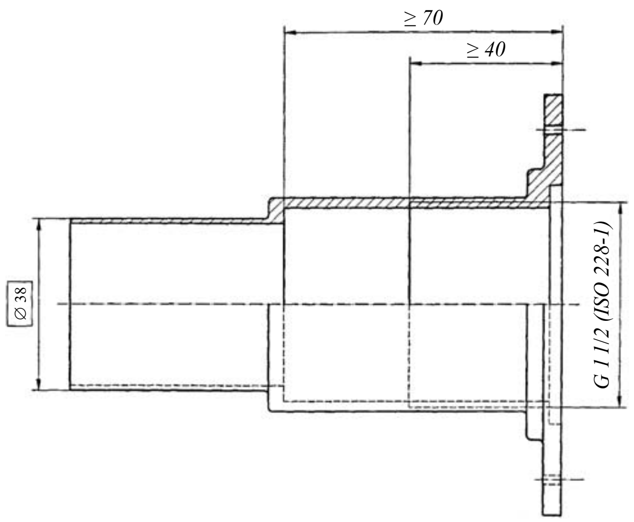


Fig. 3.5.7.1-1
Pump-out deck fitting according to ISO 8099:2000

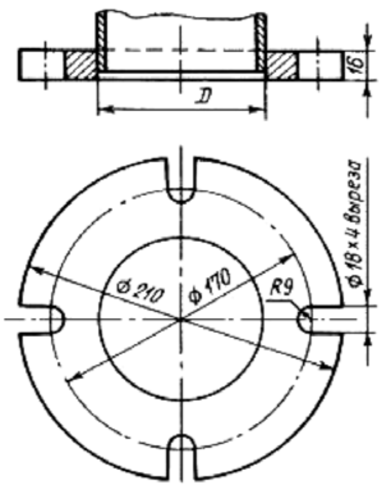


Fig. 3.5.7.1-2
Flange of the standard discharge connection

N o t e . The flange is intended for pipes with an inner diameter of up to 100 mm and shall be manufactured of steel or other equivalent material with a flat machined face. The flange together with a suitable gasket shall be designed for a working pressure of 0,6 MPa. For craft with a moulded depth of 5,0 m or less, the inner diameter of the discharge connection may be 38 mm. Coupling is effected by means of four 16 mm diameter bolts of requisite length.

3.5.7.2 The discharge system shall be provided with pump-out means. If this is unreasonable and impracticable from the constructional considerations, the holding tanks shall be emptied by the discharge arrangements of the reception facilities (see Figs. 3.8-1 and 3.8-2).

The discharge manifolds may be located in one place convenient for connection of hoses to provide discharge at both sides of the craft, and shall have distinguishing nameplates.

3.5.7.3 The pump-out deck fittings for discharge pipe shall be marked by at least the following symbol:

.

The symbol shall be placed visibly on, or in the vicinity of, the fitting.

3.6 REQUIREMENTS FOR HOLDING TANKS

3.6.1 Holding tanks for collecting sewage may be built-in or independent, including portable tanks.

3.6.2 Requirements for fixed holding tanks.

3.6.2.1 The construction of the tank shall provide removal of at least 90 per cent of its contents through the pump-out deck fitting/discharge pipeline. Fixed tanks shall have bottom inclined towards the outlet.

3.6.2.2 The fixed tanks shall be provided with arrangements for flushing with water and for disinfection.

3.6.2.3 The fixed built-in tanks shall be separated by cofferdams from the tanks used for drinking and washing water, as well as from accommodation and service spaces. The independent and portable tanks shall be located in a separate space/compartment or in machinery space fitted with efficient exhaust ventilation.

3.6.2.4 The construction of the tanks including covers of openings/manholes shall provide gas- and water-tightness.

3.6.2.5 The tank shall be subjected to leakage test by excess pressure of 25 kPa during 5 min.

3.6.3 Requirements for portable holding tanks.

3.6.3.1 Portable holding tanks shall be of capacity less than 20 l and shall not be connected to any craft's fittings arranged on the shell plating.

3.6.3.2 The inner diameter of venting pipeline for portable holding tanks, if used, shall be not less than 16 mm and shall have a quick disconnect from the tank-vent opening. All openings of the tank shall be fitted with closing devices which ensure water- and gas-tightness, also during transportation thereof.

3.6.3.3 Handles or recesses for carrying the tank shall be provided on the tank in a location that will allow safe transport and emptying of the tank.

3.6.3.4 The tank shall have an instruction for its safe disconnection , transport and emtying of its contents.

3.6.3.5 The tank shall be securely attached to hull structures.

3.6.4 Capacity of the holding tanks.

Total capacity of the sewage holding tank/tanks shall be determined having regard to the intended area of navigation, service conditions of the craft and number of persons on board. The calculation of the total capacity shall be submitted to the Register for review.

The volume of the holding tanks V shall be calculated by the following formula:

$$V = f \cdot K \cdot N \cdot T \quad (3.6.4)$$

where K = design value of accumulated amount of sewage and domestic waste waters (if appropriate), l/per person per day, according to the norms established by the Flag Administration;
N = maximum admissable number of persons on board;
T = period between emptyings of the on-board tanks to reception facilities, in days;
f = 0,3 – factor accounting for the possibility of craft operating in the area, where discharge of untreated sewage is allowed. In case where such possibility does not exist, f = 1.

3.6.5 Identification.
Prefabricated holding tanks/containers shall be legibly marked with the following information:
name or trade mark of the Manufacturer;
name and/or model number;
number of the normative document the requirements of which are met by the tank/container;
symbol "Toilet waste tank" as specified in 3.5.7.3 or in language acceptable in the country of use;
tank capacity, in l.

3.7 OWNER'S MANUAL

3.7.1 Documentation on the system operation and maintenance shall be included into the Owner's Manual incorporating a sewage system drawing and shall include the following information:
.1 description of the system operation and maintenance thereof;
.2 method of control of the three-way valve:
sealing;
avoidance of inadvertent discharge;
.3 capacity of the holding tank, in l;
.4 materials acceptable for use:
deodorants;
anti-freeze solutions;
.5 description of pump-out procedure including use of manual relief valve, if applicable;
.6 instructions that the system shall be empty during storage at freezing temperatures.

3.8 TYPICAL INSTALLATIONS FOR TOILET RETENTION SYSTEMS

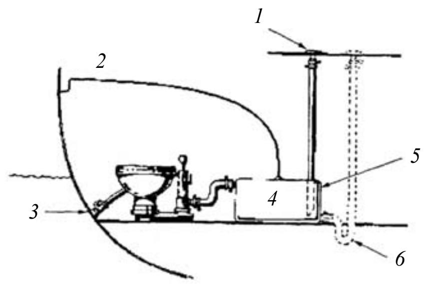


Fig. 3.8-1
Toilet retention system with deck pump-out only:
1 – pump-out deck fitting;
2 – venting pipeline;
3 – suction valve with a pump (if appropriate);
4 – holding tank;
5 – discharge pipe;
6 – P-trap

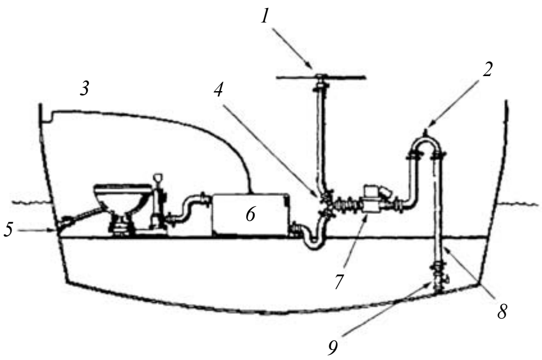


Fig. 3.8-2
Toilet retention system with deck pump-out and overboard discharge capability:
1 – pump-out deck fitting;
2 – siphon break may be necessary if system is below the waterline);
3 – venting pipeline;
4 – Y-valve;
5 – suction valve with a pump (if appropriate);
6 – holding tank;
7 – macerator pump;
8 – overboard discharge pipeline;
9 – overboard discharge valve

3.9 SEWAGE TREATMENT PLANTS

3.9.1 The rated capacity of the sewage treatment plant, in liters per day, shall be not less than the daily accumulated amount of sewage and domestic waste waters (if appropriate) determined according to the requirements of 3.6.4.
3.9.2 The sewage treatment plant, all its associated pumps and other accessories, piping and fittings which are

in contact with sewage shall be reliably protected from its attack.

3.9.3 The sewage treatment plants shall ensure a level of treatment in accordance with the current international and national standards. The required level of treatment shall be achieved only through purification and disinfection of sewage.

3.9.4 The sewage treatment plants shall be tested by a test pressure equal to 1,5 the pressure of water column measured from the tank bottom to the lower sanitary fixture having no shut-off valve on the discharge pipeline, but not less than 25 kPa.

Pipelines shall be tested by a hydraulic test pressure $p_{test} = 1{,}5\,p$ (where p = working pressure).

3.9.5 The sewage treatment plants shall be tested at the Manufacturer or on board the craft according to the program approved by the Register.

3.9.6 The sewage treatment plants may be located in machinery spaces or in separate spaces with forced exhaust ventilation.

3.9.7 Provision shall be made for washing and disinfection of the sewage treatment plant, associated machinery and piping, to carry out work in connection with the inspection and repair of the plant.

3.10 SEWAGE COMMINUTION AND DISINFECTION SYSTEMS

3.10.1 The sewage comminution and disinfection systems shall meet the requirements of 3.9.

3.10.2 The sewage comminution and disinfection systems shall provide for comminution of solid particles contained in sewage to a size not exceeding 25 mm.

4 REQUIREMENTS FOR CRAFT'S EQUIPMENT AND ARRANGEMENTS FOR PREVENTION OF POLLUTION BY GARBAGE

4.1 GENERAL

4.1.1 Every craft with a crew on board shall be provided with arrangements for collection and storage of garbage and food wastes generated during operation of the craft.

4.1.2 Garbage processing devices, incinerators and their systems shall comply with the requirements of the Parts V "Machinery Installations. Machinery. Systems and Piping", Part VIII "Electrical Equipment", and equipment for control, regulation and monitoring shall comply with the requirements of Part VI "Automation".

4.2 INCINERATORS

4.2.1 The incinerator installed on board the craft on or after 1 January 2000 shall comply with the requirements of Resolution MEPC.76(40) and be approved by the Register on behalf of the Administration.

4.2.2 Incinerator installed in existing craft, the date of contract for delivery of which is before 1 January 2000, may have type approval in accordance with the requirements of Resolution MEPC.59(33) or other normative documents.

4.2.3 Where fuel oil and oil residues leakages are likely to occur, trays shall be fitted which shall be effectively drained. The leaked fuel oil and oil residues collected in trays shall be trapped to the oil leakage collecting pipeline.

4.2.4 Special receptacles shall be provided for collecting ash from incinerators after garbage incineration.

4.2.5 The incinerators may be installed in machinery or separate spaces.

4.2.6 The fuel oil system supply to the oil burners shall be so designed that it can shut down from two positions one of which must be outside the space in which the incinerator is installed.

4.3 GARBAGE RECEPTACLES

4.3.1 Garbage receptacles shall be removable.

4.3.2 The calculation of the total capacity of the garbage receptacles having regard to the intended area of navigation, service conditions of the craft and number of persons on board shall be submitted to the Register.

The capacity of the receptacles for collecting garbage and food wastes V_g shall be calculated by the following formula:

$$V_g = G_g \cdot N \cdot T \qquad (4.3.2)$$

where G_g = daily accumulated amount of garbage in accordance with the service condition of the boat per one person, in m^3:
dry garbage – 0,002;
solid food wastes – $k \cdot 0{,}004$;
plastics – $k \cdot 0{,}000015$,
where k = 5,0 – for boats engaged on voyages of 8 hours and more in duration;
k = 1,0 – for boats engaged on voyages of less than 8 hours in duration;
N = maximum allowable number of persons on board;
T = time intervals between emptying of garbage containers at collection points, in days.

The total capacity of receptacles for collecting garbage and food wastes for craft engaged on voyages of 16 hours or more in duration shall make up not less than two day standard for accumulation.

4.3.3 The garbage receptacles shall be clearly marked to identify the category of garbage to be collected (plastics, food wastes, other garbage) and differ in colour.

4.3.4 The garbage receptacles shall have inner surfaces which allow easy cleaning.

4.3.5 The garbage receptacles shall be provided with covers ensuring tight closure, installed in well- ventilated places and have fixtures for reliable securing on board the craft.

4.3.6 Separate receptacles with fastened covers (cans, barrels, buckets) may be used for collecting garbage inside the spaces.

4.3.7 In boats with hull length of less that 10 m garbage and food wastes may be collected in separate dense polyethylene bags with subsequent unloading to reception facilities.

4.3.8 Garbage from the garbage receptacles may only be disposed to reception facilities or delivered to the craft's incinerator, if appropriate (if no restrictions are imposed by the Administrations), as well as to the sea areas where disposal is allowed (depending on the garbage category).

5 REQUIREMENTS FOR INTERNAL COMBUSTION ENGINES FOR PREVENTION OF AIR POLLUTION BY EXHAUST GASES

5.1 GENERAL

5.1.1 General requirements.

5.1.1.1 The provisions of this Section apply to all internal combustion engines installed on board the craft.

5.1.1.2 Engines which are covered by the provisions specified in 5.2.1 and 5.2.2 shall be submitted to the pre-certification survey at the Manufacturer's facilities. Meeting of the requirements shall be tested by means of the test procedure specified in ISO 8178-1:1996, ISO 8178-4:1996, Annex VI to MARPOL 73/78 and Technical Code on Control of Emission of Nitrogen Oxides (NO_x) from Marine Deisel Engines[1].

5.1.1.3 To avoid certification testing of every engine for compliance with the emission limits, the Manufacturer may adopt one of two concepts according to ISO 8178, namely the engine family or engine group concept.

5.1.1.4 The engine family concept according to ISO 8178-7 may be applied to any series produced engines, which through their design are proven to have similar emission characteristics, and which, during installation on board, require no adjustments or modifications which could adversely affect to the emissions.

5.1.1.5 The engine group concept according to ISO 8178-8 may be applied to a smaller series of main engines with similar design and which require minor adjustment and modifications during installation for operation on board.

5.1.2 Definitions and explanations.

The definitions and explanations relating to the general terminology of this Part of the Rules are given in 1.2.

For the purpose of this Section the following definitions and explanations have been adopted:

Parent engine for determining the emission is the marine engine with a set of similar features specific within the family or the group (see 5.1.1.3) and having the highest emissions.

Remanufactured engine is a reconditioned second-hand engine, similar to the engine replaced in terms of power, rating and application.

Emission is a mass of carbon monoxide (CO), hydrocarbons (HC), nitrogen oxide (NO_x) and particulates (PT) released into the atmosphere with the exhaust gas per unit time.

Engine group (according to the definition of the Resolution UNO EEC No.61) is a group of engines selected by the Manufacturer, approved by the competent authority, which as a result of their design must all have similar features as regards the level of exhaust and air-pollutant particulate emissions and meet the requirements of this Part, the adjustment and modification of individual engines being permissible after the type testing on the Manufacturer's test bed within fixed limits.

Substantial modification of an engine is any modification to an engine that:

could potentially cause the engine to exceed the emission standards set out in 5.2. Routine replacement of engine components which does not influence the emission level shall not be considered as "substantial modification";

increases the rated power of the engine by more than 15 per cent.

Test cycle is a range of the engine operating modes on the test bed, fixed by speed and power, to be established in accordance with its application and realized in the process of testing for calculating the specific weighted mean of emission.

Components are those interchangeable parts which influence the emission performance, identified by their design or plant number.

Rated power is the maximum continuous rating as specified on the nameplate and in the Technical File/Passport of the marine engine emissions.

Rated speed is the crankshaft revolutions per minute at which the rated power occurs as specified in the Technical File/Passport of the marine engine emissions.

[1] Hereinafter referred to as "the NO_x Technical Code".

Nitrogen oxides are a mixture of various nitrogen oxides generated in the process of combustion of fuel in the engine cylinder, denoted by the symbol NO_x.

Exhaust gases are a mixture of the products of complete fuel combustion, excess air and various microimpurities (both gaseous and as liquid and solid particulates) emitted into the engine exhaust system from the engine cylinders and further to the atmosphere.

Propulsion engine is a compression or spark ignition internal combustion engine which is used to produce power necessary for propulsion of the craft, including two- and four -stroke engine, stern drive engine with or without integral exhaust, as well as outboard engine.

Settings are the state (adjustment) of the adjustable features influencing the emission performance within the allowances specified by the Technical File/Passport of the marine engine emissions.

Engine family is a grouping of engines selected by the Manufacturer, approved by the competent authority, which as a result of their design must have similar features as regards the level of exhaust and air-pollutant particulate emissions and meet the requirements of this Part.

Marine diesel engine is a reciprocating compression – ignition internal combustion engine operating on liquid or dual fuel (on a gas-diesel cycle).

Engine type is a batch of engines which are identical in terms of the essential features of the engine; at least one unit of the engine type must be constructed (definition of Resolution UNO EEC No.61).

Technical File/Passport of marine enginee missions is a record containing all details of parameters, including components and settings of an engine, which may influence the emission of the engine.

A record book of engine parameters is the document for recording all parameter changes, replacements of components and settings which have been occurred in operation.

5.2 EMISSION LEVELS

5.2.1 The emission levels of carbon monoxide (CO), hydrocarbons (HC), nitrogen oxides (NO_x) and particulates (PT) released from propulsion engines (spark-ignition and compression-ignition ones) installed on craft operating in marine environment or in inland waterways of countries which are not the EC members shall not exceed the values specified in Table 5.2.1 in accordance with the EC Directive 2003/44/EC. The above mentioned engines which undergoes major conversion shall meet the requirements of this regulation.

5.2.2 The emission levels released from any compression-ignition (diesel) engines with rated power output greater than 19 kW referred to in 5.1.1.1, installed on craft of 20 m in length and upwards, operating in inland waterways of the EC countries shall not exceed the values specified in Table 5.2.2-2 depending on the rated power output. As an equivalent, for propulsion diesel engines the requirements for the emission levels set out in Table 5.2.2-1 may apply. The spark-ignition propulsion engines shall comply with 5.2.1.

5.2.3 The requirements for the diesel engines mentioned in 5.2.2 do not apply to engines installed on board prior to 1 July 2007 as well as to remanufactured engines installed prior to 31 December 2011 inclusive on board boats in service at 31 December 2002.

5.2.4 When applying the requirements of 5.2.1 and 5.2.2 to engines installed on craft operating in marine environment, in EC countries inland waterways and in none EC countries inland waterways, more stringent emission standards shall be accepted.

5.2.5 After the installation of the engine on board, but before commissioning, an installation check shall be made or the engine shall be checked by other specified approved methods in accordance with ISO 8178-2:1996 (GOST R 52408-2005).

The craft shall keep on board approved by the Register Technical File/Passport of the diesel engine emissions developed by the Manufacturer and the Record Book of engine parameters/constructional alterations.

Table 5.2.1

Limit values of emissions

Type	Carbon monoxide $CO = A + B/P_N^n$, in g/kWh			Hydrocarbons $HC = A + B/P_N^n$, in g/kWh			Nitrogen oxides NO_x, in g/kWh	Particulates PT, in g/kWh
	A	B	n	A	B	N		
Two-stroke spark ignition	150,0	600,0	1,0	30,0	100,0	0,75	10,0	NA
Four-stroke spark ignition	150,0	600,0	1,0	6,0	50,0	0,75	15,0	
Compression ignition	5,0	0	0	1,5	2,0	0,5	9,8	1,0

Notes: 1. A, B and n are appropriate constants; P_N is the rated engine in kW. Exhaust emissions are measured in accordance with the harmonized standard – EN ISO 8178-1:1996.

2. For engines above 130 kW E3 test cycle may be used in accordance with the NO_x Technical Code.

Table 5.2.2-1

Category	Swept volume *SV*, in l Net power, *P*, in kW	Carbon monoxide (CO), in g/(kWh)	Sum of hydrocarbons and oxides of nitrogen ($HC + NO_x$), in g/(kWh)	Particulates (PT), in g/(kWh)
VI:1	$0{,}9 \geq SV$ and $P \geq 37$	5,0	7,5	0,40
VI:2	$0{,}9 \leq SV < 1{,}2$	5,0	7,2	0,30
VI:3	$1{,}2 \leq SV < 2{,}5$	5,0	7,2	0,20
VI:4	$2{,}5 \leq SV < 5{,}0$	5,0	7,2	0,20
V2:1	$5 \leq SV < 15{,}0$	5,0	7,8	0,27
V2:2	$15 \leq SV < 20$ and $P < 3300$	5,0	8,7	0,50
V2:3	$15 \leq SV < 20$ and $P \geq 3300$	5,0	9,8	0,50
V2:4	$20 \leq SV < 25$	5,0	9,8	0,50
V2:5	$25 \leq SV < 30$	5,0	11,0	0,50

Table 5.2.2-2

Rated power, P_N, in kW	Carbon monoxide (CO), in g/(kWh)	Hydrocarbons (HC), in g/(kWh)	Oxides of nitrogen (NO_x), in g/(kWh)	Particulates (PT), in g/(kWh)
$19 \leq P_N < 37$	5,5	1,5	8,0	0,8
$37 \leq P_N < 75$	5,0	1,3	7,0	0,4
$75 \leq P_N < 130$	5,0	1,3	6,0	0,3
$130 \leq P_N < 560$	3,5	1,0	6,0	0,2
$P_N \geq 560$	3,5	1,0	$n \geq 3150$ min^{-1} = 6,0 $343 \leq n < 3150$ min^{-1} = $45\,n^{(-2)} - 3$ $n < 343$ min^{-1} = 11,0	0,2

6 PREVENTION OF USE OF OZONE DEPLETING SUBSTANCES

6.1 SCOPE OF APPLICATION

6.1.1 The requirements of the present Section apply to new installations fitted on board craft after 19 May 2005.

6.2 DEFINITIONS AND EXPLANATIONS

6.2.1 Definitions and explanations relating to the general terminology of the Rules are given in Section 2 of the General Regulations for Small Pleasure Craft and in 1.2 of these Rules.

For the purpose of this Section the following definitions and explanations have been adopted:

New installations are the installation of systems, equipment, including new portable fire extinguishing units, insulation, or other material on a craft, but excludes repair or recharge of previously installed systems, equipment, insulation, or other material, or recharge of portable fire extinguishing units.

Ozone depleting substances are controlled substances defined in paragraph 4 of article I of the Montreal Protocol on Substances that Deplete the Ozone Layer, 1987, listed in Annexes A, B, C or E to the said Protocol.

6.3 OZONE DEPLETING SUBSTANCES

6.3.1 New installations which contain ozone depleting substances shall be prohibited on all craft, except that new installations containing hydro-chlorofluorocarbons (HCFCs) are permitted until 1 January 2020.

Ozone depleting substances that may be found on board craft include, but are not limited to:

Group I (chlorofluorocarbons):

CFC-11 – trichlorofluoromethane, $CFCl_3$;

CFC-12 – dichlorodifluoromethane, CF_2Cl_2;

CFC-113 – 1,1,2-trichloro-1,2,2-trifluoroethane, $C_2F_3Cl_3$;

CFC-114 – 1,2-dichloro-1,1,2,2-tetrafluoroethane, $C_2F_4Cl_2$;

CFC-115 – chloropentafluoroethane, C_2F_5Cl;

Group II (Halons):

Halon 1211 – bromochlorodifluoromethane, CF_2BrCl;

Halon 1301 – bromotrifluoromethane, CF_3Br;

Halon 2402 – 1,2-dibromo-1,1,2,2-tetrafluoroethane, $C_2F_4Br_2$ (also known as Halon 114B2).

6.3.2 Any deliberate emissions of ozone depleting substances shall be prohibited. Deliberate emissions include emissions occurring in the course of maintaining, servicing, repairing or disposing of systems or equipment, except that deliberate emissions do not include minimal releases associated with the recapture or recycling of an ozone depleting substance.

6.3.3 The ozone depleting substances referred to in 6.3.1, and equipment containing such substances, shall be delivered to appropriate reception facilities when removed from craft.

7 NOISE PRODUCED BY CRAFT

7.1 GENERAL

7.1.1 Noise produced by a craft while underway, and, in particular, noise produced by air intakes and exhaust arrangements shall be abated by appropriate means.

7.1.2 The level of noise produced by a craft while underway shall not exceed 75 dB(A) when at a distance of 25 m from the craft side.

7.1.3 The level of noise produced by a craft while moored shall not exceed 65 dB(A) when at a distance of 25 m from the craft side.

7.1.4 The noise emission level shall be measured in accordance with ISO 14509:2000.

7.2 ESSENTIAL REQUIREMENTS FOR NOISE EMISSION LEVEL

7.2.1 Pleasure craft with permanently installed engines or stern drive engines with or without integral exhaust, or outboard engines shall comply with the following essential requirements for noise emission levels,

7.2.1.1 The said craft shall be designed, constructed and assembled so that noise emissions measured in accordance with ISO 14509:2000 shall not exceed the limit values in Table 7.2.1.1.

7.2.1.2 As an alternative to sound measurement tests as specified in 7.2.1.1, the pleasure craft with permanently installed engine or stern drive engine without integral exhaust, shall be deemed to comply with the noise level requirements if at the maximum running speed they have a Froud number of ≤ 1,1 and a ratio of rated power, in kW, to displacement on service test, in t, (see 3.2.27, General Regulations) not exceeding 40 and where the engine and exhaust system are installed in accordance with the engine manufacturer's specifications.

7.2.1.3 Froude number shall be calculated by dividing the maximum craft speed V, in m/s, by the square root of the waterline length multiplied by a given gravitational constant (g = 9,8 m/s^2).

7.2.1.4 In addition to 7.5.1.2, pleasure craft with permanently installed engine or stern drive engine without integral exhaust, shall be deemed to comply with these noise requirements if their key design parameters are the same as or compatible with those of a certified reference craft to tolerances specified in 7.2.1.1.

Certified reference craft shall mean a specific combination of craft with permanently installed engine or with stern drive engine without integral exhaust that has been found to comply with the noise emission requirements, when measured in accordance with 7.2.1.1, and for which all appropriate key design parameters and sound level measurements have been included subsequently in the published list of certified reference craft.

Table 7.2.1.1

Single engine power, in kW	Maximum sound pressure level, in dBA
$P_N \leq 10$	67
$10 < P_N \leq 40$	72
$P_N > 40$	75
Note. For twin-engine and multiple-engine units of all types an allowance of 3 dBA may be applied.	

8 SHIPBOARD INCINERATION

8.1 DEFINITIONS AND EXPLANATIONS

8.1.1 Shipboard incineration is the incineration of wastes and other matter on board a craft, if such wastes and other matter were generated during normal operation of that craft.

8.2 GENERAL REQUIREMENTS

8.2.1 Shipboard incineration shall be allowed only in a shipboard incinerator of the approved design.

8.2.2 Shipboard incinerator installed on board a craft on or after 1 January 2000, shall comply with the requirements of Resolution MEPC.76(40) and have the Register Type Approval.

9 SULPHUR CONTENT OF MARINE FUEL

9.1 DEFINITIONS AND EXPLANATIONS

9.1.1 SO_x Emission Control Area means an area where the adoption of special mandatory measures for SO_x emissions from craft is required to prevent, reduce and control air pollution from SO_x and its attendant adverse impacts on land and sea areas. SO_x Emission Control Areas include those listed in Regulation 14 of Annex VI to MARPOL 73/78/97, as appended.

9.2 GENERAL REQUIREMENTS

9.2.1 The sulphur content of any fuel oil used on board craft shall not exceed 4,5 per cent m/m.

9.2.2 While craft are within SO_x Emission Control Areas, at least one of the following conditions shall be fulfilled:

.1 the sulphur content of fuel oil used on board craft in a SO_x Emission Control Area does not exceed 1,50 per cent m/m;

.2 as an alternative, an exhaust gas cleaning system, approved by the Administration, taking into account the provisions of Directive EC 2005/33/EC is applied to reduce the total emission of sulphur oxides from craft, including both auxiliary and main propulsion engines to to the levels equivalent to the limits of sulphur content of any fuel oil specified in 9.2.2.1.

.3 the fuel system of craft which use various kinds of fuels shall be so designed that it can be flushed of all kinds of fuels with sulphur content exceeding 1,5 per cent m/m prior to entry into SO_x Emission Control Areas or other areas established by the Administration.

9.2.3 The sulphur content of any fuel oil used on board craft operating in territorial waters of the EC countries, including inland waterways and ports, shall comply with the requirement of Directive EC 2005/33/EC, as amended.

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LIST OF CIRCULAR LETTERS AMENDING/SUPPLEMENTING NORMATIVE DOCUMENT

ND 2-020101-071-E Rules for the Classification and Construction of Pleasure Craft (2012), Part VI "Automation" and Part VII "Electrical Equipment"

(Normative document No. and title)

Item No.	Circular letter No., date of approval	List of amended and supplemented paras
1.	315-07-975c dated 23.01.2017	Part VI: 2.1.3, 2.9.4 Part VII: 4.3.1.1, 4.3.1.6

RUSSIAN MARITIME REGISTER OF SHIPPING

HEAD OFFICE

CIRCULAR LETTER **No.** 315-07-975c dated 23.01.2017

Re:

amendments to Parts VI "Automation" and VII "Electrical Equipment" of the Rules for the Classification and Construction of Pleasure Craft, 2012, ND No. 2-020101-071-E

Item of supervision:

construction of ships

Implementation	01.01.2017
Valid: till	-
Validity period extended till	-
Cancels / amends / supplements Circular letter No.	-
Number of pages:	1+1
Appendices:	text of amendments to Parts VI "Automation" and VII "Electrical Equipment" of the Rules for the Classification and Construction of Pleasure Craft, 2012, ND No. 2-020101-071-E
Director General	Konstantin G. Palnikov

Amends Rules for the Classification and Construction of Pleasure Craft, 2012 ND No. 2-020101-071-E

It is necessary to do the following:

1. Familiarize the RS surveyors with the content of the Circular Letter.
2. Bring the content of the Circular Letter to the notice of the interested organizations in the area of the RS Branch Offices' activity.
3. Apply the amendments to the RS Rules given in the Appendix to the Circular Letter.

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Appendix to Circular Letter

No. 315-07-975c dated 23.01.2017

RULES FOR THE CLASSIFICATION AND CONSTRUCTION OF PLEASURE CRAFT, 2012, ND No. 2-020101-071-E

PART VI. AUTOMATION

Para 2.1.3 shall be supplemented with the following text:

"Control systems of the main machinery having power of 220 kW and less may be supplied from the attached generators and starting accumulator batteries floating on the generators.".

Para 2.9.4 shall be amended to read:

"**2.9.4** For machinery installations with main engines having power less than 220 kW, outboard engines and mechanical remote control system, engines with sterndrives, the range of alarm signals may be reduced after review of the technical documentation for control systems, as well as with regard to the experience of application of such equipment on board the ships.".

PART VII. ELECTRICAL EQUIPMENT

Para 4.3.1.1 shall be amended to read:

"**4.3.1.1** Frames, front panels and enclosures of main, emergency, section and group switchboards shall be constructed of metal or some other durable non-combustible material that shall be demonstrated by the appropriate tests.".

Para 4.3.1.6 shall be amended to read:

"The generator panels may be illuminated with the luminaires with built-in accumulators, at that the generator panels shall be provided with the power supply indicator light on the generator side.".

Российский морской регистр судоходства

Правила классификации и постройки прогулочных судов

Russian Maritime Register of Shipping

Rules for the Classification and Construction of Pleasure Craft

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