RULES FOR THE CLASSIFICATION AND CONSTRUCTION OF HOUSEBOATS

2021

GDAŃSK

The Rules for the Classification and Construction of Houseboats – 2021 have been approved by the PRS SA Management Board on 30 September 2021 based on the Technical Committee Resolution No. 1/21 of 7 September 2021 and enter into force on 1 October 2021.

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1 RULES STRUCTURE AND SCOPE

Regulations relating to the scope of PRS supervision activity, PRS liability, the survey procedures, methods and forms, the procedure for technical documentation approval, as well as the kind of the issued documents are given in, separately published by PRS, *Supervision Activity Regulations*.

Additional recommendations and guidance on the issues included in the *Rules* are included in separately issued *Publications "I"* (informative), cited in different parts of the *Rules*.

1.1 Application

1.1.1 *The Rules for the Classification and Construction of Houseboats* apply to houseboats of hull length less than 24 with or without own propulsion.

1.1.2 These *Rules* are applicable both to new and existing houseboats. Where in the *Rules* the houseboat age is mentioned, it is determined from the date of construction completion.

1.1.3 The *Rules* specify requirements upon compliance of which the houseboat may be assigned PRS class.

1.2 Terms and definitions

The following terms have been adopted in the *Rules*:

Amidships – the middle part of the houseboat hull of length equal to 0.6 L_H counting from midship section towards bow and stern, 0.3 L_H each direction.

Auxiliary engine – the engine providing energy supply to the houseboat and ensuring operation of defined systems.

Builder – a shipyard, other plant, workshop or a person who constructs the houseboat by own capacity.

Deadweight – permitted (or declared) load of the houseboat, equal to combined mass of persons, stores (of fuel, water, sewage and food) and cargo, the houseboat can be loaded with.

Design displacement volume (V_k) – the volume of immersed hull part of the houseboat fully equipped for navigation, however, without cargo, crew, fuel, water, sewage and food supplies.

Design waterline – the line of intersection of the hull body and water surface plane at defined design displacement and rake of keel.

Direct classification survey – technical survey carried out during the houseboat construction directly by PRS surveyors.

Draught (T) – the houseboat draught is measured from the designed waterline plane to the keel bottom.

Examinations:

- External (general) examinations – a visual inspection of structure or machinery, without dismantling, to provide a general assessment of their condition and to determine, where necessary, the scope of an additional close-up examination;
- Internal examinations – a visual examination of structure, machinery or equipment in dismantled condition (partially or wholly) or a visual examination of an arrangement (tanks) from the inside, aimed at the assessment of their condition and determination, where necessary, the scope of an additional close-up examination.
- Close-up examination – a survey where the details of structure, machinery or equipment are subject to close visual inspection by the Surveyor, and possible hammer inspection of metal

elements, puncturing of wooden elements with a spike, ultrasonic gauge measurement or magnifying glass testing.

Flooding angle (φ_z) – an angle of heel of the houseboat at considered loading condition, at which the flooding point enters in water.

Flooding height (h_z) – a distance from the flooding point to the waterline plane corresponding to considered loading condition of the houseboat in upright position.

Flooding point – the place at any opening through which water can enter into the unit interior, bilge or cockpit in the amount posing threat to the unit stability or buoyancy.

Houseboat – a floating unit, with or without own propulsion, intended for housing purposes, specially constructed or converted for the purpose, or equipped for twenty-four-hour rest or residence of no more than 12 persons, ensuring a place to sleep and rest to the persons onboard. Special furnishing ensure the place and equipment for food storage and preparation of meals as well as a sanitary part with toilet, washbasin and shower. A houseboat is provided with water and sewage tanks and electric batteries of capacity ensuring its autonomy during voyage and stay at a harbour. For the houseboat with own propulsion, the rate of the installed drive output [kW] to the object weight [t] may not exceed 10 and the maximum speed of the unit may not exceed 12 km/h.

Houseboat class – conformity of the houseboat (hull, machinery, equipment and systems) structure, construction and condition with the relevant requirements of these *Rules*, confirmed by the assignment of symbol of class and the issue of *Class Certificate of Houseboat*.

Houseboat propulsion – internal combustion engine: diesel or petrol engine, permanently built-in or outboard, as well as an electric motor.

Hull breadth (B_H) – a distance between extreme points of houseboat hull, measured parallel to the loaded houseboat waterline, without considering items of hull equipment protruding beyond the hull outline, such as fenders, etc., in accordance with the requirements of PN-EN ISO 8666 Standard.

Hull length (L_H) – the distance between extreme points of the houseboat hull, measured parallel to houseboat load waterline, without consideration of items of the hull equipment protruding beyond the hull outline, such as ruder, outboard engine, fenders, etc., in accordance with the PN-EN ISO 8666 Standard.

Indirect classification survey – technical survey during which inspection activities within the houseboat construction are carried out by respective technical services of the builder. Ensuring by the builder satisfactory and uniform level of manufacturing quality – holding the *Approval of the plant* – is a condition for covering the houseboat with indirect survey.

Loaded houseboat waterline – the line of intersection of the houseboat hull body and water surface plane, at full deadweight and rake of keel at the given loading condition.

Mass of empty unit (m_{EC}) – the mass of the unit fully equipped for navigation, however, without crew, cargo and provisions.

Midhip section – the outline of the transverse cross-section of a houseboat hull in the middle of the design waterline length.

Moulded depth of hull (H) – hull depth measured amidships from the keel bottom to the top of main deck at side or to the point of intersection of the moulded lines of the deck and side.

Overall length (L_c) – the length of the houseboat measured between extreme points aft and fore, taking into account such parts of hull equipment as: outboard engine, dismountable platform/terrace, fenders, etc., so the elements which protrude beyond the hull outline.

Place of refuge – water area, with natural or artificial protection, where the houseboat can find safe berth in conditions which threaten the houseboat safety.

Propulsion engine – the engine intended for the houseboat propulsion.

Rated power (kW) – the power on the propeller shaft as declared by the engine manufacturer in accordance with the requirements of PN-EN ISO 8665 Standard, respectively to the engine purpose and expected operational conditions.

Space open to atmosphere – a room having at least 0.34 m^2 permanently and directly exposed to atmosphere per each cubic meter of net volume of the space.

Survey – a set of activities relating to a houseboat, its machinery, appliances, equipment, etc. performed through the review of technical documentation, as well as conducting appropriate examinations, measurements and tests.

Symbol of class – a group of conventional marks and notations, specifying a class of a houseboat, kind of survey during the houseboat construction and in service, as well as the houseboat structural features and operational limitations, if any. Symbol of class consists of the main symbol of class and additional marks.

Testing:
- Operation tests – external examinations of machinery or appliance under working conditions, combined with the measurements of essential operational parameters.
- Non-destructive strength tests – a test load, specified by PRS, is applied to the tested object or product. The tested object shall not be damaged during testing.
- Destructive strength tests – a load is applied to test samples and increased until the sample is damaged
- Tightness test – a pressure of the liquid or gas medium is applied to the tested body. Kind of medium, test procedure and pressure value shall be agreed with PRS. For deck openings, watertightness and weathertightness tests are distinguished.

Waterline length (L_w) – the length of the houseboat, measured along the designed waterline between extreme points of hull fore and aft, in accordance with the requirements of PN-EN ISO 8666 Standard.

1.3 Form and scope of survey

1.3.1 PRS carries out classification survey of houseboats in the form of a direct or indirect survey.

1.3.2 Classification survey of a houseboat covers its hull and equipment, machinery and electrical appliances, together with installation and other equipment referred to in the *Rules*. Stability, subdivision and fire protection are also subject to survey, according to the principles set forth in the *Rules.*

1.3.3 During periodical classification surveys, the houseboat equipment not covered with classification survey may be subject to PRS technical survey after agreement with the Flag State.

1.4 Classification principles

1.4.1 PRS may assign a class to a new or an existing houseboat, as well as to confirm, renew, suspend, withdraw or reinstate class of an existing houseboat classed with PRS.

1.4.2 Submission of a written application by the houseboat owner, with the required technical documentation, and positive result of the initial survey for class assignment are the conditions for class assignment to a houseboat.

1.4.3 After completion of the initial survey for class assignment, the PRS Branch Office/Survey Station issues *Temporary Class Certificate of Houseboat*, to enable the houseboat to sail. The results and survey reports are subject to verification by the PRS Head Office.

1.4.4 The assignment, renewal or reinstatement of class confirms that the houseboat complies, fully or to a degree considered satisfactory by PRS, with the requirements of the *Rules* valid in the time of class assignment, unless set forth otherwise in the further revisions of the *Rules* or in amendments thereto.

1.4.5 The assignment, renewal or reinstatement of the houseboat class is effected by the issue of the *Class Certificate of Houseboat* and by entering appropriate records in the *Register of Houseboats*.
The Register of Houseboats is a publication containing information on the houseboats in service granted valid *Class Certificate of Houseboat*.

1.4.6 The class is assigned or renewed generally for a period of 5 years. Considering technical condition of the houseboat hull, machinery or electrical installations, PRS may assign a class to a houseboat for a shorter period or shorten the validity period of class after survey for class assignment, entering appropriate additional mark in the symbol of class.

1.5 The symbol of class

1.5.1 A new houseboat constructed under PRS survey, which upon completion of initial survey is assigned PRS class, is given the main symbol of class consisting of mark ♦ , followed by mark HB and mark of navigation area, e.g.:

♦ **HB 2** – for the houseboat intended for operation in region 2.

1.5.2 An existing houseboat built without survey of any classification society, however, granted CE certificate, which upon completion of initial survey is assigned PRS class, is given main symbol of class without mark ♦ , e.g.:

HB 2 – for the houseboat intended for operation in region 2.

1.5.3 An existing houseboat built without survey of any classification society, which does not have CE certificate, which upon completion of initial survey is assigned PRS class, is given the main symbol of class in brackets, e.g.:

(HB 2) – for the houseboat intended for operation in region 2.

1.5.4 Depending on compliance with respective requirements of the *Rules* and on operating area, the marks of operation region 2,3 or 4 are placed in the main symbol of class, with the following meaning:

- **2** navigation on inland waters and internal sea waters, with wave height of up to 1.2 m. This operation area includes such Polish water reservoirs as: the Szczecin Bay, the Kamieński Lagoon, the Vistula Bay, the Puck Bay, the Włocławek Reservoir and a part of Mazurian Lakes scheme with the lakes Śniardwy, Niegocin and Mamry;
- **3** navigation on inland waters where wave of height up to 0.6 m may be encountered. This area includes such Polish water reservoirs as: inland waterways not mentioned in area **2** and sea harbours;
- **4** navigation on inland waterways other than mentioned above.

1.5.5 Permanent operational limitations

The class of a houseboat is assigned under condition of compliance, in operation, with the below permanent operational conditions:

- permissible wind force is restricted to 4° Beaufort scale (8 m/s) and wave height up to 0.5 m;
- when weather conditions worsen, the houseboat under way should head to the nearest place of refuge;
- the speed of the houseboat should be adopted to navigational conditions;
- the number of persons present onboard the houseboat should be not higher than the maximum number of persons given in the *Class Certificate of Houseboat*;
- the recommendations concerning stability safety, contained in the *Rules* and in the PRS approved *Stability Booklet*, if required, shall be complied with.

1.5.6 Additional marks in the symbol of class

1.5.6.1 In order to indicate the purpose of the houseboat, compliance with additional requirements or limitations provided in the *Rules*, additional marks are placed in the symbol of class, after the main symbol of class.

1.5.7 Marks of limited period of class validity

1.5.7.1 If, in result of survey, the validity of class shall be shortened (see 1.4.6), the symbol of class of a houseboat the class of which shall be assigned, renewed or reinstated, is supplemented with the mark of the limited period of class validity:

<2 – with limitation up to 2 years,
<1 – with limitation up to 1 year.

Such mark is put after the main symbol of class.

1.5.7.2 No class validity limitation mark is inserted in the symbol of class of houseboats with class to be assigned or renewed for the period of 5 years.

1.5.8 Houseboat mobility mark

1.5.8.1 If the houseboat is equipped with propulsion engine, the symbol of class is supplemented with the mark:

m

Such mark is inserted after the main symbol of class and the class validity limitation mark, if any.

1.5.9 The houseboat purpose (year-round operation) mark

1.5.9.1 If, due to design and operational reasons, it is found that a houseboat may be operated also in the winter season, an appropriate mark denoting year-round use is added in the symbol of class:

R

Such mark is inserted after the main symbol of class and the houseboat mobility mark, if used.

1.5.9.2 The houseboat with year-round class but without ice strengthening mark, may not operate at thin ice cover or in fine ice pieces, but may only be moored to the berth/pier.

1.5.10 Mark of exemption from intermediate survey

1.5.10.1 If a houseboat intended for recreational purposes is not subject to intermediate survey due to its age and purpose according to 1.7.4, the symbol of class is supplemented with the mark of exemption from intermediate survey:

x

Such mark is inserted after the year-round operation mark.

1.5.10.2 If a houseboat becomes subject to the intermediate survey on account of its age, the mark of exemption from the intermediate survey is deleted from the symbol of class during the class renewal survey or survey for class reinstatement.

1.5.11 Subdivision mark

If a houseboat fulfils the subdivision requirements defined in *Chapter 4 – Stability and Subdivision*, the subdivision mark:

n

is affixed to the houseboat symbol of class

The mark is placed after the mark of the houseboat purpose and the mark of exemption from intermediate survey, if applicable.

1.5.12 Ice strengthening mark

1.5.12.1 If a houseboat is designed for navigation in fine ice pieces, as well as in a thin ice shell, the breaking of which does not significantly reduce its speed, the following ice strengthening mark is inserted in the symbol of class after the limited weather conditions mark, if applicable:

L

The conditions for assignment of the ice strengthening mark are subject to PRS consideration against the relevant requirements specified in the *Rules for the Classification and Construction of Inland Waterways Vessels.*

1.5.12.2 The necessity for the ice strengthening mark assignment to a houseboat is subject to its Builder's or Owner's discretion.

1.5.13 Daytime restriction mark

1.5.13.1 Where the houseboat navigation is restricted to daytime only due to lack of navigational lighting, the following mark is inserted at the end of the symbol of class:

d

1.5.14 Additional descriptive information

Records on other additional class requirements, conditions or service restrictions which extend beyond the scope related to the additional marks are entered respectively in the *Class Certificate of Houseboat / Temporary Class Certificate of Houseboat*.

1.6 Class Assignment

1.6.1 The Initial Survey for Assignment of Class aims at determining the possibility for the class assignment to a houseboat reported to PRS for classification for the first time.

1.6.2 The detailed scope of the survey of the houseboat construction and initial survey for the houseboat under construction is set by the supervising PRS Surveyor in agreement with PRS Branch Office/Survey Station concerned, in accordance with the *Rules* and approved documentation taking also account of the local building conditions.

1.6.3 Existing houseboat which has never been classed before may be accepted to be classed with PRS and subjected to the initial survey in the scope determined by PRS against the class renewal survey requirements depending on the yacht age as well as the technical condition of hull, machinery and equipment.

1.6.4 When submitting, for classification, an existing houseboat without class, technical documentation shall be submitted within the scope specified by PRS Head Office in each particular case. In justified cases PRS may partly waive this requirement.

1.6.5 Where the structural details of a houseboat to be classed with PRS or its equipment do not comply with the requirements of the *Rules* and the Owner presents evidence of the houseboat or equipment satisfactory behaviour during hitherto operation, PRS may accept the evidence as technically equivalent.

1.6.6 The condition for the class assignment to a houseboat having CE mark is submission of the *Declaration of conformity* issued by the houseboat manufacturer, the *Certificate* corresponding to the applied conformity assessment module issued by the Notified Body and, for reference, the *Owner's manual.*

The houseboat having CE mark is not subject to the stability and buoyancy tests during the initial survey if module A1 or higher has been applied in its certification process. Where module B or G has been applied for the certification, the scope of survey may be reduced to the assessment of the houseboat technical condition and operation tests of all the machinery and equipment.

1.6.7 The *Class Certificate of Houseboat* validity period starts from the Initial Survey completion date.

1.7 Class maintenance, periodical and occasional surveys

1.7.1 The conditions for maintaining the houseboat class are as follows:

- maintaining the houseboat, i.e. its hull, machinery and equipment, in a satisfactory technical condition,
- operation of the unit in accordance with the conditions specified in the *Class Certificate of Houseboat*, the guidelines provided by the machinery and equipment manufacturers as well as good seamanship,
- carrying out due periodical surveys at scheduled dates,
- fulfilment of conditions of class at scheduled dates,
- carrying out required occasional surveys.

1.7.2 Houseboats are subject to the following periodical surveys:

- Annual survey,
- Intermediate survey,
- Class renewal survey.

1.7.3 The purpose of the annual and intermediate surveys is to ascertain that a houseboat hull and its equipment, machinery and installations are maintained in satisfactory technical condition.

1.7.4 Houseboats in good technical condition intended for recreational service may be exempted from intermediate survey, unless their age (considered as the period between completion of their construction and the end of a new classification cycle) exceeds:

- 20 years for laminate hulls and those made of other plastics,
- 15 years for metal hulls,
- 10 years for wooden and concrete hulls.

1.7.5 If the houseboat age (considered as the period between completion of its construction and any date within a particular classification cycle) exceeds the values specified in 1.7.4, then such a houseboat is subject to an intermediate survey in that classification cycle.

1.7.6 Class renewal survey aims to demonstrate that the houseboat's hull, its equipment as well as machinery and installations comply with the requirements of the *Rules* and to ensure that the houseboat is fit for its intended purpose for the subsequent 5-year or shortened period, subject to proper operation and maintenance.

1.7.7 In justified cases, PRS Surveyor may dispense with a survey of particular items of machinery in dismantled condition or limit the scope of survey if external examinations, measurements and operation tests prove that the machinery item is in a good and efficient condition. The Surveyor may also limit the scope of surveys in dismantled condition of main engine and auxiliary engines after analysis of maintenance records of the given engine.

1.7.8 Intervals between periodical surveys

1.7.8.1 Intervals between periodical surveys of a houseboat commence as of the date of classification cycle beginning.

1.7.8.2 PRS may shorten intervals between visual examinations, measurements or tests of the hull, particular items of machinery, installations and equipment if it is found necessary due to their technical or service conditions.

1.7.8.3 Intermediate survey is held no sooner than 2 years and no later than 3 years after the assignment, renewal or reinstatement of class.

1.7.8.4 Where the class validity periods has been shortened to 2 years, the intermediate survey shall be performed no sooner than 3 months before, and no later than 3 months after one year has passed after class assignment, renewal or reinstatement.

1.7.8.5 Annual survey is held no sooner than 3 months before, and no later than 3 months have passed from the anniversary date of the assignment, renewal or reinstatement of class.

1.7.9 Class renewal survey

1.7.9.1 Class renewal survey shall be held at intervals not exceeding 5 years. In exceptional cases, however, upon PRS agreement following the Owner's request, a maximum 3-month extension of class beyond the 5th year may be granted.

1.7.9.2 Class renewal survey completed within 3 months before or after expiry date of class validity has no effect on the schedule of the following surveys.

1.7.9.3 If the class renewal survey is complete more than 3 months before the class validity expiry date or the survey for the class reinstatement is complete more than 3 months after the class validity expiry date, then a new class validity period is determined from the survey completion date.

1.7.10 Scopes of periodical surveys

1.7.10.1 Intermediate survey

Intermediate survey of a houseboat is performed ashore, prior to hull painting, as well as afloat when the houseboat is ready for navigation. The survey covers:

.1 survey of hull and its equipment including visual examinations as far as practicable, and the measurements and operation tests of the following
- shell plating, corrosion protection means,
- propeller,
- hull openings and side fittings
- bulwark, guard rails,
- deck, deckhouses, cockpits, deck openings and their closing appliances,
- steering gear (main and auxiliary), operation tests thereof,
- anchoring equipment (anchors, chains, ropes, windlasses, anchor stoppers, hawses) and operation tests of windlasses
- mooring equipment (mooring lines, towing lines, capstans, hawses, cleats, bollards)

.2 survey of machinery, piping systems and electrical installations:
- main engine operation tests,
- operation tests of auxiliary engines
- operation tests of the remote closing appliances of fuel tank valves
- operation tests of ventilation systems, particularly that of the engine room
- sewage and bilge system operation tests
- liquid gas system operation tests,
- visual examinations and operation tests of generators and accumulator batteries, as well as energy converters
- visual examinations and operation tests of switchboards and power shore connection installations
- visual examinations and operation tests of electric drive arrangements
- operation tests of lighting installation in the houseboat compartments
- operation tests of navigation and signaling lights
- operation tests of signaling and automatic control systems
- visual examinations of fire-fighting installations and equipment.

1.7.10.2 Class renewal survey

Class renewal survey covers the scope of an intermediate survey and additionally:

.1 hull and hull equipment survey:
- visual examinations of bottom, bulkheads, deck plating, hull structural members, pipings and bilges,
- visual examinations of peaks, internal ballast securing,
- internal examinations of the side fittings, if practicable considering their construction,
- visual examinations of the engine and machinery seatings,
- visual examinations of the accessible devices for securing non-integral tanks,
- visual examinations of integral and non-integral tanks, as well as tightness tests, depending on the examination results,
- tightness tests of deck openings closing appliances, depending on the examination results;

.2 thickness measurements of metal hull structural members, depending on the examination results;

.3 visual examinations, measurements and tests of the following machinery, to the extent not exceeding that required for proper assessment of their technical condition:
- main engine – visual examinations of the elements essential for proper operation of the main engine and main engine-driven machinery as well as devices securing the engine to the seating,

- visual examinations and operation tests of cooling water, oil fuel, exhaust gas and hydraulic systems,
- visual examinations of the ventilation systems,
- measurement of power network insulation resistance – subject to the examination results,
- visual examination of lightning and earthing protection,
- checking control instruments and gauges.

1.7.10.3 Annual survey

1.7.10.3.1 The annual survey of a houseboat is performed afloat, when the houseboat is ready for navigation. The survey covers correct operation of all machinery and systems, as for intermediate survey.

1.7.10.4 Occasional surveys

1.7.10.4.1 Occasional surveys of a houseboat or its particular machinery items, installations or equipment are held upon request in all cases not covered by the initial survey and periodical surveys.

1.7.10.4.2 Occasional survey may be held at the request of the Owner or Underwriter in the scope depending on the request.

1.7.10.4.3 The scope and performance method of an occasional survey is determined by PRS Branch Office/PRS Surveyor considering the survey purpose as well as the houseboat age and technical condition.

1.7.10.5 Survey after damage

1.7.10.5.1 One of occasional surveys is survey after damage to which a houseboat shall be subjected in case of damage sustained by the hull, machinery, installations and equipment covered by the requirements of the *Rules* and being subject to technical survey of PRS if the consequences of the damage cannot be completely removed using the means available to the persons onboard.

The Owner is responsible for immediate reporting the damage to PRS.

1.7.10.5.2 Survey after damage shall be performed at a port where the damage occurred or at the first port the houseboat calls after the damage.

Survey after damage aims at assessing the extent of damage, specifying the scope of work required to eliminate the consequences of the damage and determining the possibility and conditions for class maintenance or reinstatement.

1.7.10.5.3 If the houseboat is in a port where repairs connected with damage cannot be made, at the Owner's request, PRS may allow a single trip of the unit directly to a port or shipyard where the specified repairs will be possible. In such case, temporary repairs to allow the yacht to undertake such trip may be required.

1.8 Suspension and withdrawal of class

1.8.1 Class of a houseboat is suspended automatically for the following reasons:

.1 damage to the hull, machinery, installations or equipment covered by the requirements of the *Rules*,

.2 transgressing the service conditions specified in the *Class Certificate of Houseboat*,
.3 exceeding the deadline for the class renewal survey or intermediate survey required by the *Rules*,
.4 exceeding the deadline for fulfilment of conditions of class,
.5 change of the houseboat Owner or technical characteristics,
.6 if the Owner has not paid PRS for its services connected with the houseboat survey at the agreed date.

Notice of PRS intent to suspend the class will be sent to the Owner one month in advance. The class will be reinstated automatically after settlement of payments.

Except for the reasons stated in .2, .5 and .6, the reinstatement of class may take place after successful completion of the appropriate survey.

1.8.2 Class of a houseboat is withdrawn for the following reasons:
.1 introduction of alterations to hull, machinery, installations and equipment covered by the requirements of the *Rules*, without the prior agreement with PRS,
.2 suspension of class for a period exceeding 6 months; PRS may, however, grant a longer suspension period at the Owner's request,
.3 the houseboat has sunk or been scrapped,
.4 at the Owner's written request for the houseboat withdrawal from *PRS Register of Houseboats.*

The houseboat whose class has been withdrawn, may be subjected to the class reinstatement survey at the Owner's request. The scope of such a survey is determined by PRS in each particular case.

1.8.3 Replacement of an outboard engine for the same or similar engine of the same weight and rated power is not the cause for withdrawal of houseboat class.

2 HULL

2.1 Application

2.1.1 This Chapter of the Rules applies to the structures of houseboats defined in Chapter 1 – *Classification Regulations*, similar as regards the shape and relations of main dimensions to typical displacement boats. Houseboats of other structure are subject to individual consideration by PRS.

2.1.2 The houseboat structure shall ensure appropriate general stiffness of hull through the use of appropriate stiffenings of hull(s), bulkheads, transverse divisions or of reinforced frames.

2.2 Terms and definitions

2.2.1 Definitions

R_m – Tensile strength of the used material, [MPa].

R_g – Bending strength of the used material, [MPa].

E_m – Young's modulus of the material at tension, [MPa].

E_g – Young's modulus of the material at bending, [MPa].

2.3 Plating

2.3.1 The requirements given in the *Rules* concerning plating are related to the rectangular plate of minor curvature, with stiffened edges.

2.3.2 Basic dimensions of the plate (width a and length b) are measured to the nearest edges of stiffeners, as shown in Fig. 2.3.2-1. It is assumed that $b \geq a$.

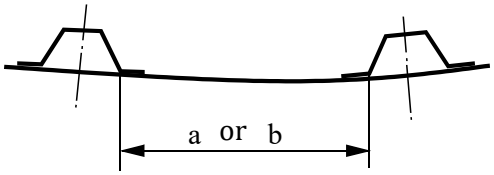


Fig. 2.3.2-1

If the plate is not a rectangle, the dimensions a and b – parallel to centre lines shall be determined as in Fig. 2.3.2-2.

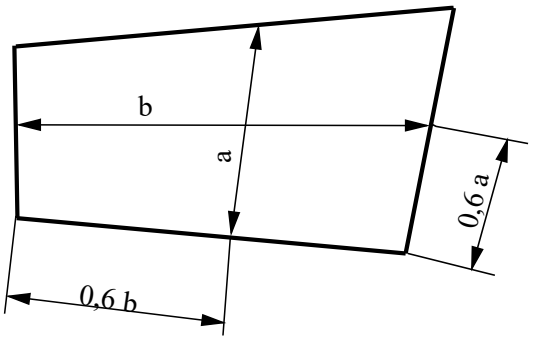


Fig. 2.3.2-2

2.3.3 Where the ratio of length b to width a is less than 2, the plate thickness may be reduced in accordance with coefficient k_k, determined from the below formula:

$$k_k = -0{,}22\left(\frac{b}{a}\right)^2 + 0{,}87\frac{b}{a} + 0{,}14 \qquad (2.3.3)$$

it shall be assumed: $2 \geq \frac{b}{a} \geq 1$.

2.3.4 Where the ratio of deflection arrow *f* shown in Fig. 2.3.4 to plate width *a* exceeds 0.03, the plate thickness may be reduced, in accordance with coefficient k_p given in Table 2.3.4:

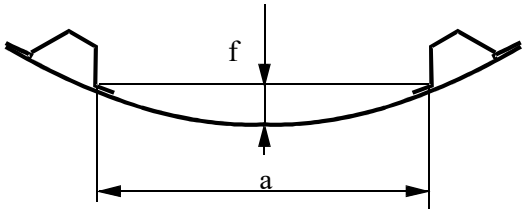


Fig. 2.3.4

Table 2.3.4

f/a	k_p
0 – 0.03	1
0.03 – 0.1	1.15 – 5 f/a
– 0.1	0.65

2.4 Stiffeners

2.4.1 Houseboat plating shall be stiffened by transverse and longitudinal primary supporting members. Frames, transverse bulkheads and divisions, elements of interior structure, floors and transverse beams are considered transverse members. Longitudinals, longitudinal bulkheads and divisions and longitudinal elements of interior structure are considered longitudinal supporting members.

2.4.2 A sharp edge of plating (chine) can be considered as stiffener, provided that the angle between adjacent plating plates does not exceed 150° and the edge is brought to other appropriate stiffeners. The laminate plating of such bend shall comply with the requirements of 2.6.13.3.

2.4.3 The minimum section moduli given for stiffeners are calculated together with the effective flange of width a_w determined from the formula:

$$a_w = k_E\left(e + 2b_w\right), \quad \text{[cm]} \qquad (2.4.3\text{-}1)$$

k_E – coefficient of Young's modulus, determined from the formula:

$$k_E = \frac{E_p}{E_u}$$

E_p – Young's modulus of plating, [MPa],

E_u – Young's modulus of stiffener, [MPa],

e – stiffener width in the place adjacent to the plating, [cm],

b_w – effective width (one-sided), [cm]:

$b_w = 10\,g$ for glass-polyester laminated plating,

$b_w = 50\,g$ for metal plating,

$b_w = 20\,g$ for concrete structure plating,

g – plating thickness, [cm].

Adopted values $e + 2\ b_w$ shown in Fig. 2.4.3 are not to be greater than the stiffener spacing or 1/6 of the respective stiffener span.

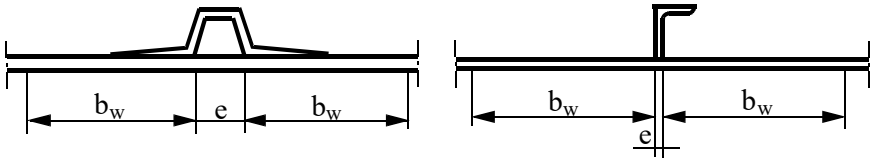


Fig. 2.4.3

For stiffener laid at the plating edge, width of the co-acting stripe *aw* shall be calculated according to formula:

$$a_w = k_E\left(e + b_w\right), \quad [\text{cm}] \tag{2.4.3-2}$$

2.4.4 The required section moduli are given for continuous stiffeners with firmly fixed ends. The required section modulus shall be kept on the whole length of the stiffener, especially in its support points.

2.4.5 In the case of a stiffener of simply supported ends, the required section modulus shall be increased by 50%. Such increased modulus shall be kept in the central part of stiffener and can be reduced towards the ends.

2.4.6 The parts of internal furniture can be considered as stiffeners, provided that they comply with the requirements specified for stiffeners.

2.5 Design loads

2.5.1 General

The calculation of hull plating and stiffeners is based on the multi-support beam scheme subjected to uniform hydrostatic load. The design load is the height of water column. The water column height is calculated to the lowest edge of the considered plating shell – for plating, and to the centre of the stiffener span – for stiffeners. Deviations from this requirement are given each time in appropriate paragraphs of the *Rules*.

2.5.2 Load of bottom

The total hydrostatic load of bottom should be assumed from the below formula:

$$h = 0{,}8k_{sd}\ (h_s + 0{,}05L_H + 0{,}5), \quad [\text{m}] \tag{2.5.2-1}$$

k_{sd} – coefficient of distribution of static load of bottom, changing according to Fig. 2.5.2-1,

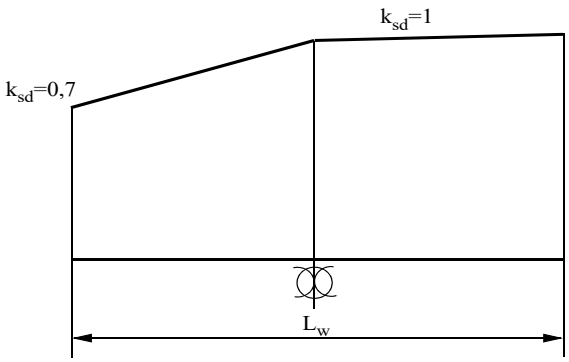


Fig. 2.5.2-1

h_s – vertical distance from the calculated part of the structure to the edge at the joint between the houseboat side and the main or superstructure deck in the considered place, [m],

2.5.3 Load of sides

The total hydrostatic load of sides *h* shall be assumed from the formula:

$$h = 0{,}85k_{sb}\,(h_s + 0{,}05L_H + 0{,}5)\ \ ,\ \ [\text{m}] \qquad (2.5.3\text{-}1)$$

k_{sb} coefficient of distribution of static load of sides, changing according to Fig. 2.5.3,

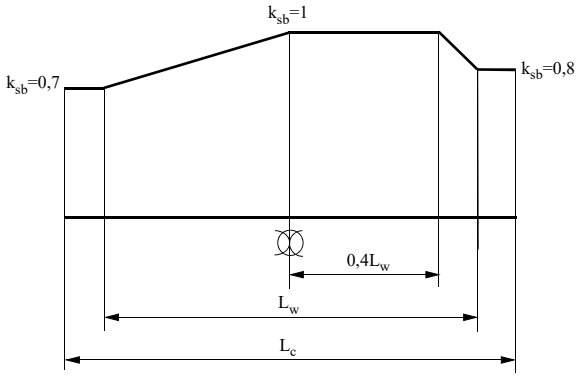


Fig. 2.5.3

h_s, – see 2.5.2.

2.5.4 Load of superstructures

Load of superstructure side walls shall be calculated as the load of sides in the same area.

2.5.5 Load of deck

Hydrostatic load of deck *h* shall be calculated from the formula:

$$h = 0{,}8k_{sp}\,k_p\,(0{,}05L_H + 0{,}5)\ [\text{m}] \qquad (2.5.5)$$

k_{sp} – coefficient of longitudinal distribution of load, changing according to Fig. 2.5.5.

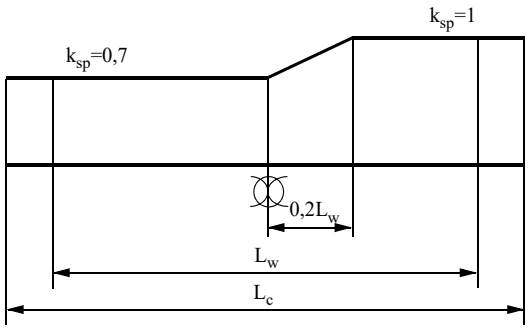


Fig. 2.5.5

k_p – coefficient of distribution of loads of deckhouses:

k_p = 1.0 for the main or superstructure deck.

2.5.6 Load of bulkheads

Load of bulkheads *h* shall be calculated from the formula:

$$h = 0{,}88\ (h_g + 0{,}05L_H + 0{,}5),\ [\text{m}] \qquad (2.5.6)$$

h_g – the vertical distance from the calculated fragment of the bulkhead structure to the deck above the bulkhead, [m].

2.5.7 Load of tanks

Load of integral water or sewage tanks h shall be calculated from the formula:

$$h = 0{,}94\gamma\left(h_z + 0{,}6h_p + 1\right),\quad [\text{m}] \qquad (2.5.7)$$

γ – a specific mass of liquid in the tank, [g/cm^3],

h_z – the vertical distance from the calculated part to the tank top, [m],

h_p – the height of air venting pipe above the tank top, [m].

2.6 Glass reinforced plastic structures

2.6.1 General requirements

2.6.1.1 Requirements of these *Rules* apply to GRP structures. The materials of which glass reinforced plastics are made shall meet the requirements specified in Chapter 7 *"Materials"*.

2.6.1.2 Other structural materials, such as steel, aluminium and copper alloys, etc., used for the construction shall meet the requirements specified in Chapter 7 "Materials". Satisfactory joints between additional materials and the laminate shall be ensured by a proper selection of materials, choice of joint or a proper treatment of its surface. Metal alloys containing copper shall not be used in a direct contact with polyester resins.

2.6.1.3 Constructions of laminates other than GRP shall be considered by PRS individually.

2.6.2 Construction process of glass reinforced plastic structures

2.6.2.1 The requirements contained in the *Rules* are related to the glass reinforced laminates shaped by manual contact method. Other methods of grp structures performance shall be considered individually by PRS.

2.6.3 Stores

2.6.3.1 The resins shall be stored in hermetically closed containers (preferably in original factory package), in a place without access of light and in the temperature recommended by the manufacturer. The storage time of each resin is not to exceed its warranty period.

2.6.3.2 Initiators and accelerants shall be stored in cool, dry, clean and well ventilated spaces.

2.6.3.3 All resin additives shall be stored in closed containers and protected against dust and humidity.

2.6.3.4 Reinforcement materials shall be stored in original packages in dry and dust-free spaces.

2.6.3.5 All the materials, prior to their using, shall be brought to the temperature not less than the temperature existing in the production space.

2.6.4 Production spaces

2.6.4.1 In respect of size and type of production, the production space shall be properly separated from the storage spaces. Various cycles of the construction process (such as: preparation of resin, reinforcement cutting, laminating) shall be carried out in separate but adjacent spaces.

2.6.4.2 Production space should enable to maintain constant temperature within l6–25°C. In exceptional cases the temperature can be lowered to 12°C but not during laminating or gelation of any structural part of the hull and not earlier than 12 hours after resin gelation. Period of time of lowered temperature should be minimized with respect to the construction weight and the period of time from the latest lamination.

2.6.4.3 Production space floor shall be clean and shall not emit the dust. It shall be kept as clean as practicable. The air in the space shall be dust-free. Particularly the dust of substances affecting the polymerization process or separating the laminated parts shall be avoided. Dust emitting machines cannot be used in the production space.

2.6.4.4 The relative humidity in the space shall not, in general, exceed 70 %. For short periods of time, the relative humidity up to 85 % can be accepted.

2.6.4.5 Continuous temperature and humidity control in the production space shall be provided.

2.6.4.6 Ventilating system used in the production space should not cause excessive vaporization of styrene.

2.6.4.7 Laminated parts shall be protected against sun radiation.

2.6.5 Moulds

2.6.5.1 Materials used for moulds cannot affect the resin polymerization process.

2.6.5.2 The moulds shall be of sufficient rigidity and their shape should enable easy removal of the moulded part from the mould.

2.6.5.3 Big moulds shall he provided with proper stagings enabling access to the whole laminated surface.

2.6.5.4 It is recommended, particularly for bigger hulls, to use rotable (or swinging) moulds in order to enable the downhand laminating.

2.6.5.5 Construction of yachts without hull moulds shall be considered by PRS individually.

2.6.6 Laminating

2.6.6.1 Resin for gelcoat and for structural layers of laminate shall be prepared according to the manufacturer's recommendations.

2.6.6.2 Gelating time of the resin is not to exceed 1 hour. Each alteration of gelating time should be controlled by alteration of accelerant quantity without altering the recommended quantity of the initiator.

2.6.6.3 Glass reinforcement should be used in as large sections as possible. It is recommended to use mats with torn out rather than cut out edges.

2.6.6.4 Continuous control of resin-reinforcement proportion shall be ensured during the whole laminating process. When preparing the glass mats for lamination process, the mass of binder shall be taken into consideration (the binder mass shall be subtracted from the total mass of the reinforcement).

2.6.6.5 Prior to beginning the hull plating laminating, the moulds shall be thoroughly cleaned, dried and brought to the space temperature. The lutes used for maintenance of the moulds and the separating agents cannot react chemically with the resins.

2.6.6.6 Gelcoat layer can be put on with the use of brush, roller or spraying device. Generally, the gelcoat layer thickness shall be within 0.4 – 0.6 mm.

2.6.6.7 Gelcoat layer, after a period of time not longer than 6 hours (after hardening), shall be coated with the first layer of the laminate reinforced with light fabric or mat of surface mass not greater than 300 g/m^2. This layer should be particularly well deaerated, the glass content being 20 - 30 %.

2.6.6.8 Laminating of proper structural layers shall be made manually with contact method using soft and hard rollers and brushes. Laminating method of spraying resin together with the cut roving needs separate agreement with PRS.

2.6.6.9 Laminating shall be carried out without pauses ("wet to wet"). If the pauses occur and are longer than 24 h, the contact surface should be properly prepared by grinding or by putting on formerly a polyamide fabric, which is torn off before the next layer is laid on.

2.6.6.10 The successive layers of reinforcement shall be laid on without waiting until the resin of the former layer becomes hardened. Too great number of laminate layers should not be laid because this can produce overheating of the laminate.

2.6.6.11 If laminating is stopped in such a moment that the last resin layer has been already hardened, then the first of the successive layers should be begun with the glass mat. It is also recommended to use mat for the last layer of laminate in the bottom area.

2.6.6.12 Reinforcement overlap width of the same layer is not to be less than 50 mm. The overlaps should be shifted in relation to these belonging to other layers by at least 100 mm.

2.6.6.13 Steps of the reinforcement content in the laminate are not to exceed 600 g/m^2 for each 25 mm of the transient band width.

2.6.6.14 Edges of materials such as wood, plywood, metals and core foams, laminated into the plating, shall be tapered.

2.6.7 Hardening

2.6.7.1 Upon the completion of the laminating, the hull parts shall be left in the moulds for the time necessary for initial hardening of the laminate. This time cannot be shorter than 24 hours.

2.6.7.2 Parts removed directly from the moulds shall be properly supported or joined with other parts in the way preventing their distortion before acquiring the proper rigidity.

2.6.7.3 Upon the completion of the laminating, the hull parts shall be left in the production space or other room of temperature not less than 16° C, until a proper hardness (about 35 - 40 acc. to Barcol) is attained. If the hardness cannot be measured, then the hardening time may be assumed as:

30 days in 16°C,

15 days in 25°C,

15 hours in 40°C,

9 hours in 50°C,

5 hours in 60°C.

Heating of the hull is recommended. Abrupt changes of the temperature should be avoided. Gradual raising of the temperature shall be carried out according to the resin manufacturer's recommendations. The air in the heating room shall be properly dried and the hull shall be properly supported during the heating process. The thermal resistance temperature of laminate or core foam used for the hull construction must not be exceeded.

2.6.8 Quality control

2.6.8.1 The whole laminating process shall be constantly controlled for the compliance with:
- the requirements of 2.6.3 – as regards storing of materials,
- the requirements of 2.6.4 – as regards production spaces,
- the requirements of 2.6.5 – as regards condition of moulds,
- the requirements of 2.6.6 and 2.6.7 – as regards GRP moulding and hardening process,
- the approved classification documentation – as regards succession, type and number of put-on glass reinforcement layers. In the case of disclosed defects, the corrective means shall be taken. Any repairs can be performed in the way previously agreed with PRS surveyor.

2.6.8.2 In well-grounded cases, PRS may require from the builder to submit the results of the control panel GRP test in order to determine strength properties according to Chapter 7 – *Materials*:
- for each houseboat built individually,
- for a houseboat selected by the Surveyor in the case of houseboats built in series.

2.6.8.3 A control panel should have dimensions of 400 x 500 mm. Its construction and thickness should exactly correspond to the plating laminate. The control panel hardening process shall be identical with the houseboat hull hardening. After having agreed that with PRS Surveyor, pieces of plating obtained while cutting out significant holes can be regarded as samples.

The control panel should be made by the same persons that make the hull, in the conditions corresponding to those of the laminating process and of the same materials as the hull.

2.6.8.4 Tests of control panel samples shall be carried out in the PRS–recognized laboratory. The test report should contain the following:

Hardened GRP properties	Test acc. to the standard
Glass reinforcement content, [%]	**PN-EN ISO 1172:2000**
Tensile strength, [MPa]	**PN-EN ISO 527-4, -5:2000**
Tensile Young's modulus, [MPa]	**PN-EN ISO 527-4, -5:2000**
Bending strength, [MPa]	**PN-EN ISO 178:2011**
Bending Young's modulus, [MPa]	**PN-EN ISO 178:2011**
Hardness acc. to Barcol	**ASTM*)/D 2583-87**

*) American Society for Testing Materials

2.6.8.5 If needed, depending on the houseboat purpose, the scope of samples examination may be extended by water absorption examinations, flammability and diesel oil, sea water and UV radiation resistance. .

During bending test, the sample shall be loaded so that the gelcoat is expanded.

2.6.9 Properties of laminate

2.6.9.1 Laminates reinforced with glass mats shall have the reinforcement content within 28 – 35 % with respect to the mass of laminate.

2.6.9.2 Laminates with alternate reinforcement (mats with other reinforcements alternatively) shall have the reinforcement content z within the following limits:

$$z_{\min} = \frac{M_{zb}}{3{,}6\ M_M + 2{,}2\ M_T + 2{,}0\ M_K}\ 100\% \qquad (2.6.9.2\text{-}1)$$

$$z_{\max} = \frac{M_{zb}}{3{,}0\ M_M + 1{,}65\ M_T + 1{,}5\ M_K}\ 100\% \qquad (2.6.9.2\text{-}2)$$

M_{zb} total mass of reinforcement in laminate, [g/m^2],

M_M mass of mat reinforcement, [g/m^2],

M_T mass of fabric reinforcement, [g/m^2],

M_K mass of unidirectional reinforcement, [g/m^2].

2.6.9.3 The use of laminates of glass reinforcement content other than specified above is separately considered by PRS.

2.6.10 Laminate thickness

2.6.10.1 For average correct handwork, the laminate thickness g shall approach value:

$$g = \frac{M_{zb}}{1000}\left(\frac{83}{z} - 0{,}44\right), \quad [\text{mm}] \qquad (2.6.10.1)$$

M_{zb} total mass of reinforcement in laminate, [g/m^2],

z reinforcement content in laminate.

2.6.11 Mechanical properties

2.6.11.1 The mechanical properties of laminates reinforced with glass mats: tensile strength R_m, bending strength R_g, Tensile Young's modulus E_m and Bending Young's modulus E_g shall have values not less than determined from the below formulae:

$$R_m = 4z - 30, \quad [\text{MPa}] \qquad (2.6.11.1\text{-}1)$$

$$R_g = 4z + 35, \quad [\text{MPa}] \qquad (2.6.11.1\text{-}2)$$

$$E_m = 200z + 1000, \quad [\text{MPa}] \qquad (2.6.11.1\text{-}3)$$

$$E_g = 200z + 500, \quad [\text{MPa}] \qquad (2.6.11.1\text{-}4)$$

z – reinforcement content in laminate.

For detailed values, see Table 2.6.11.1:

Table 2.6.11.1
Properties of mat reinforced laminates

Reinforcement **Content [%]**	Reinforcement quantity for 1 mm of thickness [g/m²]	Specific mass of laminate [g/m²]	R_m [MPa]	R_g [MPa]	E_m [MPa]	E_g [MPa]
28	**396**	**1.41**	**82**	**147**	**6600**	**6100**
29	**413**	**1.42**	**86**	**151**	**6800**	**6300**
30	**430**	**1.43**	**90**	**155**	**7000**	**6500**
31	**447**	**1.44**	**94**	**159**	**7200**	**6700**
32	**464**	**1.45**	**98**	**163**	**7400**	**6900**
33	**482**	**1.46**	**102**	**167**	**7600**	**7100**
34	**500**	**1.47**	**106**	**171**	**7800**	**7300**
35	**518**	**1.48**	**110**	**175**	**8000**	**7500**

2.6.11.2 Mechanical properties of laminates with alternate reinforcement at uniform distribution of along thickness of mat and fabric layers: tensile strength R_m, bending strength R_g, Tensile Young's modulus E_m and Bending Young's modulus E_g shall have values not less than determined from the below formulae:

$$R_m = 0{,}19z^2 - 10z + 210, \quad \text{[MPa]} \qquad (2.6.11.2\text{-}1)$$

$$R_g = 0{,}19z^2 - 10z + 270, \quad \text{[MPa]} \qquad (2.6.11.2\text{-}2)$$

$$E_m = 400z - 5800, \quad \text{[MPa]} \qquad (2.6.11.2\text{-}3)$$

$$E_g = 12z^2 - 750z + 18400, \quad \text{[MPa]} \qquad (2.6.11.2\text{-}4)$$

z – reinforcement content in laminate.

For detailed values, see Table 2.6.11.2:

2.6.11.3 Mechanical properties specified in 2.6.11.1 and 2.6.11.2 are minimum values for the control panel samples hardened according to 2.6.7.3. If the plating reinforcement uses unsymmetrical or unidirectional fabrics, the laminate properties shall be considered individually by PRS based on the properties of control plate, direction of reinforcements in relation to shorter side of the plate, direction of stiffening and direction of general hull bending.

Table 2.6.11.2
Properties of laminates with alternate reinforcement

Reinforce-ment content [%]	Reinforcement quantity for 1 mm of **thickness [g/m²]**	Specific mass of **lami-nate [g/m²]**	R_m **[MPa]**	R_g **[MPa]**	E_m **[MPa]**	E_g **[MPa]**
35	**518**	**1.48**	**93**	**153**	**8 200**	**6 850**
36	**536**	**1.49**	**96**	**156**	**8 600**	**6 952**
37	**555**	**1.50**	**100**	**160**	**9 000**	**7 078**
38	**573**	**1.51**	**104**	**164**	**9 400**	**7 228**
39	**592**	**1.52**	**109**	**169**	**9 800**	**7 402**
40	**612**	**1.53**	**114**	**174**	**10 200**	**7 600**
41	**631**	**1.54**	**119**	**179**	**10 600**	**7 822**
42	**651**	**1.55**	**125**	**185**	**11 000**	**8 068**
43	**671**	**1.56**	**131**	**191**	**11 400**	**8 338**
44	**691**	**1.57**	**138**	**198**	**11 800**	**8 632**
45	**712**	**1.58**	**145**	**205**	**12 200**	**8 950**
46	**733**	**1.59**	**152**	**212**	**12 600**	**9 292**
47	**754**	**1.60**	**160**	**220**	**13 000**	**9 658**
48	**776**	**1.62**	**168**	**228**	**13 400**	**10 048**
49	**796**	**1.63**	**176**	**236**	**13 800**	**10 462**
50	**820**	**1.64**	**185**	**245**	**14 200**	**10 900**

2.6.12 Rule laminate

2.6.12.1 The requirements given in further chapters refer to rule laminate of reinforcement content z = 34 % (about 500 g/m² of reinforcement for 1 mm of the laminate thickness) with the following strength properties:

R_m = 106 MPa,
R_g = 171 MPa,
E_m = 7800 MPa,
E_g = 7300 MPa.

2.6.12.2 For laminates of reinforcement content lower than 34 %, the required mass of glass reinforcement may be calculated as for the rule laminate.

2.6.12.3 For laminate of reinforcement content higher than 34 %, the required mass of glass reinforcement M_1 for plating shall be calculated according to the following formulae:

– for strength criterion:

$$M_1 = M\frac{z}{41{,}5 - 0{,}22\,z}\sqrt{\frac{171}{R_g}}\ , \quad [\text{g/m}^2] \qquad (2.6.12.3\text{-}1)$$

– for rigidity criterion:

$$M_1 = M \frac{z}{41{,}5 - 0{,}22\, z} \sqrt[3]{\frac{7300}{E_g}}\ , \quad [\mathrm{g/m^2}] \qquad (2.6.12.3\text{-}2)$$

M – required rule mass of reinforcement, [g/m²],
z – true content of reinforcement in the laminate,
R_g – design bending strength of the laminate, [MPa],
E_g – design Young's bending modulus, [MPa].

The following criteria shall be assumed as design strength and design Young's bending modulus:
– 90% of appropriate values obtained during strength tests of control panels of applied laminate (if such tests were performed prior to construction commencement), or
– appropriate values given in Table 2.6.11.2 for reinforcement content z_{max} calculated from the formula 2.6.9.2-2 (if no strength tests were performed prior to construction commencement).

Required section modulus W_1 and inertia moments I_1 for stiffenings shall be calculated in a similar way:

$$W_1 = W \frac{171}{R_g}\ , \quad [\mathrm{cm^3}] \qquad (2.6.12.3\text{-}3)$$

$$I_1 = I \frac{7300}{E_g}\ , \quad [\mathrm{cm^4}] \qquad (2.6.12.3\text{-}4)$$

W – rule bending section modulus, [cm³],
I – rule moment of inertia of stiffening, [cm⁴].

2.6.13 GRP plating

2.6.13.1 Bottom and sides plating of a houseboat shall meet all the following criteria specified in Table 2.6.13.1 for all plating areas indicated in Fig. 2.6.13.1.

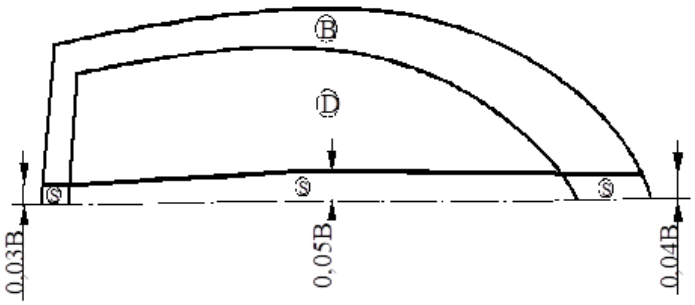


Fig. 2.6.13.1

Table 2.6.13.1
Rule reinforcement mass for bottom and sides of a houseboat, [g/m²]

Plating area		Criterion			Other require-ments
		Bending strength	Rigidity	Min. mass of reinforce-ment	
Keel	**K**	**6.0 *ak*** $\sqrt{h}$	**7.2 *ak*** $\sqrt[3]{h}$	**1350** $\sqrt{L_H}$	**2.6.13.2**

Bottom	**D**	**4.6 *ak*** $\sqrt{h}$	**5.5 *ak*** $\sqrt[3]{h}$	**920** $\sqrt{L_H}$	**2.6.13.3**
Sides	**B**	**4.6 *ak*** $\sqrt{h}$	**4.8 *ak*** $\sqrt[3]{h}$	**750** $\sqrt{L_H}$	**2.6.13.3**
Transom		**4.6 *ak*** $\sqrt{h}$	**4.8 *ak*** $\sqrt[3]{h}$	**750** $\sqrt{L_H}$	**2.6.13.5**

a – breadth of plating shell, [mm],

$k = k_k \cdot k_p$ acc. to 2.3.3 and 2.3.4,

h – load height acc. to 2.5.

2.6.13.2 If the hull plating is composed of halves, the keel strake reinforcement shall be increased by 100 per cent in respect of the bottom plating and its width shall be not less than 0.1 *B* or 70 x bottom thickness.

2.6.13.3 Sharp plating edges, which create shell plating stiffenings or other sharp corners exposed to damage shall have reinforcement increased by 50 per cent at the width at least 0.025 B, as shown in Fig. 2.6.13.3.

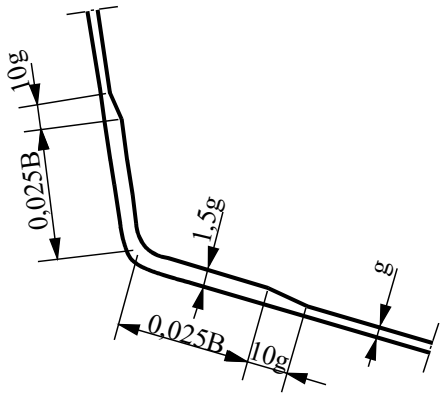


Fig. 2.6.13.3

2.6.13.4 Bottom plating shall be brought at least 150 mm above the designed water line.

2.6.13.5 Transom plating reinforcement shall be not less than the reinforcement of sides. If an outboard motor is used, then the transom shall be additionally strengthened by increasing the plating thickness, additional stiffenings or laminating a plywood plate into the transom plating. The recommendations of outboard engine manufacturer shall be observed.

The transom plating thickness, on which an outboard engine is mounted should not be less than that given in Table 2.6.13.5.

Table 2.6.13.5

Thickness of transom plating carrying an outboard motor

Outboard **motor power [kW]**	Plywood core **thickness [mm]**	Total transom **thickness [mm]**
Up to 7	**–**	**15**
7 – 18	**15**	**25**
18 – 30	**20**	**30**

30 – 40	**25**	**35**
40 – 90	**30**	**40**
over 90	Construction to be considered individually	

2.6.13.6 All other fragments of bottom and side plating subjected to increased load or abrasion shall be properly strengthened. Similar requirements are applied to the plating around bigger openings.
Plating with increased reinforcement shall be brought to the nearest longitudinal or transversal stiffenings.

2.6.14 Deck and erection

2.6.14.1 Deck and erection plating shall meet the criteria specified in Table 2.6.14.1.

Table 2.6.14.1
Rule reinforcement mass for deck and erection, [g/m²]

Plating area	**Criterion**		
	Bending **strength**	**Rigidity**	Min. mass of **reinforcement**
Main deck	**5,0 *ak*** $\sqrt{h}$	**5,4 *ak*** $\sqrt[3]{h}$	**640** $\sqrt{L_H}$
Superstructure deck	**5,0 *ak*** $\sqrt{h}$	**5,4 *ak*** $\sqrt[3]{h}$	**640** $\sqrt{L_H}$
Superstructure walls	**4,6 *ak*** $\sqrt{h}$	**4,8 *ak*** $\sqrt[3]{h}$	**700** $\sqrt{L_H}$

a – plating shell breadth, [mm],
$k = k_k \cdot k_p$ acc. to 2.3.3 and 2.3.4,
h – load height acc. to 2.5.

2.6.14.2 It is recommended to increase the stiffness of erection plating subjected to load of walking crew above the requirements specified in 2.6.14.2 and to ensure that the rule reinforcement mass M is not less than determined from the formula:

$$M = 6{,}2ak, \quad [\mathrm{g/m^2}] \qquad (2.6.14.2)$$

a, k – acc. to 2.6.14.1.

2.6.14.3 In the area where the deck equipment is fastened to the plating, the plating shall be strengthened considering existing loads. Laminating plywood is permitted upon agreeing technology with PRS.

2.6.14.4 All the openings in the deck and superstructure shall have rounded corners and edges stiffened with coamings. In the vicinity of big openings, particularly near the corners, the plating shall be adequately strengthened.

The strengthened plating with a closed opening shall have the strength and rigidity at least equal to those of the non-strengthened plating without openings.

2.6.15 Bulkheads and tanks

2.6.15.1 Plating of bulkheads and tanks shall meet the criteria mentioned in Table 2.6.15.1.

Table 2.6.15.1
Rule mass of reinforcement for bulkheads and tanks, [g/m²]

Plating area	Criterion		
	Bending strength	Rigidity	Min. mass of reinforcement
Bulkheads	$4.2\,ak\sqrt{h}$	$4.8\,ak\sqrt[3]{h}$	$550\sqrt{L_H}$
Side walls of tanks (or sides)	$5.4\,ak\sqrt{h}$	$6.3\,ak\sqrt[3]{h}$	2400
Deck above tank	$5.0\,ak\sqrt{h}$	$6.3\,ak\sqrt[3]{h}$	2400

a – plating shell breadth, [mm],

$k = k_k \cdot k_p$ acc. to 2.3.3 and 2.3.4,

h – load height acc. to 2.5.

2.6.16 Sandwich Plating

2.6.16.1 Sandwich plating can be used for sides, deck, erections and bulkheads instead of massive plating. Sandwich plating can be used also for bottom, excluding the areas in vicinity of ballast and engine bed.

In the areas subjected to increased loads, the sandwich plating should pass into a massive one or a proper filling is to be used.

2.6.16.2 Bending section modulus W for 1 mm wide plating bend, calculated for claddings should not be less than the following value:

– for bottom, sides, deck and tanks:

$$W = 19{,}5\,h\left(\frac{a}{1000}\right)^2, \quad [\text{mm}^3] \qquad (2.6.16.2\text{-}1)$$

– for erections and bulkheads:

$$W = 15{,}6\,h\left(\frac{a}{1000}\right)^2, \quad [\text{mm}^3] \qquad (2.6.16.2\text{-}2)$$

h – load height acc. to 2.5;

a – plating shell breadth, [mm].

2.6.16.3 Thickness g_p of sandwich plating should not be less than:

$$g_p = k_R\, h \frac{a}{100 R_t}, \quad \text{[mm]} \qquad (2.6.16.3)$$

k_R – core material coefficient:

$k_R = 0{,}89$ for balsa wood,

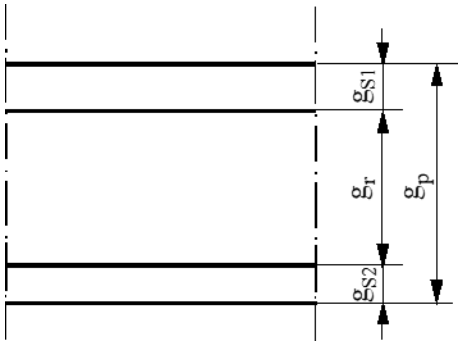
$k_{R\min} = 0{,}61 + \frac{0{,}35}{\sqrt{n}}$ for other core materials,

$k_{R\min} = 0{,}7$,

n – coefficient of relative core thickness acc. to Fig. 2.6.16.3,

h, a – acc. to 2.6.16.2,

R_t – shear strength of core, [MPa],



g_r - core thickness, [mm],
g_{s1}, g_{s2} - cladding thickness, [mm],

$$n = \frac{g_r}{0{,}5\left(g_{s1} + g_{s2}\right)},$$

Fig. 2.6.16.3

2.6.16.4 Designed relative sandwich plating shell deflection δ shall not exceed the following value:

$$\delta = \frac{ha^3}{384 E_p I_p} + \frac{ha}{8 G_r g_r} \le \delta_d \qquad (2.6.16.4)$$

h, a – acc. to 2.6.14.1,

E_p – bending Young's modulus of cladding, [MPa],

I_p – moment of inertia for 1 mm wide plating band, calculated for cladding, [mm^4],

G_r – modulus of rigidity of core, [MPa],

g_r – acc. to Fig. 2.6.16.3,

δ_d – permissible relative plating shell deflection:

δ_d = 1.5 for bottom, main deck, fragments of sides with small curvature and for these parts of the erection which are subjected to direct load of walking occupants,

δ_d = 3.0 for curved fragments of sides and for deckhouse decks.

2.6.16.5 External layer of the laminate shall have the reinforcement M not less than:

– for bottom and sides $M = 360\sqrt{L_H}$, [g/m^2],
– for main deck $M = 320\sqrt{L_H}$, [g/m^2],
– for erection and bulkheads $M = 300\sqrt{L_H}$, [g/m^2],

– for tank walls $M = 900$, [g/m^2].

2.6.16.6 Where laminate of other than rule properties has been applied for sandwich plating, the required sandwich plating section modulus shall be calculated according to formula 2.6.12.3-3.

2.6.17 GRP stiffeners

2.6.17.1 Section moduli W and moments of inertia I of the stiffeners with co-acting stripes of plate laminate are to be not less than the values given in Table 2.6.17.1.

Table 2.6.17.1

Stiffeners	W, [cm^3]	I, [cm^4]
Bottom longitudinals	**13.6 *hsl*^{2}**	**26.0 *hsl*^{2}**
Floors	**13.6 *hsl*^{2}**	**22.8 *hsl*^{2}**
Side longitudinals	**11.7 *hsl*^{2}**	**26.0 *hsl*^{2}**
Frames	**10.3 *hsl*^{2}**	**22.8 *hsl*^{2}**
Deck longitudinals	**10.3 *hsl*^{2}**	**26.0 *hsl*^{2}**
Beams	**9.7 *hsl*^{2}**	**22.8 *hsl*^{2}**
Web frames	**13.6 *hsl*^{2}**	**22.8 *hsl*^{2}**
Bulkhead stiffeners	**9.7 *hsl*^{2}**	**22.8 *hsl*^{2}**

h – load height acc. to 2.5.,

s – supported breadth of the plating, [m],

l – unsupported length of the stiffener, [m].

2.6.17.2 The stiffeners shall be properly strengthened in areas where parts of equipment are fastened, as well as in vicinity of big openings of stiffener.

2.6.18 Bottom Stiffeners

2.6.18.1 The houseboat bottom shall be stiffened transversely, longitudinally or both.

2.6.18.2 Fore part of the bottom – from stem to midship section shall be stiffened with floors meeting the requirements specified in 2.6.17.1, assuming the unsupported length to be not less than 0.4 B.

2.6.19 Web Frames

2.6.19.1 The applied web frames are to be a continuous construction connecting floors, frames and beams and should meet the requirements of 2.6.17.1, assuming that the values of unsupported lengths of the stiffeners *l* are to be not less than:
- distance from the centre line of the bottom to the bilge/sharp edge bottom-side (for bottom part of the web frame),
- distance from side-deck edge to the bilge/ sharp edge bottom-side (for the frame part),
- half of the deck breadth in the place under consideration (for the beam part).

If the pillars are used inside the web frame, then the design unsupported length of stiffener *l* is to be reduced accordingly.
The joint of frames with beams and floors shall have the strength at least of the weaker item. The connections shall be separately considered by PRS.

2.6.20 Design Requirements

2.6.20.1 Mass of reinforcement of trapezoidal stiffeners web *M* shall be not less than:

$$M = 10d + 450, \quad [\mathrm{g/m^2}] \qquad (2.6.20.1\text{-}1)$$

d – height of stiffener, [mm].

Web or T-type or angle type stiffener is to have mass of reinforcement two times greater than that specified above.

Stiffener stringer reinforcement *M* is to be not less than:

$$M = 15m + 450, \quad [\mathrm{g/m^2}] \qquad (2.6.20.1\text{-}2)$$

m – width of stringer, [mm].

2.6.20.2 If, due to design considerations, the stiffeners are considerably higher than those required by the *Rules*, then the requirements specified in 2.6.20.1 can be dispensed with, provided that the stiffening surfaces are secured against buckling.

2.6.20.3 If fully prefabricated stiffeners are used, then their laminating to the plating M_B is to meet the condition:

$$M_B = 10d + 450, \quad [\mathrm{g/m^2}] \qquad (2.6.20.3)$$

2.6.20.4 Transversal and longitudinal partitions can be considered as stiffeners, provided that they are properly secured against buckling and are properly laminated to the plating.

2.6.20.5 Internal plating elements (inserted modules) can be considered as stiffeners,provided that the requirements specified in 2.6.17 ÷ 2.6.20.3 are complied with.

2.6.20.6 When using trapezoid and other closed profile stiffening, it is recommended to fill them with closed cell type foam. It is not recommended for stiffeners and it is not permitted for bottom stiffeners to be made of wood or plywood cladded fully with laminate.

2.6.20.7 For approximate values of stiffener section modulus W, assuming that the stringer reinforcement is the same as for effective strake/plating strake, see Table 2.6.20.7. In the case the differences are high, PRS shall consider the requirements for section modulus individually.

Table 2.6.20.7

Approximate values of stiffener section modulus, [cm³]

Stiffener height [mm]	Plating reinforcement, [g/m²]	Stiffener web reinforcement x stringer width: [kg/m²] x [mm]								
		80	160	240	320	400	560	720	800	960
1	2	3	4	5	6	7	8	9	10	11
20	2000	5,3	10	15	20	24	32	–	–	–
	4000	6,6	12	17	23	28	38	48	54	66
	6000	–	15	21	27	33	44	55	62	75
	8000	–	–	26	31	38	51	63	71	85
40	2000	11	19	28	36	43	58	–	–	–
	4000	12	21	31	40	49	66	83	91	108
	6000	14	24	34	43	53	72	91	100	119
	8000	–	27	37	48	58	78	98	109	129
60	2000	19	31	43	54	66	87	–	–	–
	4000	21	34	48	59	71	96	120	132	155
	6000	23	36	50	63	78	103	129	142	167
	8000	25	40	53	67	81	110	137	151	178
80	2000	30	46	60	75	89	118	–	–	–
	4000	33	50	65	81	97	130	161	175	205
	6000	35	53	69	86	103	137	170	186	219
	8000	38	56	74	91	109	145	180	197	231
100	2000	41	60	78	95	114	150	–	–	–
	4000	44	65	84	103	123	163	201	219	254
	6000	47	69	89	109	130	171	212	231	270
	8000	50	75	93	114	136	179	222	242	283
120	2000	59	81	102	122	144	186	–	–	–
	4000	64	88	110	132	156	202	248	268	310
	6000	68	93	116	139	164	213	261	283	328
	8000	72	98	122	146	171	222	272	295	343
150	2000	91	118	143	167	194	246	–	–	–

	4000	89	129	155	181	210	267	323	348	398
	6000	105	136	163	191	221	281	340	366	421
	8000	110	142	170	199	230	292	363	380	438
180	2000	133	165	193	221	252	314	–	–	–
	4000	146	180	210	241	274	341	408	436	496
	6000	154	190	222	254	289	369	429	456	522
	8000	162	198	231	264	301	373	445	476	543
1	2	3	4	5	6	7	8	9	10	11
210	2000	202	238	269	300	336	407	–	–	–
	4000	221	260	294	327	366	442	518	549	617
	6000	235	276	311	346	386	466	545	578	550
	8000	247	288	325	361	402	485	567	602	677
240	2000	252	293	328	362	403	483	–	–	–
	4000	277	321	358	395	439	525	611	646	722
	6000	294	340	379	418	463	553	643	680	761
	8000	308	355	395	438	483	575	688	707	791
270	2000	332	378	415	453	498	597	–	–	–
	4000	364	413	453	494	542	637	732	770	854
	6000	387	437	480	522	572	672	771	812	901
	8000	405	457	501	545	597	699	802	844	937
300	2000	397	447	489	530	579	677	–	–	–
	4000	436	489	533	578	630	736	839	881	974

	6000	463	518	565	611	666	775	884	929	1047
	8000	484	541	590	638	694	807	919	966	1068
330	2000	503	558	602	646	700	807	–	–	–
	4000	551	608	656	703	760	874	987	1032	1131
	6000	585	645	696	744	803	922	1040	1087	1193
	8000	613	678	726	777	838	960	1082	1131	1241
360	2000	584	644	691	738	797	912	–	–	–
	4000	639	702	763	803	865	988	1101	1159	1267
	6000	680	744	798	851	915	1043	1171	1222	1335
	8000	712	778	833	889	955	1087	1218	1271	1389

2.6.21 General strength of GRP hull

2.6.21.1 The general strength of the structure of the hull shall be checked with respect to the houseboats of length more than 12 m, with sandwich plating of deck and sides.

2.6.21.2 The general strength is to be checked by calculating hull bending section modulus at midship.

2.6.21.3 The general strength of the multi-hull houseboat shall be individually considered by PRS.

2.6.22 Hull Bending Section Modulus

2.6.22.1 The Rule hull bending section modulus W_k should not be less than:

$$W_k = 47\, L_W^2 B_W \left(C_b + 0{,}7\right), \text{ [cm}^3\text{]} \qquad (2.6.22.1)$$

B_w – houseboat breadth at waterline, [m],
C_b – block coefficient of the submerged part of the hull.

2.6.22.2 Formula 2.6.22.1 refers to rule laminate (see 2.6.12). The cross section areas of hulls made of other type of laminate are to be multiplied by the coefficient k:

$$k = \frac{E_g}{7300} \qquad (2.6.22.2)$$

E_g – Young's bending modulus for plating and longitudinals stiffeners, [MPa].

2.6.23 Butt joints with grp plating

2.6.23.1 The examples given below are to be considered as recommended design solutions. Other solutions can be accepted after the equivalence of the joint strength has been stated.

2.6.23.2 Step by step chamfered butt joints have better strength properties, as shown in Fig. 2.6.23.2.

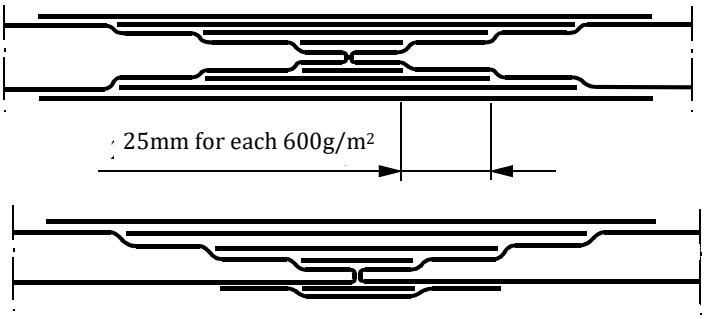


Fig. 2.6.23.2

2.6.23.3 Less loaded elements can be joined without chamfering, as shown in Fig. 2.6.23.3. Number of layers of the joining laminate both sides shall be not less than the number of layers of thinner of the joined elements.

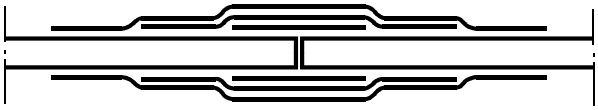


Fig. 2.6.23.3

2.6.23.4 When joining elements of different thickness, the thickness of the thicker element shall be gradually reduced before the joint area, as shown in Fig. 2.6.23.4.

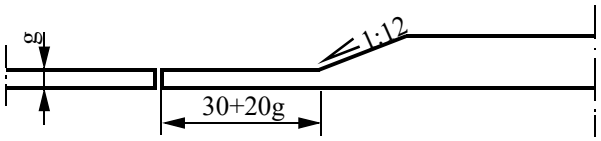


Fig. 2.6.23.4

2.6.23.5 The longitudinal joint of two halves of plating shall meet the requirements specified in 2.6.13.2. This joint can be made according to the Fig. 2.6.23.5 or in any other agreed way:

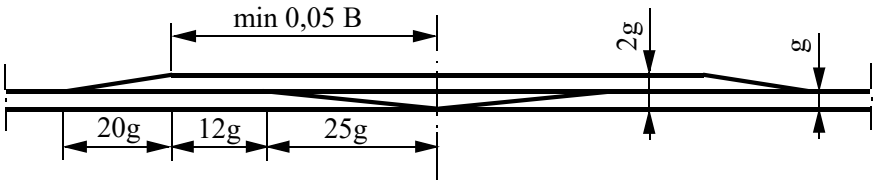


Fig. 2.6.23.5

2.6.24 Deck to Sides Joints

2.6.24.1 Joint of deck to sides should carry the bending load of deck and sides as well as the shear load due to houseboat's hull torsion.

2.6.24.2 It is recommended to use lap joint strengthened with bolts or rivets.

2.6.24.3 Examples of correct joints are shown in Fig. 9.3.3-1 to 9.3.3-4. The reinforcement mass of the joint is to be not less than 40 per cent of the side plating reinforcement.

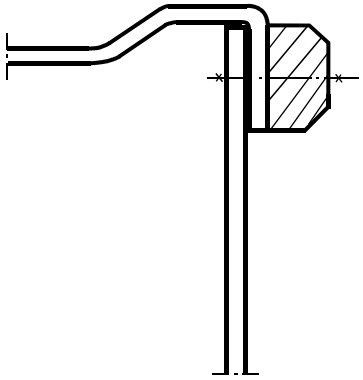


Fig. 2.6.24.3-1

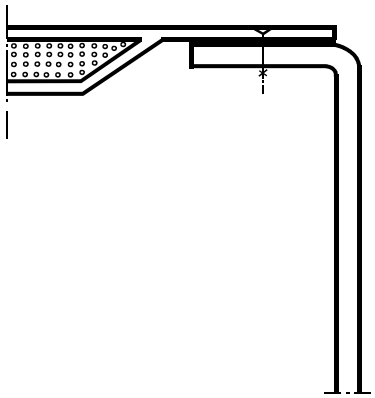


Fig. 2.6.24.3-2

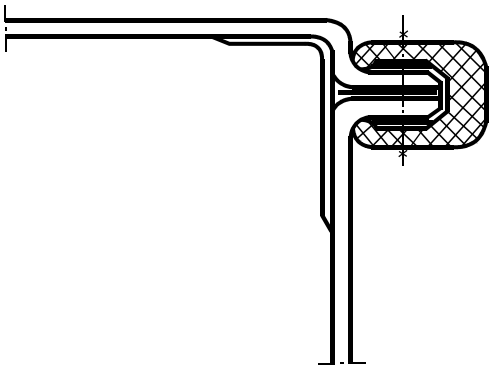


Fig. 2.6.24.3-3

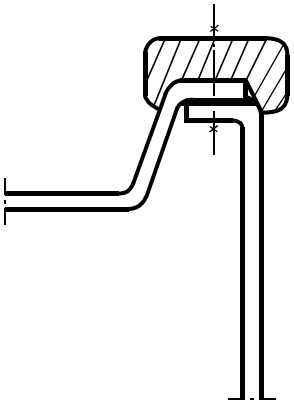


Fig. 2.6.24.3-4

2.6.25 Joints of Bulkheads to External Plating

2.6.25.1 When joining bulkheads with external plating, the thickness of laminated joint shall be not less than half the side thickness. Too rigid joints shall be avoided.

2.6.25.2 Recommended joints of bulkheads to external plating are shown in Fig. 2.6.25.2.

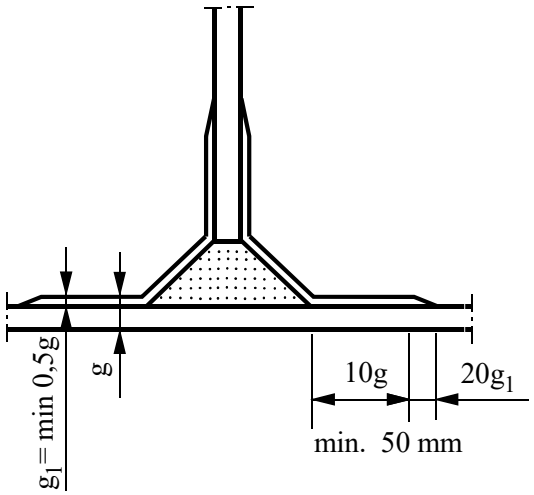


Fig. 2.6.25.2

2.6.25.3 Design solutions permissible for houseboats of not more than 12 m in length are shown in Figs. 2.6.25.3-1 ÷ 4.

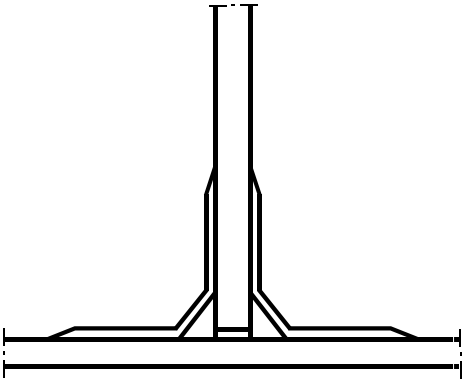


Fig. 2.6.25.3-1

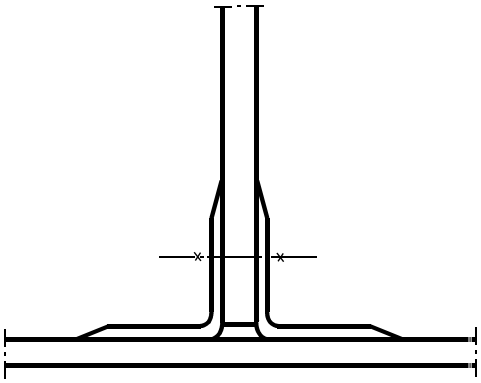


Fig. 2.6.25.3-2

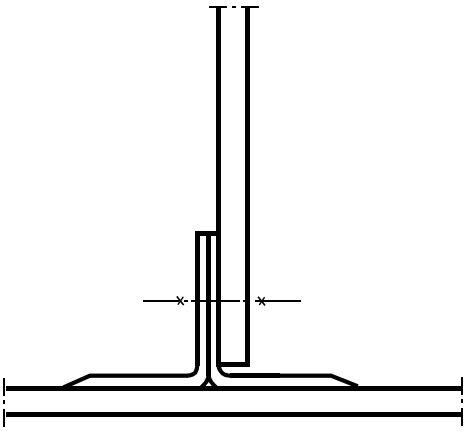


Fig. 2.6.25.3-3

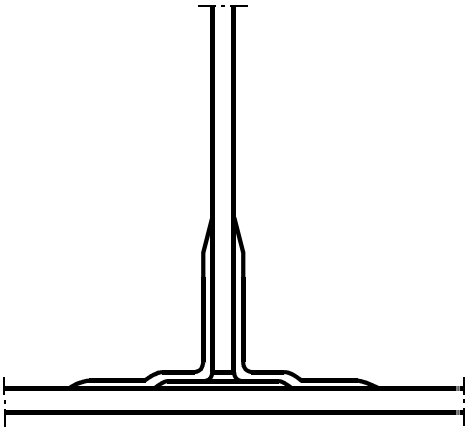


Fig. 2.6.25.3-4

2.6.26 Fastening of internal furniture

2.6.26.1 The following requirements concerning each of the two laminate reinforcements are to be observed when joining the internal furniture elements with the plating:

– for parts made of monolithic laminate – min. 50 % of the thinner part reinforcement,
– for parts of sandwich plating - min. 100 % of the thinner cladding reinforcement.

For single side laminating, the above values are to be doubled.

2.6.26.2 The reinforcement of laminating joints is to be, in general, not less than:

– 1800 g/m^2 (or 2 x 900 g/m^2) for constructional parts strengthening directly the external plating,
– 1200 g/m^2 (or 2 x 600 g/m^2) for less loaded parts.

2.6.27 Fastening of Stiffeners

2.6.27.1 Shape laminated stiffeners can be joined with the plating in the way shown in Figs. 2.6.27.1-1 ÷ 2.

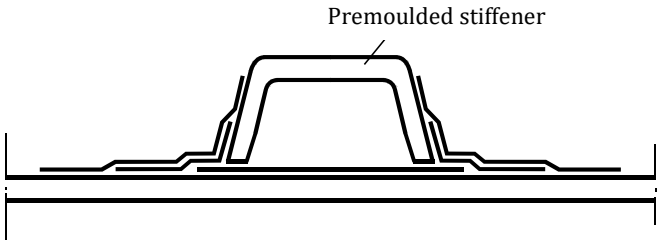


Fig. 2.6.27.1-1

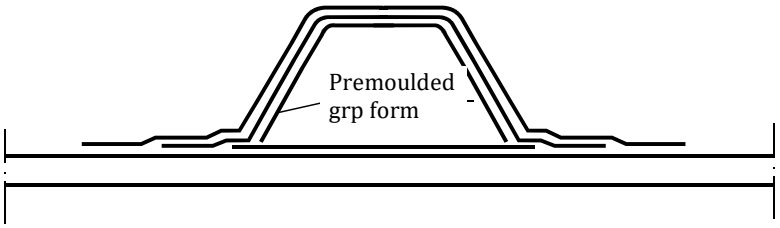


Fig. 2.6.27.1-2

In both solutions the reinforcement of laminated joint shall be not less than the reinforcement of the stiffeners webs.

2.6.28 Sandwich plating

2.6.28.1 Monolithic plating, instead of core foam, is to be used in the places of the equipment fastening as shown in Fig. 2.6.28.1. Plywood inserts laminated inside the sandwich plating in these places are allowed, the technology of which is to be agreed with PRS.

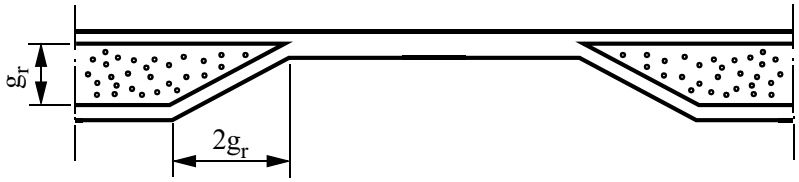


Fig. 2.6.28.1

2.6.28.2 Core foam is to be chamfered with at least 1:2 slope in all passages from the sandwich plating into the monolithic one.

2.6.28.3 Monolithic laminate thicknesses and application shall be adapted to occuring loads. The following stresses are allowed: 0.5 for destructive loads and 0.9 for working loads.

2.7 Metal structures

2.7.1 General

2.7.1.1 Metals used in the hull structure shall meet the requirements specified in Chapter 7 – Materials.

2.7.1.2 For both sides zinc sprayed steel hulls, the plating thickness and section moduli of stiffeners can be reduced by 10 per cent in respect of the values required by the *Rules*.

2.7.1.3 It is recommended that parts of plating and stiffeners exposed to increased corrosion as bilges, water tanks, scuppers, to be made of plate thicker than required and not thinner than 3 mm.

2.7.2 Conditions of building

2.7.2.1 The welding site should be protected against frost and humidity. In the case of inert-gas arc welding, against wind and air currents.

If the welding is carried out in temperature below – 5°C, then the proper quality of welded joints shall be secured by covering or heating the welded parts of construction. Quick cooling shall be avoided when welding thick plates.

2.7.2.2 The welding shall be made exclusively by a welder with PRS licence or equivalent. There is a possibility for amateur builders of one houseboat to be granted the licence during the houseboat construction.

2.7.2.3 Preservation of the metal hull is to be made in a way recommended by the manufacturer of preservative materials.

2.7.3 Rule Metal

2.7.3.1 The requirements specified in the next Chapters apply to steel having the following mechanical properties:

R_m = 400 MPa,

R_e = 235 MPa,

E = 206 000 MPa.

2.7.3.2 When using steel of other properties or aluminium alloy, the plating thickness g_1 and stiffener section modulus W_1 shall be not less than determined from the below formulae:

– for bending strength criterion:

$$g_1 = g\sqrt{\frac{635}{R_m + R_e}}, \text{[mm]} \qquad (2.7.3.2\text{-}1)$$

– for criterion of rigidity:

$$g_1 = g\sqrt[3]{\frac{2\,100\,000}{E}}, \text{[mm]} \qquad (2.7.3.2\text{-}2)$$

$$W_1 = W\frac{635}{R_m + R_e}, \text{[cm}^3\text{]} \qquad (2.7.3.2\text{-}3)$$

g – required Rule plating thickness, according to 2.7.4,

W – required stiffener bending section modulus for Rule metal, according to 2.7.5,

R_m – tensile strength of the used material, not greater, however, than 600 MPa,

R_e – yield strength of the used material, [MPa],

E – Young's modulus of the used material, [MPa].

2.7.4 Steel plating

2.7.4.1 Steel plating thickness g of a houseboat shall be not less than that given in the Table 2.7.4.1 and shall meet additional criteria, as given below.

Table 2.7.4.1
Required Rule steel plating thickness of a houseboat, [mm]

Plating area	Criterion		Other criteria
	Bending strength	Minimum thickness	
Keel, stem, stern	**5.2 *ak*** $\sqrt{h}$	**1.1**$\sqrt{L_H}$	
Bottom	**5.0 *ak*** $\sqrt{h}$	**0.9** $\sqrt{L_H}$	
Sides	**5.0 *ak*** $\sqrt{h}$	**0.85** $\sqrt{L_H}$	
Main deck	**5.0 *ak*** $\sqrt{h}$	**0.75** $\sqrt{L_H}$	**2.7.4.2**
Deckhouses	**4.8 *ak*** $\sqrt{h}$	**0.7** $\sqrt{L_H}$	**2.7.4.2**
Bulkheads	**4.8 *ak*** $\sqrt{h}$	**0.6** $\sqrt{L_H}$	
Walls of integral tanks	**5.2 *ak*** $\sqrt{h}$	**0.8** $\sqrt{L_H}$	

a – breadth of plating shell, [m],

$k = k_k \cdot k_p$ acc. to 2.3.3 and 2.3.4,

h – load height acc. to 2.5.

2.7.4.2 The thickness g of flat plating shells, shells of small curvature and parts subjected to load of walking occupants, due to rigidity criterion, shall be not less than that calculated from the formula:

$$g = 5{,}3ak\sqrt[3]{h}\text{, [mm]} \qquad (2.7.4.2)$$

a, k, h – acc. to 2.7.4.1,

it is to be taken that $h \geq 0{,}5$ m.

2.7.4.3 All openings in deck and erection shall have rounded corners, their edges being stiffened with coamings.

2.7.5 Steel stiffeners

2.7.5.1 The bending section moduli W of the applied steel stiffenings shall be not less than those given in Table 2.7.5.1 and shall meet additional criteria given in the Table :

Table 2.7.5.1

Stiffeners	Bending section **modulus** W, [cm^3]	Other criteria

Bottom longitudinals	**3.5 *hsl*²**	**2.7.7**
Floors	**3.5 *hsl*²**	**2.7.7**
Side longitudinals	**3.0 *hsl*²**	
Frames	**2.6 *hsl*²**	
Deck longitudinals	**2.6 *hsl*²**	**2.7.8**
Beams	**2.4 *hsl*²**	**2.7.8**
Web frames	**3.5 *hsl*²**	
Bulkhead stiffeners	**2.4 *hsl*²**	
Tank stiffeners	**3.5 *hsl*²**	

h – load height acc. to 2.5,

s – supported breadth of plating, [m],

l – unsupported span of stiffener, [m].

2.7.6 Keel

2.7.6.1 Flat keel, as well as the stem and stern made of bent plates shall meet the requirements specified in 2.7.4.1 or 2.7.4.2.

The width b of these structural parts is to be not less than:

$b = 0.10\ B$ [mm] – for keel at midship, (2.7.6.1-1)

$b = 0.06\ B$ [mm] – for stem, (2.7.6.1-2)

$b = 0.08\ B$ [mm] – for stern. (2.7.6.1-3)

2.7.6.2 The thickness g of bar keel and its height h shall be not less than:

$$g = 0.4L_H + 8, \text{ [mm]}, \quad (2.7.6.2\text{-}1)$$

$$h = 2L_H + 60, \text{ [mm]}. \quad (2.7.6.2\text{-}2)$$

2.7.6.3 The thickness g and height h of bar stem and stern shall be not less than:

$$g = 0.5L_H + 3, \text{ [mm]}, \quad (2.7.6.3\text{-}1)$$

$$h = 2L_H + 50, \text{ [mm]}. \quad (2.7.6.3\text{-}2)$$

2.7.7 Bottom Stiffeners

2.7.7.1 In transversal framing system, floors shall be installed for each frame. The floors shall be made of plate having the same thickness as the bottom plating.

2.7.7.2 If the floor span exceeds 75 times its thickness, then on its upper edge a reverse bar, the width of which shall be not less then 10 floor thicknesses, shall be installed.

2.7.8 Deck Stiffeners

2.7.8.1 For transversal framing system, beams are to be installed on each frame. For houseboats the length of which does not exceed 12 m, the beams in the half deck area longwise the deckhouse can be installed on every other frame.

2.7.8.2 Properly strengthened or supported beams shall be installed in areas where bigger parts of equipment are fastened and also on edges of big openings.

2.7.8.3 The height of web of the longitudinal supporting the transversal beams shall be not less than 0.04 its unsupported span or 1.5 the height of the supported beams.

2.7.9 Web Frames

For longitudinal framing system, web frames shall be installed. The structure of web frames shall be of continuous type. It means that the floor, frames and beam are connected together.

The values of unsupported lengths of web frame parts shall be substituted into formulae 2.7.4.1. However, the values are to be not less than:
- distance between the bottom centre line and turn of the bilge/sharp edge bottom-side (for the bottom part of the web frame),
- distance between the deck-side edge and turn of the bilge/sharp edge bottom-side (for the frame part of the web frame),
- half the breadth of deck in a given place (for the deck part of the web frame).

If pillars inside the web frame are installed, the unsupported length l of stiffener can be reduced accordingly.

2.7.10 Welded joints

2.7.10.1 The welding materials shall be approved by PRS according to the requirements specified in *Part IX – Materials and Welding* of the *Rules for the Classification and Construction of Seagoing Ships*.

2.7.10.2 Welded joints are to be designed in a way enabling easy access to them during manufacturing.

In order to reduce, as far as possible, the welding stresses and deformations, the welding shall be made in a proper succession. Where practicable, the welding shall be made in a downhand position.

2.7.10.3 Small spacing between the welded joints shall be avoided. Parallel butt joints shall not be nearer each other than 100 mm. Fillet welded joints shall not be nearer butt joints than 50 mm.

2.7.10.4 Continuous fillet welds shall be used for joining the following structural parts:
- plating,
- keel, stem and stern,
- floors to keel,
- engine and equipment foundations,
- brackets to stiffeners,
- stiffeners ends at the length equal to 1,5 times their height.

Interrupted fillet welds may be used for joining the stiffeners to the plating. Stiffeners joined together without brackets shall be welded with continuous fillet welds.

2.7.11 Butt Joints

2.7.11.1 For the manual welding of plates up to 5 mm thick, the edge scarfing can be dispensed with. Plates thicker than 5 mm are to be V or X-scarfed. Butt joints are to be welded from both sides; for plates up to 3 mm in thickness, the weld can be laid on one side only, provided that the continuous root melting has been obtained.

2.7.11.2 If butt welded parts differ in thickness by more than 25 per cent of the smaller thickness or by more than 3 mm then the thicker part is to be scarfed in 1 : 3 ratio.

2.7.12 Fillet Welds

2.7.12.1 Thickness *a* of fillet welds is to be not less than that specified in Table 2.7.12.1.

Table 2.7.12.1

Thickness of welded part *g*, [mm]	Thickness of welded part *a*, [mm]
< 4	2.0
4 ÷ 6.5	2.5

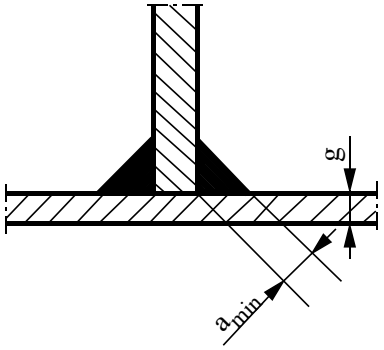


Fig. 2.7.12.1

2.7.12.2 For interrupted fillet welds, the dimensions according to Table 2.7.12.2 are recommended:

Table 2.7.12.2

Part thickness *g*, [mm]	Length of welded joint *l*, [mm]	Spacing *t*, [mm]
3 ÷ 4.5	25	100
5 ÷ 6.5	30	120
7 ÷ 8.5	40	160
>9	55	220

2.7.13 Lap Welding

2.7.13.1 Lap welded joints shall be avoided where possible.

2.7.13.2 For lap welded joints, the lap width *l* shall not be less than:

$$l = 1{,}5g + 15 \text{ , [mm]} \qquad (2.7.13.2)$$

g – thickness of the thinner part.

The applied fillet weld shall be continuous and closed around.

2.7.14 Hole Welding

2.7.14.1 The hole length *l* and pitch *t* are to be in compliance with Table 2.7.12.2. The thickness *a* of the fillet weld shall be in accordance with Table 2.7.12.1. The base for calculations is the thinner plate thickness.

The hole width shall be equal to two times the thickness of the plate and shall be not less than 12mm. The hole ends are to be rounded.

2.7.14.2 Flat or shaped bar being the base for the hole welding shall have the width not less than four times the plate thickness but it need not exceed 20 mm.

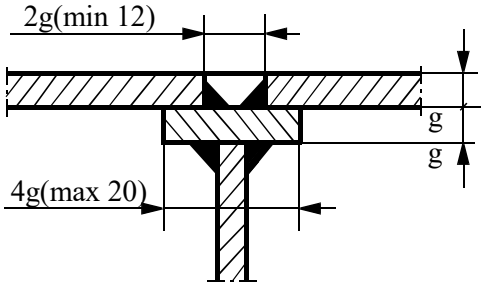


Fig. 2.7.14.2

The caving remaining after the hole welding can be filled with a proper material but it is not to be welded over.

2.7.14.3 Plug welding cannot be used for important structural parts joining.

2.7.15 Welded Joints of Stiffeners

2.7.15.1 If the stiffener is made of several sections of shape bar, the butt joint can be applied to a place subjected to small load.

2.7.15.2 Stringers of shape bars with different web heights are to be joined in a way shown in Fig. 2.7.15.2.

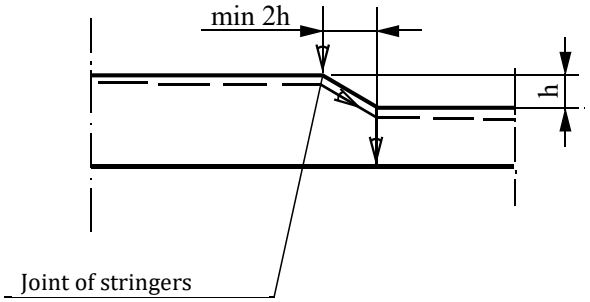


Fig. 2.7.15.2

2.7.15.3 For the recommended joints of frames to floors, see Figs. 2.7.15.3-1 ÷ 2.

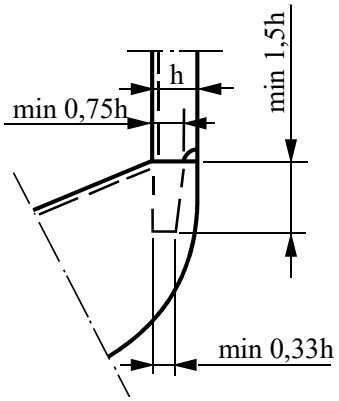


Fig. 2.7.15.3-1

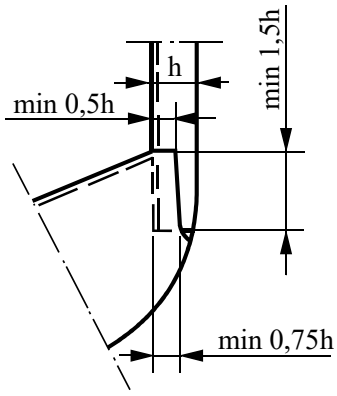


Fig. 2.7.15.3-2

2.7.15.4 For the recommended joints of frames to beams see drawings 2.15.4-1 ÷ 2.

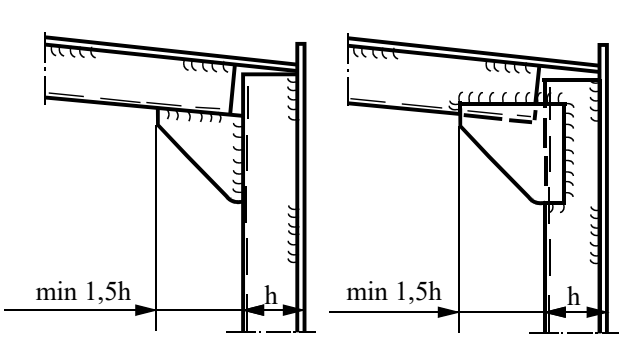
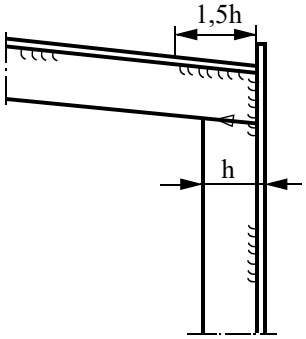


Fig. 2.7.15.4-1



(for houseboat with L_H < 10 m)

Fig. 2.7.15.4-2

2.8 Wooden structures

2.8.1 General Requirements

2.8.1.1 Sorts of timber and glues shall meet the requirements specified in Chapter 7 – Materials.

2.8.1.2 The *Rules* apply to the rounded planked hulls or hulls with diagonal glued of facing boards (moulded plywood), as well as to houseboats with developable plywood plating. Other constructions of a wooden houseboat need special agreement of PRS.

2.8.1.3 The Rules can also be applicable to the design of wooden decks and plywood bulkheads on metal or laminate plated houseboats, provided that the joints used meet the condition of carrying the shearing forces.

2.8.2 Conditions of Building

2.8.2.1 Prior to beginning the houseboat construction, the Builder is obliged to receive from the PRS representative supervising the building the acceptance of the material storage and place of the hull assembly. These conditions shall meet the requirements of PRS, as well as the requirements of the material suppliers or manufacturers, necessary for maintaining the full technological standard of the materials during the yacht construction.

2.8.2.2 Each material used for important structural parts shall be, prior to its usage, accepted by the PRS representative supervising the building.

2.8.3 Rule timber

2.8.3.1 The requirements specified in the following Chapters refer to timber having the following properties:

$$R_g = 82 \text{ MPa},$$
$$E_g = 9500 \text{ MPa}.$$

2.8.3.2 When using timber of other mechanical properties, the plating thickness g_1, section modulus W_1 and sectional area of stiffeners F_1 shall be recalculated according to the following formulae:

– for bending strength criterion:

$$g_1 = g\sqrt{\frac{82}{R_g}}, \text{ [mm]} \qquad (2.8.3.2\text{-}1)$$

– for criterion of rigidity:

$$g_1 = g\sqrt[3]{\frac{9500}{E_g}}, \text{ [mm]} \qquad (2.8.3.2\text{-}2)$$

$$W_1 = W\frac{82}{R_g}, \text{ [cm}^3\text{]} \qquad (2.8.3.2\text{-}3)$$

$$F_1 = F\frac{82}{R_g}, \text{ [cm}^2\text{]} \qquad (2.8.3.2\text{-}4)$$

g – required plating thickness acc. to 2.8.4,
W – required section modulus acc. to 2.8.7,
F – required sectional area of stiffener acc. to 2.8.7,
R_g – bending strength of applied timber, [MPa],
E_g – Young's modulus of applied timber, [MPa]

2.8.4 Wooden plating

2.8.4.1 Rule thickness

2.8.4.1.1 The wooden plating thickness g shall be not less than that specified in the Table 2.8.4.2 and additionally should meet other requirements given in the table.

Table 2.8.4.1.1
Required rule thickness of wooden plating [mm]

Type of plating	Criterion		Other require-ments
	Bending strength	Minimum thickness	
Planking: **– with bent frames only**	**–**	**$6 + 0.60\,L + 60\,s$**	**2.8.5.3**

– with other frames	**–**	**8 + 0.88 *L* + 40 *s***	**2.8.5.3**
Planked deck	**–**	**6 + 0.88 *L* + 40 *s***	**2.8.5**
Deckhouse walls from solid wood	**–**	**9 + 1.3 *L***	
Diagonal moulded plating	**35.0 *ak*** $\sqrt{h}$	**4.0**$\sqrt{L_H}$	**2.8.6**

s – frame spacing, [m],

a – plate shell breadth, [m],

k = $k_k \cdot k_p$ acc. to 2.3.3 and 2.3.4,

h – load height acc. to 2.5.

2.8.4.1.2 For composite structures, the wood plating fastened to steel stiffeners shall be properly protected against a direct contact with steel.

2.8.5 Planking

2.8.5.1 The minimum thickness of hull planking is 12 mm. The minimum thickness of deck planking is 18 mm for a single layer of planks. If the deck is covered with laminate or fabric, then the minimum planking thickness shall be 12 mm. The minimum thickness does not depend on the kind of the timber used.

2.8.5.2 The recommended widths of planks b_k for a single layer planking are as follows:

hull planking – $b_k = 2{,}25g + 55 \pm 10\%$, [mm] (2.8.5.2-1)

deck planking – $b_k = 0{,}62g + 32 \pm 5\%$, [mm] (2.8.5.2-2)

g – plank thickness acc. to 2.8.4.2.

2.8.5.3 The planks shall be as long as practicable. The planks can be extended with the use of diagonally glued joints (in plank thickness) or with the use of butt straps.

Horizontal distances between the plank joints in adjacent belts shall be not lees than:

1.0 m – for plank thickness less than 20 mm,

1.2 m – for plank thickness 20 - 32 mm,

1.5 m – for plank thickness above 32 mm.

Two plank joints in the same vertical plane shall be separated by three continuous planks, acc. to Fig. 2.8.5.3.

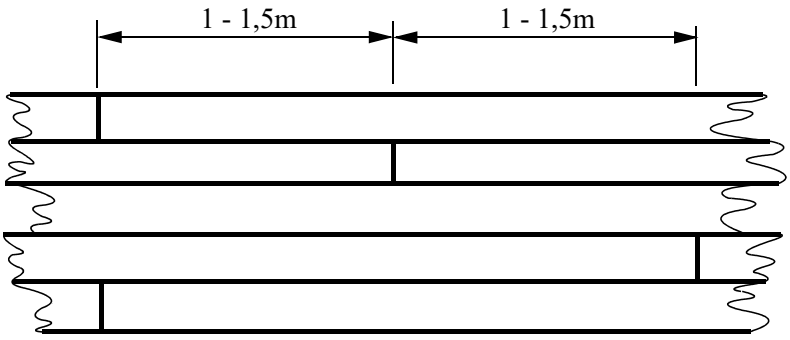
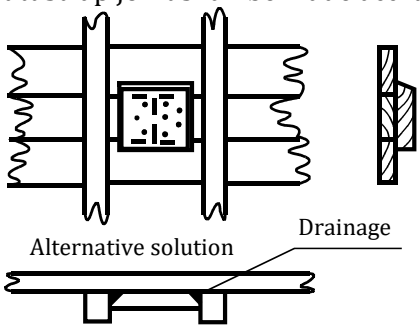


Fig. 2.8.5.3

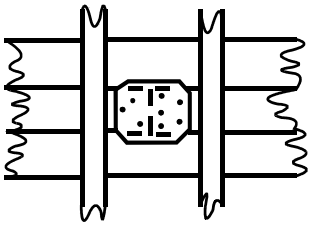
2.8.5.4 The length of diagonally glued joint (in plank thickness) shall be at least 8 times greater than the plank thickness.

2.8.5.5 A butt strap joint shall be made acc. to Figs. 2.8.5.5-1 or 2.8.5.5-2.



Joint by wooden butt strap

Fig. 2.8.5.5-1



Joint by steel butt strap

Fig. 2.8.5.5-2

Wooden butt strap thickness shall be equal to the planking thickness. Steel butt strap thickness shall be equal to 15 - 18 per cent of the planking thickness. The minimum number of metal bolts or rivets for one side of the joint is:

3 pcs., for plank width up to 100 mm,
4 pcs., for plank width 100 to 200 mm,
5 pcs., for plank width 200 to 250 mm.

The diameters of bolts or rivets are to be as specified in 2.8.5.7.

2.8.5.6 Deck planks can be joined on the beams according to the Fig. 2.8.5.6.

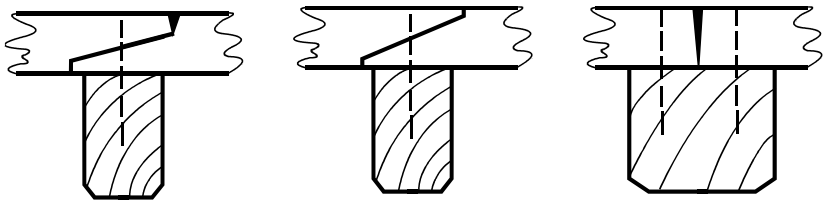


Fig. 2.8.5.6

2.8.5.7 Side planks shall be joined with the frames with the use of metal bolts or rivets. The number of bolts or rivets joining one plank to one frame is specified in Table 2.8.5.7.

Table 2.8.5.7

Plank thickness [mm]	Plank width [mm]				
	do 100	100 ÷ 150	150 ÷ 180	180 ÷ 210	pow. 210
Up to 24	2	2	3	–	–
25 ÷ 36	1	2	2	3	–
above 36	1	2	2	2	3

The diameter *d* of the bolts and rivets shall be not less than:

– copper rivets for bent frames:

$d = 0{,}14g$, [mm], however, not less than 2.5 mm, (2.8.5.7-1)

– copper rivets for other wooden frames:

$d = 0{,}8 + 0{,}17g$, [mm], however, not less than 3,5 mm, (2.8.5.7-2)

– bolts (carbon steel zinc coated, stainless steel or bronze):

$d = 1{,}3 + 0{,}17g$, [mm], however, not less than 5 mm. (2.8.5.7-3)

Lag screws of bronze or marine brass can be used in places where through holes cannot be made. The diameter *d* of lag screws is not to be less than:

$d = 0{,}8 + 0{,}17g$, [mm], however, not less than 5 mm (2.8.5.7-4)

g – plank thickness, [mm].

2.8.5.8 Side planks shall be joined with the rudder stock items with the use of bolts or lag screws where bolts cannot be used.

The diameters of bolts and screws shall be not less than those specified in 2.8.5.7, while their spacing is not to exceed twelve diameters.

2.8.5.9 Deck planks can be fastened to the beams with the use of rivets, bolts or lag screws. The diameters can be 10 per cent less than those specified in 2.8.5.7.

Deck planks can be also fastened by means of diagonally driven nails of zinc coated carbon steel or copper, of length l_g not less than that calculated from the formula:

$$l_g = 2{,}5g - 1{,}5, \text{ [mm]} \quad (2.8.5.9)$$

g – plank thickness, [mm].

Fastening of deck planks by means of nails is shown in Fig. 2.8.5.9.

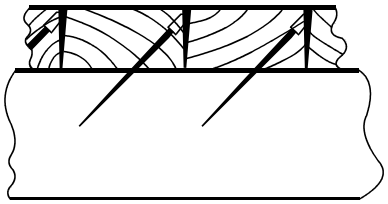


Fig. 2.8.5.9

2.8.6 Double Planking

2.8.6.1 External layer of double planking shall have the thickness 0.5 – 0.6 the thickness specified in Table 2.8.4.2.

2.8.6.2 Two layers of the double planking are to be interconnected and connected with frames in a way shown in Fig. 2.8.6.2.

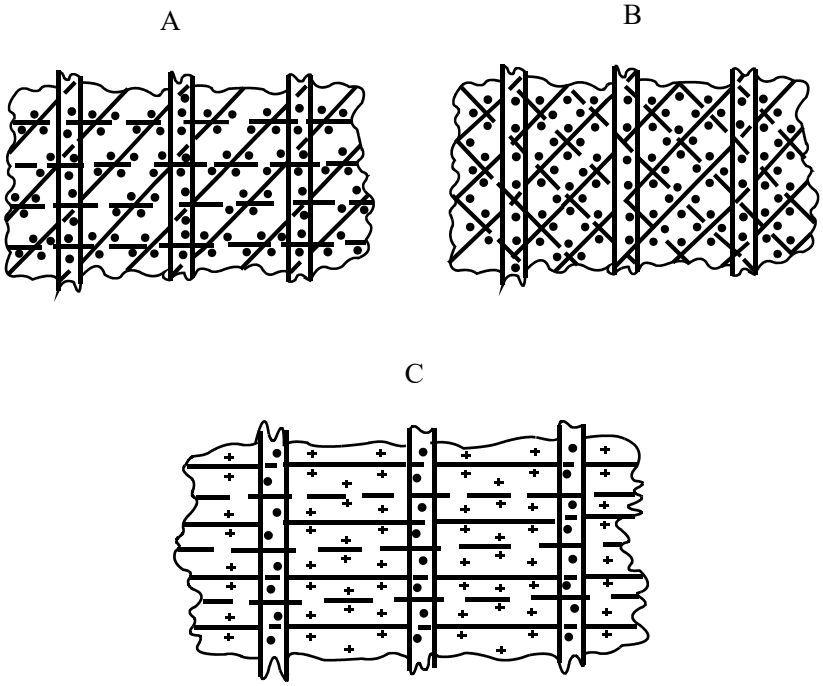


Fig. 2.8.6.2

2.8.6.3 The both layers shall be separated by canvas saturated with a preservative agent (for diagonal planking) or with resorcinol glue (for longitudinal system).

2.8.6.4 The typical design solutions of side planking-deck joining are shown in Fig. 2.8.6.4.

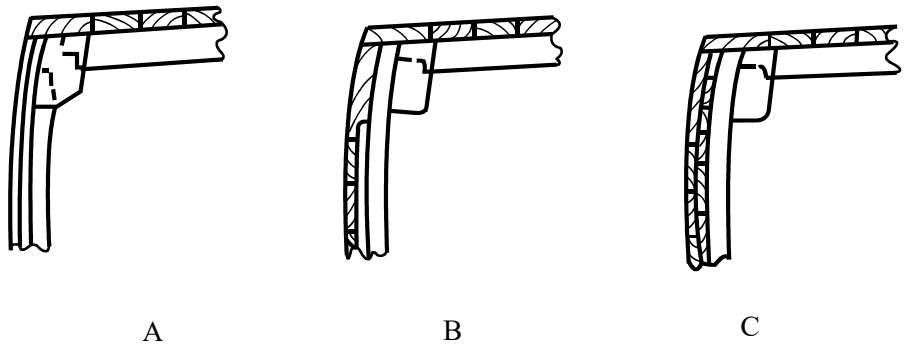


Fig. 2.8.6.4

2.8.7 Wooden stiffeners

2.8.7.1 The wooden stiffeners shall be made of homogeneous possibly long wood sections. Glued stiffeners shall be made of at least four layers of facing boards.

2.8.8 Required Stiffener Moduli

2.8.8.1 The bending section moduli *W* of applied stiffeners on the houseboat shall be not less than those given in Table 2.8.8.1 and shall meet other criteria specified in the Table.

Table 2.8.8.1

Stiffeners	W [cm³]	Other criteria
Glued floors	**37.0 *hsl*²**	**2.8.12**
Cut-out floors	**52.7 *hsl*²**	**2.8.12**
Steel floors	**4.6 *hsl*²**	**2.8.12**
Glued frames	**37.0 *hsl*²**	**2.8.13**
Cut-out frames	**52.7 *hsl*²**	**2.8.13**
Bent frames	**26.4 *hsl*²**	**2.8.13**
Steel frames	**2.93 *hsl*²**	**2.8.13**
Bottom and side stringers	**37.0 *hsl*²**	**2.8.13**
Deck stringers	**28.5 *hsl*²**	**2.8.13**
Beam stringers	**28.5 *hsl*²**	**2.8.14**
Glued beams	**12 *hsl*²**	**2.8.15**
Cut-out beams	**14 *hsl*²**	**2.8.15**
Steel beams	**1.7 *hsl*²**	**2.8.16**
Web frames	**35 *hsl*²**	**2.8.17**
Bulkhead stiffeners	**15 *hsl*²**	

h – load height acc. to 2.5,

s – supported breadth of plating, [m],

l – unsupported span of stiffener, [m].

2.8.9 Keel of planked houseboat

2.8.9.1 The keel made of one piece of wood on the houseboat shall have the width b and the cross-section F in the midship section not less than:

$$b = 54 + 10L_H, \text{ [mm]}, \quad (2.8.9.1\text{-}1)$$

$$F = 4600\ (L_H + 4), \text{ [mm}^2\text{]}. \quad (2.8.9.1\text{-}2)$$

2.8.9.2 A similar keel of a houseboat is to have width b and cross section F not less than:

$$b = 42 + 7L_H, \text{ [mm]}, \quad (2.8.9.2\text{-}1)$$

$$F = 3600\ (L_H - 4), \text{ [mm}^2\text{]}. \quad (2.8.9.2\text{-}2)$$

2.8.9.3 The width of the keel can be reduced fore and aft from the midship section to the dimensions required for stem or stern.

2.8.9.4 The keel of houseboat of the length exceeding 10 m can be made of two pieces connected in a way shown in Fig. 2.8.9.4.

This joint is to be bolted together by means of bolts of the diameter d not less than:

$$d = 3\sqrt{L_H},\ \text{[mm]} \quad (2.8.9.4)$$

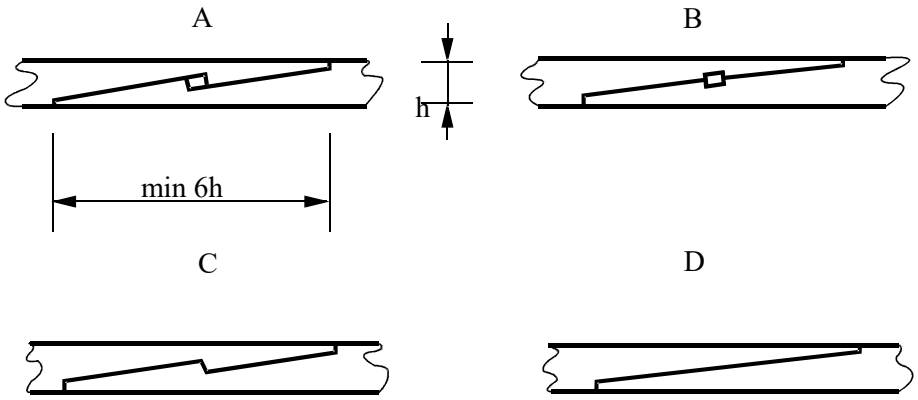


Fig. 2.8.9.4

2.8.9.5 Tightening pins made of soft wood shall be provided in the area of the plank groove cut in the keel, e.g. as shown in the drawing 2.8.9.5.

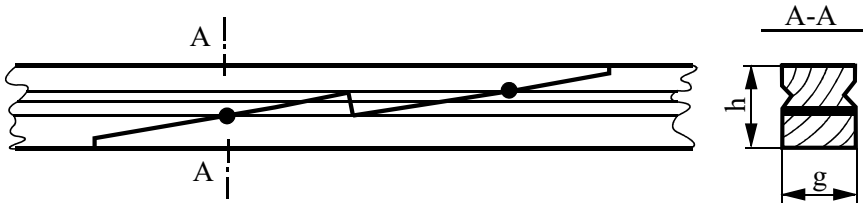


Fig. 2.8.9.5

2.8.10 Stem of planked houseboat

2.8.10.1 The thickness g or the height h of the lower part of the stem shall be not less than:

$$g \text{ or } h = 21 + 9.5\, L_H\,, \qquad \text{[mm]}.$$

Dimensions of the stem near the deck can be reduced by 20 per cent with regard to those given above.

2.8.10.2 The cross section area of glued stem can be 15 per cent less than that required in 2.8.10.

2.8.11 Stern of Planked houseboat

2.8.11.1 The thickness g or the height h of the stern shall be not less than:

$$g \text{ or } h = 48 + 5{,}7\, L_H, \qquad \text{[mm]}.$$

2.8.11.2 The cross section area of glued stem can be 15 per cent less than the required in 2.8.11.

2.8.12 Floors

2.8.12.1 Floors shall be, in general, installed at each frame as far forward and aftward as practicable. Outside the midship, the floors can be installed at every other frame. For houseboats of length less than 10 m where bent frames are used exclusively, the floors can be installed at every third frame outside the midship area.

2.8.12.2 For longitudinal framing, the floor spacing shall not to exceed the double spacing of bottom stringers.

2.8.12.3 Steel floors can be made of rolled or forged bars or can be welded of plates.

The upper edge of floors made of plates shall be bent or secured against buckling in any other way.

2.8.12.4 The required section moduli of floors shall be kept along the whole width of the keel and can be gradually reduced towards the floor ends.

2.8.12.5 The length *l* of joint of a wooden floor with a wooden frame shall be not less than:

$$l = 0{,}15h, \text{ [m]} \qquad (2.8.12.5)$$

h – load height acc. to 2.5.2.

2.8.12.6 When calculating the required section modulus for floors in the area forward of the midship section, the unsupported length of floors shall be taken not less than 0.4 *B*. Similar requirements apply to the floors in the engine area.

In no case shall the floor section modulus be less than the respective frame section modulus.

2.8.12.7 Steel floors in an engine room shall be 1 mm thicker than those required in 2.8.8.1.

2.8.12.8 Each floor is to be bolted to the keel by means of at least two bolts of the diameter *d* not less than 8 mm and not less than:

$$d = 6{,}7H - 4, \text{ [mm]} \qquad (2.8.12.8\text{-}1)$$

For bent frames, the bolts' diameter *d* shall be not less than 6 mm, not greater than 12 mm and not less than:

$$d = 4{,}5H - 2, \text{ [mm]} \qquad (2.8.12.8\text{-}2)$$

H – moulded depth, [m].

2.8.12.9 Floors shall be bolted to the frames by means of bolts of diameter *d* not less than 6 mm and not less than:

$$d = 4{,}5H - 2, \text{ [mm]} \qquad (2.8.12.9\text{-}1)$$

For bent frames connections, the bolts' diameter shall be not less than 6mm and not less than:

$$d = 3{,}3H - 1, \text{ [mm]} \qquad (2.8.12.9\text{-}2)$$

H – moulded depth, [m].

If frame–floor joint length does not exceed 250 mm, 3 bolts shall be used; for longer joints lengths – 4 bolts.

2.8.13 Frames

2.8.13.1 Provision has been made for the following types of frames:
- bent frames for houseboat of depth *H* not greater than 2.7 m,
- glued or steel frames,
- glued or steel frames alternated with bent frames – up to three bent frames can be used between two glued or steel frames for houseboat of depth *H* not greater than 3 m,
- cut-out frames for plywood plated houseboats.

Other types of frames will be considered individually by PRS.

2.8.13.2 Joints of cut-out frame parts (for plywood type plating) are to be stronger than the frame itself.

2.8.14 Deck Stringers

2.8.14.1 For houseboats with transversely stiffened deck, the required deck stringers (shelves) shall have the total cross section area F (including the beam cut-out) in the midship area not less than:

$F = 5L_H$, [cm²] – for houseboat of length $L \leq 12$ m,

$F = 10L_H$, [cm²] – for houseboat of length $L > 12$ m.

The cross section area of deck stringers may be reduced by 25 per cent, when the deck and sides plating is made of plywood, or cold moulded.

Outside the midship area, the cross sections of stringers can be reduced at stem and stern or transom down to 75 per cent of the value required above.

2.8.14.2 Deck stringers are to have properly strong, bolted connections with all the frames. The bolt diameters d shall be not less than:

$$d = 2\sqrt{L_H}, \text{ [mm]} \qquad (2.8.14.2\text{-}1)$$

Steel or wooden brackets shall be installed at joints between stringers and stem or stern or transom. The joints are to be bolted together using the bolts of the diameter d not less than:

$$d = 3\sqrt{L_H}, \text{ [mm]} \qquad (2.8.14.2\text{-}2)$$

2.8.15 Beams

2.8.15.1 The section modulus of beams required in 2.8.8.1 should be kept applied in the centre of the stiffening span. At the ends of the beams, the modulus can be reduced to 50 per cent of the required value.

2.8.15.2 End beams of the hatches or beams situated at ends of deckhouses shall be strengthened as follows:

– if the beam is a part of the accommodation room partition, its section modulus shall be increased by 50 per cent,
– if the beam has no support, its section modulus shall be doubled.

For planking deck, the strengthened beams shall also be connected with deck stringers by means of the horizontal brackets (knees).

2.8.15.3 The distance between deck stringers or distance between deck stringers and hatch coamings or side walls of deckhouse shall be substituted in to formula 2.8.8.1 as unsupported length. The distance shall be, however, not less than:

$l = 0{,}7B$ – for midship area,

$l = 0{,}5B$ – for fore and aft end, for deckhouse half beams and beams in the midship area.

2.8.15.4 If the deck is covered exclusively with planks, then strong joints between the beams and shelves are required, e.g. dovetail or pinned joints.

For houseboats of length L greater than 10 m, also steel diagonals shall be installed.

2.8.15.5 Regardless of the kind of deck plating, the strengthened beams shall be connected to the frames by means of vertical brackets (knees). The number of pairs n of such brackets shall be not less than:

$$n = 1{,}5B \qquad (2.8.15.5\text{-}1)$$

The brackets can be made of forged steel with the cross section area F in the middle of the span not less than:

$$F = 4{,}4B - 7\text{ , [cm}^2\text{]} \quad (2.8.15.5\text{-}2)$$

or can be made of steel rolled or welded bars with the section modulus W not less than:

$$W = 1{,}6B - 2{,}2\text{ , [cm}^3\text{]} \quad (2.8.15.5\text{-}3)$$

The required length l of the bracket arms shall be not less than:

$$l = 0.09B + 0.120\text{, [m]} \quad \text{– in the midship area,} \quad (2.8.15.5\text{-}4)$$

$$l = 0.07B + 0.090\text{, [m]} \quad \text{– outside the midship area.} \quad (2.8.15.5\text{-}5)$$

2.8.15.6 The vertical brackets (knees) can be dispensed with if structural partitions connected with the beams and frames are installed.

2.8.16 Steel Stiffeners of Wooden Hull

2.8.16.1 Steel beams shall meet the requirements specified in 2.8.8.1 as well as 2.8.15.2 and 2.8.15.3.

The beams shall be connected to frames with the use of brackets of the minimum height equal to 2.5 the beam height.

2.8.16.2 Steel sheerstrake shall be installed on steel beams along the sides. The width b of the sheerstrake shall be not less than:

$$b = 0.020L_H\text{, [m]} \quad \text{– in the midship area,} \quad (2.8.16.2\text{-}1)$$

$$b = 0.016L_H\text{, [m]} \quad \text{– outside the midship area.} \quad (2.8.16.2\text{-}2)$$

Steel plating is to be provided around deckhouses, superstructures and deck hatch coamings. The plating width b is to be not less than:

$$b = 0.06 + 0.004L_H\text{, [m]} \quad (2.8.16.2\text{-}3)$$

The wooden plating is to be fastened to the beams and to the above mentioned steel plates.

2.8.16.3 The thickness g of the steel stiffeners and brackets shall be not less than:

$$g = 0.9\sqrt{L_H}\text{, [mm]} \quad (2.8.16.3\text{-}1)$$

If zinc coated steel has been used, then:

$$g = 0.81\sqrt{L_H}\text{ , [mm]} \quad (2.8.16.3\text{-}2)$$

2.8.17 Web Frames

2.8.17.1 For longitudinal framing system of the houseboat hull made of plywood or cold moulded, the web frames shall be installed. The recommended web frame spacing s shall be not more than:

$$s = 0.05L_H + 0.2\text{, [m]} \quad (2.8.17.1)$$

In no case the spacing s shall be greater than:

s = 1.5 m for houseboat of length $L \leq 9$ m,

s = 2.0 m for houseboat of length L > 9 m.

2.8.17.2 The web frames shall be continuous structures connecting floors, frames and beams. The unsupported lengths l are to be substituted into the formula 2.8.8.1. The values, however, shall be not less than:

- distance between bottom axis and bilge turn (for the bottom part of the web frame),
- distance between deck-side edge and bilge turn (for frame part of the web frame),
- half the breadth of deck in the considered place (for deck part of the web frame).

If pillars are installed inside the web frame, then the value l can be reduced accordingly.

2.8.18 General strength of wooden hull

2.8.18.1 For diagonally plated houseboat of length l greater than 10 m, the general strength of the hull is to be checked.

2.8.18.2 The general strength is checked by calculating the hull bending section modulus at the midship.

2.8.18.3 Checking the general strength of the multi-hull houseboats will be considered separately by PRS.

2.8.19 Hull bending section modulus

2.8.19.1 The hull bending section modulus W_k shall be not less than:

$$W_k = 104 L_w^2 B_w (C_b + 0{,}7), \text{ [cm}^3\text{]} \qquad (2.8.19.1)$$

B_w – the houseboat breadth on waterline, [m];

C_b – block coefficient of the submerged part of the hull.

2.8.19.2 The formulae given in 2.8.19.1 are valid for the Rule timber (2.8.3) with fibres laid along the hull. The cross section areas of structural members made of other sorts of timber or for other arrangement of fibre in wood are to be multiplied by the factor k:

$$k = k_s \frac{E_g}{9500} \qquad (2.8.19.2)$$

k_s – material factor:

k_s = 1.0 for solid wood with fibres along the hull,

k_s = 0.4 ÷ 0.6 for plywoods (depending on the ratio of layers laid along the hull to the total number of layers),

k_s = 0.25 for diagonal plating,

E_g – bending Young's modulus of the timber used, [MPa].

2.9 Concrete structures

2.9.1 The principles of proceedings at ensuring solid designed ferroconcrete structures are given in Eurocode 2 (PN-EN 1992-1-1). It covers requirements for reinforcement strength and cover, with particular consideration of external zones of the concrete securing ferroconcrete elements against damage.

2.9.2 General

2.9.2.1 In accordance with standards, all internal tensile forces in the ferroconcrete structures shall be carried by the reinforcement. Scratches shall be assumed unavoidable and they shall be under control (except the cases referred to in the standard).

2.9.2.2 During designing the ferroconcrete hull, any conditions contributing to the strength of the reinforcement cover, such as: object location and purpose, the arrangement of structure items, their shape and technical solutions, shall be taken into account.

2.9.2.3 Particular attention shall be paid to maintaining structure stiffness, as it allows restricting unexpected forces, which cause additional deformations. The deformations can occur in result of concrete creeping and shrinkage, which results in additional scratches facilitating penetration of aggressive substances inside the concrete structure and accelerating destructive processes, inter alia the reinforcement corrosion.

2.9.2.4 The requirements of the *Rules* are defined only for the cubical hulls having fabric reinforced concrete or ferroconcrete structures. Other concrete structures of houseboats will be separately considered by PRS.

2.9.3 Constructional requirements

2.9.3.1 Minimum reinforcement

According to PN-EN 1992-1-1:2004+AC:2008 Standard, the minimum reinforcement shall be calculated to the below formula:

$$As_{\min}\,\sigma_s = k_c\,k\,f_{ct,eff}\,A_{ct} \qquad (2.9.3.1)$$

where :

$A_{s,min}$ – minimum cross sectional area of reinforcement in tensile zone,
A_{ct} – cross-sectional area of tensile zone of concrete directly before scratching,
$f_{ct,eff}$ – effective mean value of concrete tensile strength, tensile stress in concrete initiating scratching,
σ_s – absolute maximum stress in reinforcement, which occurs directly after scratching,
k – coefficient depending on the effect of non-uniform, self-equivalent stresses, applied for consideration of the effect of residual stresses on scratching,
k_c – coefficient depending on the distribution of stresses in the cross-section, which occur directly before and after scratching.

The coefficient k_c is determined by comparing distributions of internal forces, which occur directly before and after scratching; it shall ensure correct estimation of stresses, which can act in the reinforcement directly after scratching. For axial tension, k_c = 1.0.

Details of calculations are contained in the PN-EN 1992-1-1 +AC:2008 Standard „Stany graniczne użytkowalności (Serviceability limit states – SLS)" and in „Construction of prestressing reinforcement and tendons – General". The Standard PN-EN 1992-1-1 +AC:2008 precizes „Construction of elements and specific rules", and additionally „Additional rules for prefabricated elements and structures" are specified.

2.9.3.2 Nominal cover

2.9.3.3 The cover thickness is determined depending on:

- aggressiveness of working environment of the structure item,
- the level of fire protection,
- the class of concrete, designed period of the object service,
- structure considerations.

The minimum thickness of the cover is determined by subject standards. In accordance with the standard PN-EN 1992-1, it is recommended that the cover thickness shall be between 10 and 50 mm. During design, also the cover deflection caused by performance inaccuracy of the element on the construction site, shall be considered.

After defining the class of structure (Table 4.3N: Recommended classification of structures acc. to PN-EN 1992-1-1 Standard) and its exposure, the thickness of nominal cover of the reinforcement shall be defined.

2.9.3.4 The nominal cover is a combination of the minimum cover c_{min} and an allowance for deviation Δc_{dev}. With the purpose to fulfil bonding and environmental requirements, the greatest of the three values as c_{min} used in brackets in the below formula shall be applied:

$$c_{nom} = c_{min} + \Delta c_{dev} \quad (2.9.3.4)$$

where:

$$c_{min} = \max\{c_{min,b}; c_{min,dur} + \Delta_{cdur,\gamma} - \Delta_{cdur,st} - \Delta_{cdur,add}; 10\ mm\}$$

c_{nom} – nominal cover;

c_{min} – minimum cover;

Δc_{dev} – executive allowance. Recommended value: 10 mm;

$c_{min,b}$ – minimum cover due to bonding requirement;

$c_{min,dur}$ – minimum cover due to environmental conditions;

$\Delta_{cdur,\gamma}$ – additive safety element;

$\Delta_{cdur,st}$ – reduction for the use of stainless steel;

$\Delta_{cdur,add}$ – reduction for the use of additional protection.

In order to transmit bond forces safely and to ensure adequate compaction of concrete, the minimum cover shall be not less than the values of $c_{min,b}$ specified in Table 4.2 in the PN-EN 1992-1-1:2008P Standard . If the nominal maximum aggregate size is greater than 32 mm, $c_{min,b}$ shall be increased by 5 mm.

2.9.3.5 The minimum diameter of a steel ribbed bar shall be taken not less than 8 mm. The mesh size depending on the location shall be taken from 6 x 6 cm to 15 x 15 cm.

At bulkhead wall connections, an additional reinforcement of corners by means of l-shaped bars shall be applied, which ensure bulkheads reinforcement liaised with those of the sides. The whole reinforcement shall be rigidly interconnected and shall create lattice-spatial, mutually binding arrangement.

2.9.3.6 If the unit size exceeds 5m breadth and/or 10 length, its structure shall be additionally strengthened by addition of longitudinal bulkhead in the bow part of the houseboat in its symmetry plane.

2.9.3.7 During design and construction of steel mesh reinforcement, relevant strengthenings and special reinforcing lifting lugs shall be provided. The number of steel lugs and their location depend on the size of the houseboat.

2.9.3.8 The concrete reinforcement by means of synthetic fibres shall be subject to individual consideration of PRS. .

2.9.3.9 The bottom plate shall be closed from underneath and tightly connected with outline walls and bulkheads.

2.9.4 Concrete structure construction

2.9.4.1 Prior to construction, the builder shall submit technical documentation of the houseboat construction technology for approval, including concrete mix composition.

2.9.4.2 Prior to houseboat construction, the construction conditions shall be agreed with PRS supervisor, to be in accordance with the PRS requirements, as well as the manufacturers or suppliers of materials shall be agreed to maintain their full technological quality during construction process.

2.9.4.3 It is recommended that the concrete mix should be made in the concrete batching plant having relevant procedures and technological conditions to execute PRS approved concrete mix recipe.

2.9.5 Storage

2.9.5.1 The aggregate and other mixtures shall be stored by the concrete batching plant in accordance with procedures relevant for the given plant.

2.9.5.2 The aggregate stored externally shall be, 24 hours before preparation of the mix, transferred to the room where temperature is not lower than 10°C.

2.9.5.3 Initiators and accelerants shall be stored in cool, dry, clean and well ventilated places.

2.9.5.4 Other materials, such as cement, plasticizers and other concrete additives shall have catalogue sheets and their validity may not exceed the guarantee period.

2.9.5.5 Any other additives to concrete mix shall be stored in closed containers, protected from dust and moisture.

2.9.5.6 Reinforcement materials shall be stored in a dry place. The elements may not be fat nor rusty.

2.9.5.7 Buoyancy materials, such as e.g. styrofoam or styrodur, shall be stored in original packagings, in dry and dust-free rooms.

2.9.5.8 The temperature of materials prepared for processing shall correspond to the ambient temperature of a processing space.

2.9.6 Processing spaces

2.9.6.1 Appropriately to the size and nature of the manufacture, the processing spaces shall be adequately isolated from storage spaces and various cycles of technological process (preparation of mix, reinforcement cutting, etc.) shall proceed in separate but adjacent rooms. Preparation of the mix in separate rooms or sections ensures avoiding pollution of concrete mix.

2.9.6.2 The processing space shall ensure maintaining constant temperature within 4÷25°C. Exceptionally, temperature reduction to negative values may be allowed. The processing space shall ensure appropriate conditions of concrete curing and setting.

2.9.6.3 The processing space floor shall be clean and dust-free. The cleanliness shall be maintained as far as possible. Air in such space shall be free from dust, especially by such substances which can have negative impact on setting process or create layers separating particular elements. Operation of dust producing machinery is not allowed in such space.

The formwork shall be clean and covered with anti-adhesive means, to avoid pollution of the formwork walls and, in particular, water entry into it.

2.9.6.4 The relative humidity of the space shall generally not exceed 70%. For a short period of time, the relative humidity may be higher and reach 85%.

2.9.6.5 Continuous monitoring of temperature and humidity shall be ensured in the space where the concrete is poured.

2.9.6.6 Appropriate ventilation shall be ensured.

2.9.7 Moulds

2.9.7.1 Materials used for moulds cannot affect the concrete setting process.

2.9.7.2 The moulds shall be of sufficient rigidity and their shape should enable easy removal of the moulded part from the mould.

2.9.7.3 Big moulds shall be provided with proper stagings enabling access to the whole surface of the structure.

2.9.7.4 Construction of houseboats without hull moulds shall be considered by PRS individually.

2.9.8 Concrete pouring

2.9.8.1 Concrete mix shall be prepared by the concrete batching plant, which is provided with appropriate appliances, according to relevant procedures. Composition of each mix prepared by the plant ensures the same properties thereof, irrespective of external conditions.

The properties of the mix are each time confirmed by the relevant document issued by the concrete batching plant.

2.9.8.2 The concrete mix intended for hull structures shall be prepared in accordance with an approved recipe. The class of applied concrete shall be not lower than c 30/37 W12 F100, with addition of dispersed anti-shrinkage reinforcement and with the use of fine aggregate.

2.9.8.3 The absorbability index of applied buoyancy materials shall be below 0.7%.

2.9.8.4 During setting and hardening concrete, appropriate conditions shall be ensured, including:
- optimum thermal and humidity conditions in curing concrete,
- protection of fresh concrete from the effect of sun radiation, wind, precipitation,
- prevention from shrinkage caused by concrete drying,
- reduction of thermal stresses and the risk of concrete cracking,
- prevention from freezing processing water and proper development of concrete durability in reduced ambient temperatures.

2.9.8.5 Thinning concrete mix with water is not allowed.

2.9.8.6 It is recommended to use concrete mix sealing agents.

2.9.8.7 It is recommended to use reinforcement of AIIN class in appropriate spacing, maintaining the length of bar anchoring, with the use of local stiffenings and with appropriate arrangement of reinforcement linkage.

2.9.8.8 The reinforcing mesh from steel ribbed bars shall be used on possibly long sections. Where bars are connected, the overlaps length shall be 40 times the bar diameter.

2.9.8.9 Prior to pouring concrete on the hull plating, moulds shall be carefully cleaned, dried, brought to ambient temperature and protected by anti-adhesive means.

2.9.8.10 Pouring concrete into the mould shall be executed in one cycle, without breaks.

The pouring of all envelope beams, as well as stiffeners in the form of beams on the top of individual hull shall be made in one cycle. Additionally, in the same cycle of pouring concrete, it is recommended to fix the sump tank to the reinforcement (stiffening it along the height). The distance between ferroconcrete stanchions shall amount to ca. 80 cm.

2.9.9 Hardening

2.9.9.1 Upon the completion of the concrete pouring, the hull parts are to be left in the moulds for the time necessary for initial hardening of the laminate and proper curing, in accordance with 2.9.8.4.

2.9.9.2 Parts removed from the moulds shall be left without displacement until they reach 70% of design durability (durability examination of concrete samples taken during production process, 7 days after completion of concrete manufacture).

2.9.9.3 The concrete elements, which reached design durability, may be subjected to design load.

2.9.9.4 The thermal resistance temperature of concrete or buoyancy materials used for hull construction may not be exceeded.

2.9.10 Quality control

2.9.10.1 The builder shall present the results of examinations of concrete control sample, in order to determine durability properties in accordance with the requirements of standards related to properties and durability of concrete:
- for each houseboat built individually,
- for the houseboat selected by the Surveyor in the case of houseboats built in series.

2.10 Pillars

2.10.1 Design load of pillars

The design load of a pillar supporting fragment of the deck shall be assumed as force *Pp* not less than:

$$P_p = 7abh, \text{ [kN]} \tag{2.10.1}$$

a, b – average length and breadth of the supported fragment of the plating, [m],

h – load height acc. to 2.5.

If there is another pillar and another deck above the considered pillar, then the loads of both pillars shall be added.

2.10.2 Strength of Pillars

Under the design load P_p (according to 2.10.1), the permissible strength of pillars P_N shall not be exceeded:

$$P_N = 10^{-3}\delta_N A, \text{ [kN]} \tag{2.10.2}$$

δ_N – permissible compression stress acc. to Table 2.10.2:

Table 2.10.2

Material of pillars	δ_N [MPa]	
	$\lambda \leq 100$	$\lambda > 100$
Carbon steel, stainless steel	$121 - 0.44\,\lambda$	$\frac{770\,000}{\lambda^2}$
Aluminium alloy	$68 - 0.396\,\lambda$	$\frac{285\,000}{\lambda^2}$
Hard wood (E_{min} = 12 000)	$14.05 - 0.093\,\lambda$	$\frac{47\,500}{\lambda^2}$
Soft wood (E_{min} = 9000)	$10.55 - 0.07\,\lambda$	$\frac{35\,500}{\lambda^2}$

λ – slenderness ratio of the pillar,

l_p – pillar span, [mm],

i – radius of inertia, [mm],

$$i = \sqrt{\frac{I}{A}}$$

I – cross sectional moment of inertia, [mm^4],

A – cross section area, [mm^2].

The wall thickness of tubular and shaped pillars shall be sufficient to prevent local buckling.

2.10.3 Remarks as regards structure

2.10.3.1 Structural parts of pillar cap and footing shall be made appropriately to the carried load.

The joints shall be designed in a way preventing excessive pressures in steel parts (i.e. not more than 100 MPa).

2.10.3.2 Pillars shall be mounted on continuous stiffeners. Heavy loaded pillars shall be mounted on stringers distributing the load to several transversal stiffeners.

2.10.3.3 The use of grp laminate pillars is not recommended. If they cannot be avoided, the pillars strength shall not be greater than the strength of wooden pillars of similar dimensions.

3 DECK EQUIPMENT

3.1 Steering gear

3.1.1 General

3.1.1.1 A houseboat, except the houseboat without propulsion, shall be provided with a steering arrangement ensuring her manoeuvrability in every navigational conditions.

3.1.1.2 The steering position shall be located to ensure the possibility of observation of the houseboat surrounding, in accordance with the requirements of PN-EN ISO 11591 Standard.

3.1.1.3 If the steering position or the emergency control position does not ensure the possibility of such observation, the voice contact shall be ensured with a person who has sufficient visibility.

3.1.1.4 Steering may be ensured by rotation of propeller resulting in the change of thrust direction.

3.1.1.5 The thrust direction of the houseboat propeller shall be anytime easy to define.

3.1.1.6 No equipment which may disturb operation of an outboard engine may be installed or stored nearby.

3.1.1.7 The outboard engine shall be fastened to preclude the possibility of propeller striking the houseboat plating or the bottom.

3.1.2 Remote control systems

3.1.2.1 Remotely controlled steering gear shall ensure:
- the possibility of moving the outboard engine propeller from side to side within the range of ± 35°,
- restriction of possible deviations of the propeller to those permitted with regard to structural and operational reasons,
- the possibility of steering, also the emergency steering with the use of thrusters.
  It is recommended to install the propeller position indicator at the helmsman position.

3.1.2.2 For houseboats of length L_H above 10 m, the remotely controlled steering gear shall enable putting the rudder over at full speed from 30° on either side to 30° on the other side in not more than 30 seconds.

3.1.2.3 The cable and pulley steering systems of propeller shall be selected in accordance with the guidelines of the propulsion unit manufacturer and shall comply with relevant requirements of PN-EN ISO 8847, PN-EN 8848 or PN-EN 9775 Standards.

3.1.2.4 The hydraulic steering systems of propeller shall be selected in accordance with the guidelines of the propulsion unit manufacturer and shall comply with relevant requirements of PN-EN ISO 10592 Standard.

3.1.2.5 If more than one steering position is provided, the hydraulic system shall preclude simultaneous steering from different positions.

3.1.2.6 Hydraulic pipelines shall be manufactured in accordance with the requirements of appropriate national or international standards, installed in accordance with the requirements of the outboard engine manufacturer and protected from mechanical and thermal damages. Hydraulic oil shall be suitable for operational conditions of the steering arrangement.

After installation, the hydraulic system shall be subjected to tightness test at maximum working pressure.

It is recommended that hydraulic steering gear should comply with respective requirements of PN-EN ISO 10592 Standard.

3.1.2.7 Hydraulic steering gear with mechanical drive are subject to separate consideration by PRS.

3.1.2.8 Electrical/electronic steering systems shall comply with the requirements of PN-EN ISO 25197 Standard.

3.2 Anchoring and mooring equipment

3.2.1 General

3.2.1.1 Each houseboat shall be equipped with a device to immobilize it at the quay, platform or other place where it stays.

3.2.1.2 A houseboat may be fastened to bollards, dolphins, other units/objects, etc. by means of mooring ropes or other mooring systems. The mooring method shall enable vertical movement of the object considering changes of water level in the area.

3.2.2 Mooring by ropes

3.2.2.1 Each houseboat moored permanently by means of mooring ropes shall be equipped with mooring arrangements of sufficient safe working load, permitting maintenance of the unit position and safe carrying out any mooring operations needed for normal operation. Such operations include pulling the houseboat side or stern to the quay or floating berth, mooring to another unit side-by-side (with dragging the units against each other, if any), small displacements of the unit within the area.

3.2.2.2 The mooring equipment arrangement plan shall define: the purpose and type of each item of the equipment and its safe working load. The plan shall also show the method of transfer the loads from mooring ropes and limit angles of mooring rope deviation from the plane normal to mooring cleat. The plan shall also show the arrangement of mooring ropes and indicate the number (n) of ropes and breaking load for each of them. The selection of equipment shall be carried out in accordance with recognized standards, e.g. ISO 13795, accepted by PRS.

3.2.2.3 The mooring ropes shall be chosen in accordance with Table 3.2.2.11-1, depending on the equipment number.

3.2.2.4 The anchoring and mooring equipment of a houseboat shall consist of:
- main anchor,
- spare anchor,
- anchor chain or anchor rope,
- windlass,
- hawse pipe,
- towing line and its fastening device,
- mooring ropes and their fastening devices.

3.2.2.5 Anchors, anchor chain and anchor ropes shall be stored in a properly prepared place.

3.2.2.6 The equipment number *W* constitutes the basis for the selection of anchoring and mooring equipment. The equipment number shall be calculated from the below formula:

$$W = 0,9L_H\left(0,3B + 0,6H\right) + 0,3N + 5,5D_p^{2/3}, \text{ [m}^2\text{]} \quad (3.2.2.6)$$

Where:

L_H – hull length, [m];

B – hull breadth, [m];

H – moulded depth of hull, [m];

D_p – weight of equipped houseboat, [t];

N – area of side surface of deckhouse or superstructure if their breadth or length exceeds 0.5B, [m^2].

3.2.2.7 The required anchoring and mooring equipment shall be defined according to Tables 3.2.2.11.1 and 3.2.2.11.2. The breaking loads of anchor chains and ropes are defined in Chapter 7 – *Materials*. For intermediate values of equipment number *W*, the anchor weights shall be determined by interpolation, while the lengths and diameters of chains and ropes shall be taken according to the nearest bigger value of equipment number *W* given in the Table.

3.2.2.8 Synthetic towropes of length and diameter complying with Table 3.2.2.11.2 may be used as anchor ropes if the equipment number *W* does not exceed 90. For equipment numbers 70-90, the length of anchor ropes shall be equal to the values given in brackets.

3.2.2.9 Each houseboat shall be equipped with mooring ropes of adequate length and of diameter taken from Table 3.2.2.11.1. The number and length of mooring ropes shall enable safe mooring of houseboat.

3.2.2.10 The design load of a mooring rope taken for calculations of equipment and hull strengthenings shall amount to 1.25 of breaking load of the rope, at adopted level of stresses of 0.9 of destructive stresses for the structure supporting machinery, chosen in accordance with Table 3.2.2.11.2.

3.2.2.11 The design loads of mooring ropes shall be applied at directions shown in the towing and mooring equipment plan. However, possible alterations of directions (horizontal and vertical) of the mooring load shall be considered.

Table 3.2.2.11.1
Anchoring equipment

	Anchors				Anchor chain	
	Main anchor		Spare anchor		Length	Link diameter
W	P	D	P	D		
[m²]	kg	kg	kg	kg	m	mm
Up to 6	9	6			–	–
8	10	7			35	5
10	11	8			40	5
15	12	9			45	6
20	13	10			45	6
25	14	11			45	6
30	15	12			50	6
40	19	15	15	12	50	7
50	23	17	19	14	55	8
60	27	20	22	16	60	8
70	31	23	25	19	70	8
80	36	27	29	22	75	9
90	41	31	33	25	80	9
100	46	35	37	28	90	10
110	52	39	42	31	100	10
120	58	43	46	34	110	10
130	64	47	51	38	120	11
140	70	52	56	42	130	11
150	76	57	61	46	140	11

Anchor type symbols:

P – stockless anchor (Hall or similar),
D – high holding power anchor (Danforth, Bruce, CQR or similar).

Table 3.2.2.11.2
Towing lines and mooring ropes

W [m²]	Towing lines			Mooring ropes	
		Diameter		Diameter	
	Length	polyamide	polypropylene	polyamide	polypropylene
	m	mm	mm	mm	mm
do 6	30	10	12	10	12
8	35	10	12	10	12
10	35	12	14	12	14
15	40	12	14	12	12
20	40	14	16	12	14
25	40	14	18	14	16
30	40	16	18	14	16
40	45	16	18	14	16
50	45	16	18	14	16
60	50	16	20	16	20
70	55 (60) *)	16	20	16	20
80	60 (70) *)	18	20	16	20
90	65 (85) *)	18	22	16	20
100	65	18	22	18	24
110	70	20	24	18	24
120	70	20	24	18	24
130	75	22	26	18	24
140	75	22	26	20	24
150	80	22	28	20	26

*) Values given in brackets refer to towing line used also as an anchor rope.

3.2.2.12 The use of the following types of anchors is recommended:
- stockless anchors,
- high holding power anchors: Danforth, Bruce, CQR or similar.

Anchors shall be, as a rule, manufactured of forged or rolled steel, or cast steel.

The high holding power anchors shall be surveyed before their commissioning. PRS may require carrying out comparative tests of anchor holding power on various grounds, during the houseboat water trial. The scope and programme of comparative tests is each time subject to agreement with PRS.

3.2.2.13 If an anchor rope is used instead of anchor chain, the below requirements shall be fulfilled:
- the anchor chain section of diameter corresponding to equipment number W and of length L_H when $L_H \leq 12$ m or 12 meters when $L_H > 12$ m, shall be fitted between the rope and the anchor;
- the length of the anchor rope, together with the section of anchor chain, shall be at least equal to the required length of chain, given in Table 3.2.2.11.1;
- the anchor rope shall be protected against chaffing by a howsepipe on bow and in the connection with the anchor chain;

– for the houseboats having equipment number $W < 40$, the anchor rope without chain section may be applied.

3.2.2.14 The anchor chain end shall be fastened to the structural part of hull to enable its quick release. The use of the slip-type hooks is recommended.

3.2.2.15 Strength of connecting members may not be lower than the strength of connected chains and anchor ropes.

3.2.2.16 If the anchor weight is 30 kg or more, it shall be operated by a windlass or capstan of appropriate size and structure. The appliances shall be appropriately fastened to hull structure members and their strength shall be such to preclude their permanent deformations when anchor chain or rope breaks.

3.2.2.17 In case of anchors of weight less than 30 kg, the use of windlass is recommended.

3.2.2.18 The houseboats which are not equipped with a device for heaving anchor chain or rope shall be provided with adequately strong bow bollards for turning the anchor rope or chain.

3.2.2.19 Anchor hawse pipes and bow rollers shall have such strength and shapes to properly guide anchor chain or rope. The items shall not be subject to permanent deformation while the anchor chain breaks.

3.2.2.20 A houseboat shall be equipped as a minimum with 4 mooring lines, each of length equal to 1.5 L_H and diameter corresponding to values from Table 3.2.2.11.1.

3.2.2.21 The houseboats of equipment number $W < 10$ may be provided with 2 mooring lines and a towing line of 25 m in length.

3.2.2.22 The houseboat shall have onboard adequately strong devices for belaying the mooring lines and fairleads, which do not cause damage to the lines.

3.2.2.23 Points of fastening anchor chain and anchor ropes, mooring and towing lines shall comply with the requirements of PN-EN ISO 15084 Standard.

3.3 Openings in hull, deck, superstructures and deckhouses and their closing appliances

3.3.1 General

3.3.1.1 Any deck openings, such as: hatches, ventilation openings, inspection holes, shall be provided with adequately tight closing appliances.

3.3.1.2 Tightness of a deck opening closing appliance shall be checked by a test. The test shall be made with use of a hose ended with a nozzle od diameter minimum 12 mm, with water of static pressure min. 0.2 MPa. The test consists in developing a stream of water onto the cover from the distance of 2 m (horizontally and vertically) from different sides, for at least 3 minutes.

3.3.1.3 Watertight closing means that water cannot penetrate through.

3.3.1.4 If water leak does not exceed 0.05 l, the closing is considered weathertight.

3.3.1.5 The deck and side openings, unless permanently closed in navigation, shall be so arranged that their angles of flooding are not less than specified in 4.3.2.

3.3.1.6 Compliance with relevant requirements of PN-EN ISO 12216 Standard is considered equivalent to compliance with the requirements for strength and watertightness of windows, sidescuttles, hatches, skylights and doors specified in this Chapter.

3.3.2 Windows

3.3.2.1 Windows are considered as closed openings in hull and superstructures. Windows may be permanently closed or of opening type. Windows shall be watertight. Weathertight windows may be used on houseboats only in sheltered places, such as aft bulkhead of superstructure. In houseboats without propulsion, the use of weathertight windows is permitted, irrespective of their location.

3.3.2.2 The distance between lower edge of side windows and waterline of houseboat under load may not be less than 250 mm.

3.3.3 Companionways and doors

3.3.3.1 Companionways mean closed communication openings leading from the deck into the houseboat interior. The companionways may be closed by doors or locks. Closing appliances of companionways shall be weathertight.

3.3.3.2 Companionways shall be situated in such a way to ensure protection against direct action of waves when the houseboat is heeled. It is recommended to locate companionways near the houseboat symmetry axis and in aft walls of deckhouses. Companionways are not recommended forward of amidships in bow bulkheads of erections.

3.3.3.3 Onboard houseboats with propulsion, the external doors shall open outside or be slided towards sides or bow. Hinges of doors in side walls of deckhouses shall be situated from the bow side. The door wings shall be capable of being immobilized in the open or closed position.

3.3.3.4 Coamings of companionway sills onboard houseboats shall be not lower than 50 mm.

3.3.4 Hatches

3.3.4.1 Hatches mean openings closed by covers in horizontal or slightly inclined parts of decks.

3.3.4.2 Compliance with relevant requirements of PN-EN ISO 12216 Standard is considered equivalent to compliance with the requirements for hatches.

3.3.5 Panes of windows, hatches and skylights

3.3.5.1 The windows, hatches and skylights leading to closed spaces of houseboats with propulsion, shall be watertight, of durable structure and provided with panes made from pre-stressed glass, acrylic glass, metaplex or polycarbonate, of thickness g_s not less than:

$$g_s = 0.85 \cdot k \cdot \sqrt{\frac{F_b}{h_s}} F_s \quad \text{[mm]} \qquad (3.3.5.1)$$

k – load coefficient given in Table 3.3.5.1;
h_s – vertical distance from geometric centre of window to loaded houseboat waterline, [m];
F_s – window surface area, [m²].

Table 3.3.5.1
Window load coefficient

		Load coefficient *k* for material

Location of window, hatch or sky-light	Length of house-boat hull L_H [m]	SHW, PW	SHJ, M, A
Uncovered: in the plating or front walls of erections	$L_H < 12$	**12**	**18**
	$12 \le L_H \le 24$	**14.4**	**21**
Covered: aft and side wall of deck-houses	$L_H < 12$	**9.6**	**14.4**
	$12 \le L_H \le 24$	**12**	**18**

Symbols:

SHW –pre-stressed multi-layer glass
PW – polycarbonate
SHJ – pre-stressed single-layer glass
M – polymethylmethacrylate
A – acrylic glass.

The thickness of windows, hatches and skylights on houseboats shall be not less than:

4 mm – for pre-stressed glass,
5 mm – for other materials.

3.3.5.2 Panes used for closing appliances of hatches or skylights, designed to be walked on, shall be made of acrylic glass, polycarbonate or polymethylmethacrylate and their thickness shall be not less than $1.25g_s$ (g_s – acc. to formula 3.3.5.1). If the hatch pane is properly protected, the requirement is not applicable.

3.3.5.3 Panes made from pre-stressed glass shall be fitted in a metal frame. The frame shall overlap the glass by at least 6 mm

3.3.5.4 Panes from other materials may be fitted in a frame or directly on the plating if the connection is tight. The pane shall overlap the plating by not less than 5% of the lower dimension of window and not less than 20 mm.

3.3.5.5 In houseboats without propulsion, weathertight windows provided with panes from window glass of thickness less than specified in 3.3.4, however not less than 4 mm, may be used.

3.3.6 Ventilation openings

3.3.6.1 The ventilation openings shall be arranged to comply with the requirements of 4.3.1 and 4.3.2.

3.3.6.2 It is recommended that the closing appliances of openings leading to chain locker should be weathertight. Notwithstanding the above, the locker shall have an efficient drainage.

3.3.6.3 If the openings leading to chain locker are not closed weathertight, the locker structure shall comply with the requirements for cockpits.

3.3.7 Cockpits, recesses

3.3.7.1 All recesses in the houseboat deck, such as cockpits or liferaft beds, gas cylinder recesses, shall be so constructed that water cannot enter through into the houseboat interior. Their bottom shall be at least 50 mm above the loaded houseboat waterline. Small cavities are allowed in the bottom of recess unless its area exceeds 10% of the bottom area.

3.3.7.2 If there are openings in the walls of cockpit, their lower edges shall be placed at least 50 mm above the cockpit bottom and they shall be equipped with weathertight closings.

3.3.7.3 Instead of permanent coaming of 100 mm in height, a permanent coaming 500 mm high and dismountable extension board not less than 500 mm in height may be applied.

3.3.7.4 Cockpit design shall ensure that water which got inside is drained overboard, irrespective of possible trim and heel of the houseboat, at its maximum draught.

Total cross-sectional area of all drains from the cockpit F_o shall be not less than:

$$F_o = 1500\ V_c \quad [\text{mm}^2] \tag{3.3.7.4}$$

V_c – cockpit volume measured up to possible highest flooding level, after closing drains and other openings, [m³].

At least two drains shall be led from each cockpit, each having an internal diameter not less than 25 mm.

3.3.7.5 The recesses may be non-drainable if their volume *Vc* does not exceed:

$$V_c = 0{,}025 L_H B F_m \quad [\text{m}^3] \tag{3.3.7.5}$$

3.3.7.6 Diameters of drains shall be selected respectively to diameters of openings. The drain pipes shall be manufactured of hull material (steel, grp, aluminium alloy) or of copper alloys. Where flexible hoses or pipes of thickness less than that of the hull plating are applied, the drains located below the waterline shall be equipped with side valves. The flexible hoses shall comply with the requirements of Chapter 7 – *Materials*.

3.3.7.7 Compliance with appropriate requirements of PN-EN ISO 11812 Standard for design category D is considered as equivalent to compliance with requirements for cockpits set forth in this chapter.

3.4 Watertight bulkheads

3.4.1 It is recommended that houseboat with propulsion shall be provided with a collision bulkhead, placed ca. $0.05L_w$ from the bow perpendicular.

3.4.2 The fuel tank compartment onboard houseboats shall be separated from other hull compartments by bulkheads extending from the bottom to the tight deck. The use of other arrangements, efficiently protecting the fuel tank compartment in the event of water ingress, is allowed upon agreement with PRS.

3.4.3 For houseboats, it is recommended to separate the bilge of fuel tank compartment from other compartments.

3.4.4 The engine room adjacent to enclosed accommodation spaces shall be tightly separated from them. The petrol engine or petrol tank spaces shall be made tight in accordance with the requirements of PN-EN ISO 11105 Standard.

3.4.5 Bulkhead penetrations of electric cables and pipelines cannot compromise the bulkhead tightness.

3.5 Crew protection means

3.5.1 Onboard houseboats, the distance to the nearest exit from any room may not exceed 5 m.

3.5.2 If the accommodation space is separated from the nearest exit by means of doors or other permanent division, and the way to this exit leads directly through galley space or engine room, an emergency exit shall be provided.

3.5.3 The minimum clear dimensions of any exit from accommodation space shall be 450 mm for circular exits and 380 mm for exits of another shape, with minimum area of 0,18 m^2 and the diameter of the circle inscribed in the exit at least 380 mm.

3.5.4 The exits shall be easily accessible and shall be capable of being opened from both sides if they are bolted but not locked. If a hatch in superstructure is considered as an emergency exit, supports for feet, ladders, stairs or other means shall be provided. The vertical distance between upper feet support and the exit may not exceed 1.2 m.

3.5.5 The escape ways of a houseboat shall comply with relevant requirements of PN-EN ISO 9094 Standard.

3.5.6 Rails

3.5.6.1 A houseboat shall be provided with a guard rail which prevents falling overboard. The height of the guard rail shall be not less than 1000 mm.

3.5.6.2 Onboard houseboats of length L_H less than 10 m, instead of the guard rail other crew protection against falling overboard is allowed, upon agreement with PRS.

3.5.6.3 The side or bulwark acting as a guard rail shall be ended with a handrail.

3.5.6.4 Guard rails on a houseboat of length L_H at least 10 m shall comply with the below requirements:

.1 They shall consist of the following elements:
- permanent bow pulpit,
- permanent aft pulpit or two permanent semi-pulpits connected with steel lines,
- stanchions,
- two ropes connecting stanchions.

.2 The stanchions shall be fitted in sockets permanently fixed to the deck by welding (if metal deck) or by at least one through bolt in each socket. They may be also fixed directly to deck, without using sockets. It is recommended that the distance of stanchion axes to external edge of deck does not exceed the greater of the two values: $0.05B$ or 150 mm. The stanchion axes shall be inclined to vertical by not more than 10°. The stanchion spacing shall not exceed 2.00 m. Stanchion sockets shall not protrude beyond the deck outline.

.3 The strength of deck fixing of stanchion sockets shall be not less than 120% of the strength of stanchion at deck.

.4 The railing ropes shall be made of stainless or galvanized steel, have diameter not less than 4 mm and shall be led through stanchions at the height not less than 600 mm (upper line) and 300 mm (lower line).

.5 The bow and aft pulpit, and stanchions shall be made of material having sufficient strength and water resistant. Stanchions manufactured from carbonate steel shall be hot galvanized.

.6 The section modulus of a steel stanchion at deck W_x shall be not less than:

$$W_x = 0{,}8\, e\, h \quad [\text{cm}^3] \tag{3.5.6.4}$$

e – stanchions spacing, [m];

h – stanchion height, [m].

3.5.6.5 The houseboat railing shall comply with the requirements of 3.5.6.4 and additionally:

.1 the upper pipe shall be led on the height not less than 1000 mm above the deck;

.2 the lower pipe shall be led on the height not more than 230 mm above the deck;

.3 the distances between the railing pipes may not exceed 300 mm. It is recommended to protect the lower half of the railing by a net.

3.5.6.6 Instead the railing pipes, ropes may be applied. In well-grounded cases folded railings may be used.

3.5.6.7 Onboard houseboats without propulsion, the guard rails protecting falling overboard need not be used on decks situated not higher than 500 mm above waterline.

3.6 Decks

3.6.1 Anywhere the crew may walk, the deck shall be made so that to prevent slipping, e.g. by roughening laminate surface, deck covering with non-painted wooden planks, anti-slip coated sheets or paints and anti-slip coverings.

3.6.2 If the hatch covers may be walked on by the crew, the hatch covers shall be particularly well protected against slipping.

3.6.3 Additional requirements

3.6.3.1 It is recommended that all houseboats shall be provided with arrangements for person recovery to deck, including deck ladder.

3.6.3.2 For the protection against falling overboard and ensuring means for recovery from water, it is recommended to use arrangements complying with the requirements of PN-EN ISO 15085 Standard.

4 STABILITY AND UNSINKABILITY

4.1 General

4.1.1 Intact stability of each houseboat shall be checked. For this purpose, an inclining test shall be performed in the presence of PRS Surveyor and on the basis of the test the *Stability Booklet* shall be prepared and approved.

The stability may be checked by experiment in the presence of the PRS Surveyor. The report on experimental checking stability is subject to approval.

4.1.2 Updating the *Stability Booklet* or checking stability by experiment may be required also after conversion of a houseboat, resulting in:
- change of weight of an empty houseboat by more than 6%; or
- increase of the height of the its centre of gravity by more than 2 cm.

4.1.3 The inclining test, made for experimental determination of the houseboat centre of gravity, shall be performed by a method widely accepted in shipbuilding theory.

4.1.4 The *Stability Booklet* may be prepared without inclining test by defining the mass of an empty houseboat through weighing it and by assuming that the boat centre of gravity is 0.75 m above the main deck.

4.1.5 The *Stability Booklet* shall include :
- the houseboat's identification data (name, type, No. of build, purpose, main dimensions, the maximum number of occupants, deadweight, the minimum freeboard, the mass of ballast, expected navigation area),
- the table of hull shape or body lines with accepted coordinate system and the position of base plane,
- the results of calculations of hydrostatic curves, cross curves of stability and angles of flooding, with coordinates of flooding points,
- inclining test report endorsed by PRS Surveyor, together with calculations of the vertical centre of gravity of an empty houseboat,
- the list of adopted loading conditions,
- diagrams of the static stability righting levers curve,
- information on compliance with the requirements given in 4.3,
- recommendations for the person in chargé of the unit on hazardous situations at various loading conditions.

4.1.6 Checking stability by experiment consists in carrying out measurements, tests and calculations within the scope necessary to confirm conformity of the houseboat structure with the requirements specified in 4.3, without preparation of *Stability Booklet*.

The report of checking the stability by experiment shall contain:
- the houseboat's identification data (name, type, No. of build, purpose, main dimensions, the maximum number of occupants, deadweight, the minimum freeboard, the mass of ballast, expected navigation area),
- confirmation by PRS Surveyor of the correct execution of the test,
- the list of adopted loading conditions and the method of deadweight execution in these conditions,
- information on compliance with the requirements given in 4.3,
- recommendations for the person in chargé of the unit on hazardous situations at various loading conditions.

4.1.7 For the series production, PRS may depart from inclining test or experimental checking stability on each houseboat of the same type.

4.1.8 The stability calculations shall consider the most unfavourable loading conditions. At least the following loading conditions of the manned houseboat fully equipped for navigation, shall be considered:

- a fully loaded houseboat with full stores, with completely filled water or sewage tanks;
- a fully loaded houseboat with 10% of stores;
- a fully loaded houseboat with 10% of stores and the maximum number of occupants on the highest deck (if exists);

For the houseboat operated in winter season, having mark R in the symbol of class, additionally stability in conditions of icing and loading with snow shall be checked. The conventional mass of ice shall be taken as equal to 20 $L_H B$ [kg], and the centre of the mass shall be assumed in geometrical centre of windage area for the loading condition most unfavourable as regards stability. The conventional mass of snow shall be adopted acc. to PN-EN 1991-1-3.

4.1.9 PRS may require the *Stability Booklet* taking into account other loading conditions, such as flooding cockpit and recesses on deck.

4.1.10 The stability calculations of single-hull houseboats of non-typical shapes and multi-hull houseboats are subject to separate consideration by PRS.

4.1.11 Compliance with appropriate requirements of PN-EN ISO 12217 Standard is considered equivalent to compliance with the stability requirements for houseboats, specified in this Chapter.

4.2 Stability calculations and tests

4.2.1 The stability calculations shall be performed by methods widely adopted in shipbuilding theory.

4.2.2 The calculations of the cross-curves of stability may consider fully only the erections with external openings closed weathertight. The recesses in deck and erection shall be taken into account.

4.2.3 Non-drainable deck recesses are also considered as openings that can cause flooding.

Side openings which are closed watertight, deck openings closed weathertight, permanently closed during navigation, side outlets of pipelines and other openings having area less than $660 D_z$ [mm^2] shall be treated as openings that cannot cause flooding.

4.2.4 At determination of the centre of gravity for stability calculations, the following shall be assumed:

- the centre of mass of cargo (liquids in tanks, stores) at the real height of the centre of mass for the most unfavorable condition (as regards stability), however not less than 0.1 m above deck;
- the height of the centre of mass of standing persons: 1.0 m above the deck, distribution: 4 persons per 1 m^2 of deck surface, the height of the centre of mass of sitting persons: 0.3 m above the bench, distribution: one person per each 0.5 m of the sitting place width, assuming the mass of one person 75 kg.

4.2.5 Approximate angle of flooding φ_z may be calculated from the formula:

$$\varphi_z = arctg\, h_z / b_z \tag{4.2.5}$$

b_z – the distance from the point of flooding to the houseboat symmetry plane, [m].

4.2.6 The heeling angle due to peoples' crowding to one side φ_p may be defined by experiment or by calculation, assuming that:

- the persons are standing on the deck on available area along one side; when the deck area is occupied, remaining persons are sitting on each free area, excluding windows, roofs of wheel-houses and surfaces inclined to the highest load waterline by an angle more than 10°;
- the sitting width and projection length of 0.5×0.75 m is assumed for one sitting person;
- the persons are so distributed that the biggest heel is reached.

4.2.7 The design heeling moment due to wind M_w shall be determined from the below formula:

$$M_w = 0{,}3A_w\left(\frac{A_w}{L_w} + T_m\right)V_w^{\,2} \quad \text{[Nm]} \tag{4.2.7}$$

A_w – total lateral windage area, [m²],

T_m – the maximum draught measured amidships, [m],

V_w – wind speed V_w = 13 m/s for wind force 4°B.

4.2.8 If there are fuel, water or sewage tanks onboard the houseboat, whose centres of volume are not situated in the symmetry plane, the heeling angle shall be calculated for asymmetrical filling od tanks φ_a, resulting from the mass of liquid in the largest side tank, assuming real position of its centre of volume.

4.3 Stability criteria of houseboats

4.3.1 The minimum height of flooding h_{zm} shall be not less than the values given in Fig. 4.3.1:

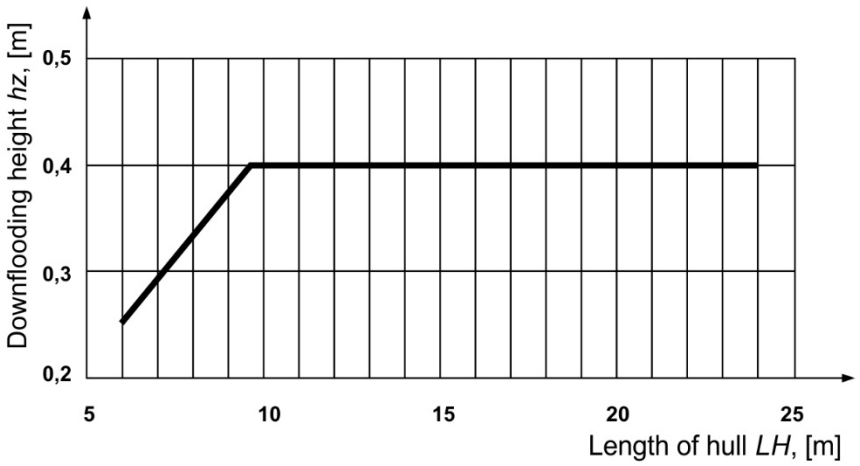


Fig. 4.3.1

4.3.2 The angle of flooding of the houseboat φ_{zm} shall be not less than:

$$\varphi_{zm} = 11{,}5 + \frac{(24-L_H)^3}{520} \tag{4.3.2}$$

4.3.3 The angle of heeling due to peoples' crowding to one side of houseboat φ_p shall be not greater than specified in Table 4.3.3:

Table 4.3.3
Permissible angle of heeling due to peoples' crowding to one side φ_p

L_H [m]	Up to 8	8 - 9	9 - 10	10 - 11	11 - 12	12 - 13	13 - 15	15 - 17	17 - 20	20 - 24
φ_p	20°	18°	17°	16°	15°	14°	13°	12°	11°	10°

For houseboats with commercial purpose, the angle of heeling φ_p shall not exceed 10°, irrespective of the unit length.

When the houseboat heels due to crowding of people toward one side, the height of the lowest downflooding point above the waterline shall be greater than 0.1 m.

4.3.4 Allowable angle of heel φ_0 resulting from simultaneous loading of houseboat with heeling moments:
- due to people's crowding towards one side,
- due to wind force,
- due to icing,
- due to asymmetric filling tanks,

shall not exceed:

$$\varphi_0 \le 0.5\ \varphi_z \qquad (4.3.4\text{-}1)$$

and:

$$\varphi_0 \le \varphi_{zp} \qquad (4.3.4\text{-}2)$$

φ_{zp} – angle of downflooding houseboat deck at its allowable load, i.e. the angle of heel at which deck edge immerses.

For the houseboat operated in winter season, assigned symbol of class R, the allowable angle of heel shall be determined for the conditions of simultaneous icing and loading with snow.

4.3.5 For determining angles of heel by experiment, an equivalent mass shall be applied so distributed that the required value of heeling moments can be achieved, in accordance with 4.2.6 - 4.2.8.

4.4 Unsinkability

4.4.1 Unsinkability of houseboats is not required, however, it may be confirmed by PRS at the request of the Owner.

4.4.2 A houseboat is recognized as unsinkable if the following requirements are fulfilled:
- the houseboat with full equipment and load, additionally loaded with mass of 25n [kg] (where n is the maximum number of occupants), is still afloat after flooding the biggest empty hull compartment and the upper edge of the side remains 0.1 m above water level;
- the angle of heel φ_p shall not exceed 6°;
- the houseboat with watertight subdivision loaded as above and with any compartment flooded, retains the resultant waterline at least 50 mm off deck edge or side coaming;
- so flooded houseboat does not capsize by the effect of heeling moment M_n defined from the below formula:

$$M_n = 0{,}5B(100 + 50n) \quad \text{[Nm]} \qquad (4.4.2)$$

- the range of positive stability of flooded houseboat shall be not less than flooding angles defined in 4.2.5.

4.4.3 The buoyancy elements which ensure unsinkability of a houseboat may be constructed as:
- fixed, empty containers of verified tightness,
- permanently fitted foam blocks,
- built-in tanks foamed internally after installation.

The buoyancy materials shall comply with the requirements specified in Chapter 7 – *Materials*.

4.4.4 Compliance with the requirements specified in 4.4.2 shall be confirmed by a test carried out to the scope agreed each time with PRS. For series production, PRS may waive checking the unsinkability of each houseboat of the same type.

4.4.5 When the houseboat unsinkability on the basis of performed calculations is requested, it is subject to a separate consideration by PRS. In such case, checking tightness of buoyance tanks is required, together with their filling ratio and actual volume.

4.4.6 During unsinkability test, the inclining test shall also be carried out for checking the values of righting moment and the range of positive stability in a flooded condition. The test method and scope shall be each time agreed with PRS.

5 MACHINERY

5.1 General

5.1.1 This Chapter of the Rules covers houseboats defined in Chapter 1 – *Classification Regulations*, driven by an internal combustion engine, diesel or petrol type, equipped with a fixed fuel system, as well as houseboats without propulsion.

5.1.2 The houseboats with built-in engine and with electric drive will be considered separately by PRS.

5.1.3 The control system shall comply with the requirements given in *Part VI – Machinery and Piping Systems* of the *Rules for the Classification and Construction of Small Sea-going Ships*, within the scope agreed with PRS.

5.1.4 Compliance with respective requirements of PN-EN ISO 8848, PN-EN ISO 9775 Standards is considered equivalent to compliance with the requirements for the steering system of houseboats specified in this Chapter.

5.1.5 The internal combustion engines, irrespective of their rated power, installed onboard houseboats, shall comply with the requirements for exhaust emissions defined in 2013/53/EU Directive.

5.1.6 It is recommended that houseboats should comply with the noise emission requirements defined in the 2013/53/EU Directive.

5.1.7 In well-grounded cases, such as application of novel or non-typical arrangements, PRS may agree to departures from the requirements of this Chapter or may extend the scope of requirements.

5.1.8 PRS supervision shall cover onboard installation and operational tests of the following elements being a part of the houseboat driving machinery:
- driving engine and propeller,
- fuel tanks,
- the control, monitoring and alarm systems of machinery,
- the fuel, bilge and sanitary systems.

5.2 Engines, control system, installations, tanks

5.2.1 Driving engines

5.2.1.1 The driving engine power shall be selected considering the dimensions of underwater part of houseboat and approximate mass of the houseboat. The engine control system shall not contribute to unsafe situations. The power of the driving engine shall ensure still water speed of up to 12 km/h.

5.2.1.2 The outboard engine shall be installed not to pose danger to the houseboat crew and shall be protected from external damage.

5.2.1.3 The driving engine shall have CE marking and its conformity with 2013/53/EU Directive on recreational craft and personal watercraft shall be confirmed.

5.2.1.4 The outboard engines shall be equipped with devices preventing engine activation with gear engaged, in accordance with the requirements of PN-EN ISO 11547 Standard.

5.2.1.5 Bolts fixing driving engines to the houseboat transom shall be effectively secured against loosening.

5.2.1.6 The allowable angle of engine inclination to design waterline shall be defined by the engine manufacturer.

5.2.1.7 It is recommended that the driving engine operation manual developed by the manufacturer should be available onboard houseboat.

5.2.2 Control position

5.2.2.1 The driving engine control position shall be equipped with:

- control devices,
- control and measuring instruments as defined by the engine manufacturer.

5.2.2.2 Direct control of driving engine by means of steering system is also permitted.

5.2.3 Fuel tanks spaces

5.2.3.1 The arrangement of tanks and their fittings shall enable access to them and their safe operation.

5.2.3.2 The spaces housing fuel tanks shall be separated from enclosed accommodation spaces, the following conditions being complied with:

- the edges of partitions shall be welded, glued or laminated;
- pipings or cable penetrations shall be sealed with gaskets or sealing compounds;
- doors and hatches shall be equipped with appropriate securing and locking arrangements.

5.2.3.3 Electrical appliances installed in the fuel tank space and in adjacent compartments, unless the spaces are open to atmosphere, shall be ignition protected, in accordance with PN-EN ISO 8846 Standard.

5.2.4 Ventilation of enclosed spaces

5.2.4.1 The space where fuel tanks are housed shall have an efficient ventilation. The ventilation system shall prevent gathering flammable gases and vapours.

5.2.4.2 Fitting side air intakes for the fuel tank space is allowed on houseboats, provided the angles of flooding given in *Chapter 4 – Stability and unsinkability* are preserved.

5.2.5 Natural ventilation

5.2.5.1 Each space which is not open to atmosphere and where a fixed fuel tank and an electrical appliance other than fuel level indicating device is provided and the space intended for the storage of portable fuel tanks shall have natural ventilation system, consisting of an inlet opening or duct open to atmosphere and of an outlet opening or duct.

5.2.5.2 The opening or branch pipe of the inlet duct shall be situated in the lower one third of the space height. The inlet and outlet openings shall be spaced by not less than 600 mm, if the space size allows it.

5.2.5.3 The outlet and inlet openings or branch pipes shall be located above the normal level of bilge water collecting in the space.

5.2.5.4 The combined area A of the internal cross-section of inlet openings or ducts and outlet openings or ducts of natural ventilation system shall be not less than:

$$A = 3\,300\, ln\frac{V}{0{,}14}, \quad [\text{cm}^2] \tag{5.2.5.4}$$

and shall be greater than 30 cm^2.

V – net volume of the ventilated space after deducting the volume of machinery and equipment installed there, [m^3].

The value of required area A for V up to 5 m^3 has been given in the diagram 5.2.5.4:

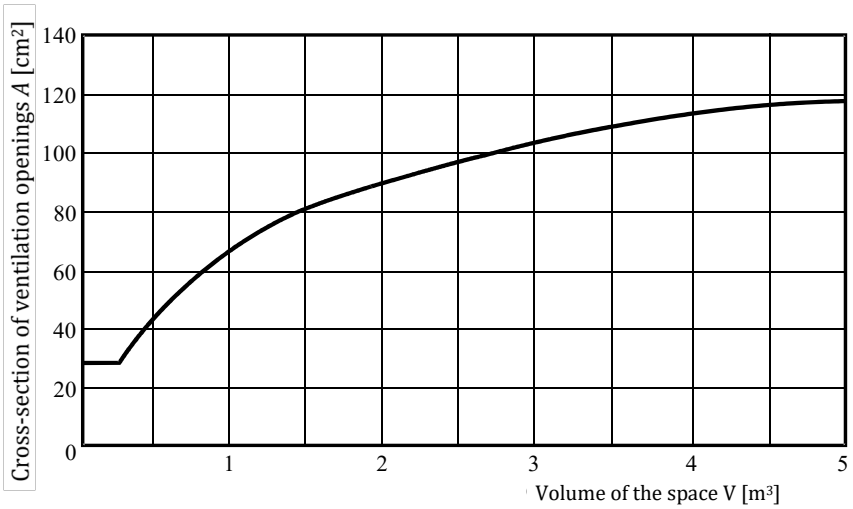


Diagram 5.2.5.4

5.2.5.5 The internal cross-section area of branch pipes of flexible ventilation ducts shall be not less than 0.8 of the value determined from formula 5.2.5.4.

5.2.6 Forced ventilation

5.2.6.1 In addition to the natural ventilation system, each space which is not open to atmosphere and which houses permanently built-in petrol engine shall be provided with mechanical exhaust ventilation system, removing air from this space to atmosphere, in accordance with the requirements of PN-EN ISO 11105 Standard.

5.2.6.2 The outlet of natural ventilation may be also an integral part of mechanical ventilation system.

5.2.6.3 The suction branch pipe of the exhaust duct shall be located in the lower one third of the ventilated space height and above the normal level of bilge water gathering in this space.

5.2.6.4 The exhaust fans shall comply with the requirements of PN-EN ISO 9097 Standard. They shall be marked: „ISO 9097 MARINE". Fans manufactured and marked in accordance with the requirements of United States Coast Guard (USCG) are permitted for use.

5.2.6.5 Combined capacity of installed exhaust fans Q shall be not less than the capacity given in Table 5.2.6.5.

Table 5.2.6.5

V [m³]	Q [m³/h]
< 1	1.5
$1 \le V \le 3$	$1.5 \times V$
> 3	$0.5 \times V + 3$

For V up to 5 m³, the value of required capacity Q has been given in the diagram 5.2.6.5.

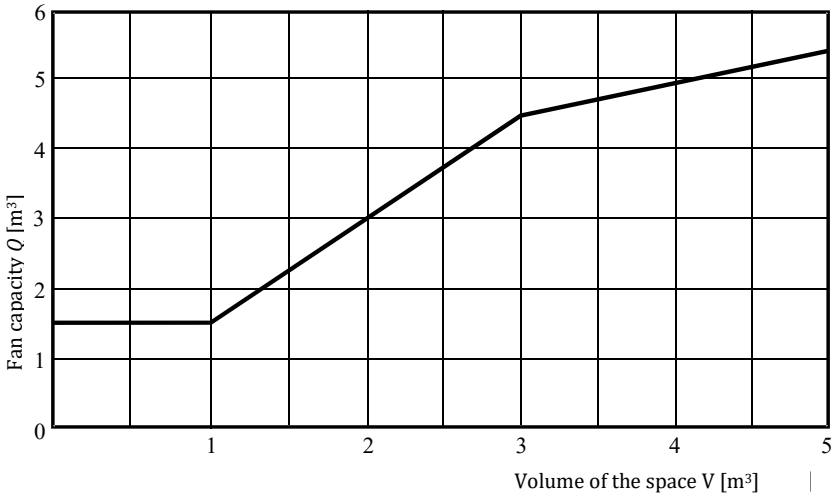


Diagram 5.2.6.5

5.3 Bilge system

5.3.1 A houseboat shall be equipped with an efficient bilge system ensuring pumping water outboard from each space, even at most adverse heel, however not exceeding 7°.

5.3.2 If the houseboat hull has any watertight bulkheads, the bilge system arrangement shall ensure pumping out water from each compartment. Peaks of combined volume not greater than 10% of the houseboat displacement in loaded condition may be drained by a branch pipe to an adjacent compartment, under the condition that a valve or an easily accessible plug is installed on the branch pipe. Larger peaks may be drained by a separate hand-operated pump.

5.3.3 The bilge system is not required for the watertight compartments, which are hermetically sealed during operation or are equipped with openings (e.g. for ventilation), which prevent water passage into the compartment.

5.3.4 Arrangement of bilge pipes shall preclude the possibility of accidental ingress of sea-water into the houseboat. If a bilge main has been applied, a non-return valve shall be installed on each suction branch.

5.3.5 The suction branches of the bilge main shall be located as low in the bilge as possible and shall be equipped with easily accessible strum boxes. It is recommended that the diameter of the strum box opening should be not greater than 10 mm, and the combined area of the openings should be not less than double area of the piping cross-section.

5.3.6 Depending on size, houseboats shall be equipped with the bilge system in accordance with Table 5.3.6.

Table 5.3.6

Houseboat size	Pumps required
Houseboats of hull length up to 6 m	min. 1 main pump, electric + 1 emergency pump, eg. hand-operated
Houseboats of hull length from 6 to 12 m	min. 2 main pumps, electric + 1 emergency pump hand/mechanically-operated
Houseboats of hull length from 12 to 24 m	min. 3 main pumps, electric + 2 emergency pumps hand/mechanically-operated

5.3.7 The below pumps may be use as bilge pumps:

- hand-operated pumps: diaphgram, piston, semi-rotary pumps, operated from deck or from an easily accessible position above waterline,
- mechanically-operated pumps: self-primimg, driven by electric motor or auxiliary diesel engine,
- submersible electrically-driven pumps, operated from main control position, including pumps operated automatically at increase of water level in the bilge.

5.3.8 Electrically-driven pumps shall comply with the requirements of PN-EN ISO 8849 Standard and shall have marking: „ISO 8849 MARINE".

5.3.9 The main bilge pumps shall be permanently installed.

5.3.10 Capacity of each pump shall be not less that specified in Table 5.3.10 and shall be capable of draining all compartments. The arrangement of pumps shall be such to minimize the risk of losing the possibility to drain bilges in emergency.

5.3.11 The capacity of operating pumps and nominal diameters of bilge pipes shall be not less than those given in Table 5.3.10.

Table 5.3.10

Hull length L_H [m]	**Bilge pump capacity**			**Nominal diameter of pipings [mm]**
	Hand-operated[1] [l/stroke]		**mechanically and electrically driven [m³/h]**	
	diaphgram	**piston[2]**		
$L_H < 8$	**0.5**	**0.7**	**3.4**	**25**
$8 \le L_H < 10$	**0.7**	**1.0**	**3.7**	**32**
$10 \le L_H < 12$	**0.9**	**1.25**	**4.1**	**32**
$L_H \ge 12$	**0.9**	**1.25**	**4.7**	**40**

1) 45 cycles per minute to be assumed to define the pump capacity;
2) also the semi rotary pump.

5.3.12 Onboard the houseboats with CE marking, bilge pumps of capacity defined in EN-ISO 15083 Standard are allowed.

5.3.13 If several bilge pumps are connected to a common outlet piping, a shut-off non-return valve shall be installed on the delivery branch of each pump.

5.3.14 Mechanically-driven bilge pumps may be used also for other purpose, such as delivery of water to deck, provided a three-way valve with *L* cross-section or other arrangement to prevent accidental ingress of sea water are applied.

5.3.15 Bilges, in which oily bilge water, spilled fuel or other flammable liquid may be present, shall be accessible for cleaning. Overboard discharge of oily bilge water and oily residues is strictly forbidden.

5.3.16 Efficient means for oily bilge water removal and discharge to shore reception facilities shall be provided. The arrangement of bilge pipings which allows for pumping oily bilge water to sewage tank or to portable container is recommended, with the use of any bilge pump or an additional hand-operated pump, which may be used as portable one.

5.4 Exhaust gas system

5.4.1 Where exhaust gas lines are led through the shell plating, near the load waterline, means shall be provided, or the line shall be properly shaped, to prevent overboard water ingress into the engine. Inside the houseboat, the exhaust gas line may be in the form of a loop whose lower edge is situated as high above the waterline as practicable.

5.4.2 At dry exhaust if an efficient thermal protection is not provided, exhaust pipes shall not be led less than 250 mm from the oil fuel tanks, being measured from the outer surface of exhaust pipe insulation.

5.4.3 At dry exhaust, each exhaust pipe shall be provided with a silencer.

5.4.4 At dry exhaust, an elongation compensating device and the possibility of drainage of exhaust gas system shall be provided.

5.4.5 At dry exhaust, the exhaust lines and silencers shall be made of steel and shall be covered along the whole length with incombustible thermo-insulating material. The temperature on the insulation surface shall not exceed 60 °C.

5.4.6 At wet exhaust, i.e. where exhaust gas is cooled with water, the entire or a part of pipeline may be made of a flexible hose complying with the provisions of Chapter 7 – *Materials*.

5.4.7 At wet exhaust, where the cooling water inlet to the exhaust line is situated near or below the waterline, means shall be provided to prevent cooling water ingress to exhaust manifold.

5.5 Fuel system

5.5.1 The fuel system fittings shall be located in well visible and easily accessible places. The fuel pipings shall be properly fixed and arranged or shielded to be protected against mechanical damage.

5.5.2 Petrol tanks shall be spaced from internal combustion engine by at least 100 mm and separated by a partition, or placed at a distance of at least 250 mm, from the elements of dry exhaust system.

5.5.3 The fuel system of driving engines shall be possible of being emptied only through plugs fitted in petrol filter casings.

5.5.4 Each element of petrol tank and of its filling system made of metal or covered with metal coating, which can contact petrol, shall be grounded so that its ground resistance is less than 1 ohm. The end of the lightning conductor should not be inserted between a flexible hose and its securing piece. The requirements for the earthing plate are provided in Chapter 6 – *Electrical Installations.*

5.5.5 Fuel tank structure

5.5.5.1 Independent diesel oil tanks shall be manufactured of carbon steel, corrosion resistant steel or aluminium alloy, while petrol tanks shall be made from corrosion resistant steel or aluminium alloy. Materials for tanks shall comply with the requirements provided in Chapter 7 – *Materials*. The petrol tanks may be manufactured from carbon steel, provided that they will be hot galvanized on both sides after manufacture. The diesel oil tanks should be neither galvanized nor painted inside. The thickness of the tank walls shall be not less than that given in Table 5.5.5.4.

5.5.5.2 Non-metallic tanks may be used if they comply with the requirements for fire resistance specified in PN-EN ISO 21487 Standard.

5.5.5.3 The use of other materials is subject to agreement with PRS.

5.5.5.4 The tanks made of aluminium alloy shall not be connected with fittings made from copper alloys, unless separation washers are used.

Table 5.5.5.4

Tank volume, [dm³]	Minimum thickness of walls, [mm]		
	Carbon steel	Corrosion resistant steel	Aluminium alloy
Up to 100	2 (1,5)[1)]	1	2
101 – 200	3 (2)[1)]	1.5	3
201 – 500	4 (3)[1)]	2	4
501 – 1000	5 (4)[1)]	3	5
above 1000	6 (5)[1)]	4	6

[1)] for hot galvanized tanks.

5.5.5.5 Depending on the tank volume and shape, appropriate stiffenings or wash bulkheads shall be applied. Open area of the bulkhead shall be not more than 30% of the tank cross-section in the bulkhead plane. The bulkhead shall not obstruct the fuel flow at the bottom and vapour flow at the top of tank.

5.5.5.6 Independent tanks shall be fixed to the hull so that the loads from the filled tank, taking into account downward and upward accelerations due to houseboat movement at maximum speed, are safely carried by the hull structure.

5.5.5.7 Flexible fixture of tanks with the use of metal or textile pressing tapes is recommended, provided that the risk of their wear and corrosion is reduced to a minimum.

5.5.5.8 Integrated fuel tanks are intended only for diesel oil. They shall be separated from the fresh water tanks or lubricating oil tanks by cofferdams. The requirements for the thickness of integrated tank walls are given in Chapter 2 – *Hull*.

5.5.5.9 Integrated fuel tanks made from laminate are subject to separate consideration by PRS.

5.5.5.10 Portable fuel tanks shall have volume not greater than 25 l and shall comply with the requirements of ISO 13591 Standard. The information that these requirements are fulfilled shall be placed on the tank.

5.5.5.11 Where portable tanks are installed, the shut-off valve need not be installed on the pipings delivering fuel to the tank if the tank is supplied by the engine manufacturer and is equipped with a quick-acting joint with the non-return valves.

5.5.5.12 Fittings and any openings in the petrol tank shall be placed in the upper wall of tank, except for filling pipe and fuel return, which may be welded in the upper part of side wall of the tank, to protrude above the upper wall of the tank.

5.5.5.13 Fittings and all branch pipes situated on the side walls of the diesel oil tank shall be protected by shut-off valves installed directly on the tank.

5.5.5.14 Tank valves having nominal diameter not greater than 25 mm shall be secured or shielded to preclude the possibility of their damage.

5.5.5.15 If the diesel oil tank shall be provided with drainage or discharge, a self-closing valve or shut-off valve and plug unscrewed only by tools shall be installed.

5.5.5.16 Diesel oil tanks shall be equipped with inspection openings of diameter at least 120 mm, located on the upper or side walls of the tank and accessible after the tank is mounted in hull, for cleaning and inspection of the tank bottom parts.

5.5.5.17 It is recommended to mark each independent fuel oil tank in accordance with PN-EN ISO 21487 Standard.

5.5.6 Examination of oil fuel tanks

5.5.6.1 The fuel tank shall be subjected to pressure tests together with all of its fittings.

5.5.6.2 Each metal or laminate diesel oil tank shall be subjected to tightness test with test pressure equal to 1.5 hydrostatic pressure, the tank may suffer in service (maximum filling above the tank upper wall). The test pressure may, however, not be lower than 0.02 MPa. The test is considered positive if no leak occurs after 5 minutes.

5.5.6.3 Depending on the material density, thermoplastic diesel oil tanks shall be subjected to respective pressure tests, in accordance with the requirements of PN-EN ISO 21487 Standard.

5.5.6.4 Each metallic petrol tank, whose structure complies with the requirements for an integral tank, specified in Chapter 2 – *Hull,* and whose welds are of quality level B, for steel in accordance with PN-EN ISO 5817 Standard and for aluminium alloys in accordance with PN-EN ISO 10042 Standard, shall be subjected to pressure test with a gradually increased pressure, equal to 1.5 hydrostatic pressure the tank may suffer in service (maximum filling above the tank upper wall) plus 0.01 MPa. The test pressure may not, however, be lower than 0.03 MPa. The test result is considered satisfactory if no tank crack or leak occurs after 1 minute.

5.5.6.5 Metallic petrol tank which does not comply with the requirements of 5.5.6.4 and non-metallic petrol tank shall be subjected to a pressure pulse test, in accordance with the requirements of PN-EN ISO 21487 Standard.

5.5.7 Filling and air pipes

5.5.7.1 The filling piping shall be routed on its shortest way from the deck filler to the tank and so arranged that all fuel flows into the tank. No valves may be installed on the filling pipes.

5.5.7.2 The filling and air pipings may be made from flexible hoses complying with the requirements of *Chapter 7 – Materials*.

5.5.7.3 The filling pipe (branch piece) shall extend above the upper wall of tank. If the tank height is greater than 800 mm, the filling pipe shall be carried possibly close to the tank bottom.

5.5.7.4 The internal diameter of the filling pipe shall not be less than 31.5 mm, while the internal diameter of the flexible hose shall not be less than 38 mm.

5.5.7.5 The filling and air pipings shall ensure filling of the tank with a rate of 30 l/min, without fuel return through the filler, within the range from 25% to 85% of the tank volume. For tanks with volume not exceeding 100 l, the capacity may be reduced to 20 l/min.

5.5.7.6 The fuel filler shall be located above the deck. Within 400 mm from the filler, no air vents may be located, which by design are not protected against fuel vapours penetration into the houseboat interior. The fuel filler shall be so situated that fuel, when overflowing during tank filling, does not penetrate into the houseboat interior.

5.5.7.7 Each fuel tank shall have its dedicated air vent piping, whose structure precludes occurrence of liquid seals.

5.5.7.8 The cross-sectional area of each element of air piping shall be not less than 95 mm^2 (∅ 11 mm).

5.5.7.9 Air pipings shall be carried to open deck and shall end at a distance not less than 400 mm from air vents, through which fuel vapours could penetrate into houseboat interior, and on such a height to prevent ingress of sea water into the tank and fuel or its vapours penetration into the houseboat interior.

6 ELECTRICAL INSTALLATIONS

6.1 General provisions

6.1.1 Application

6.1.1.1 The requirements of *Chapter 6 – Electrical Installations* are applicable to safe voltage electrical installations, as well as to electrical installations operating at higher voltages intended to supply appliances which do not affect the safety of houseboat sailing and its manoeuvring capability, specified in *Chapter 1 – Classification Regulations.*

6.1.1.2 Where electrical installations operating at a voltage exceeding the safe voltage, intended to supply appliances which affect the safety of houseboat sailing and its maneuvering capability, are installed, the following shall be additionally complied with: the requirements of *Part VII – Electrical Equipment and Automation* of the *Rules for the Classification and Construction of Inland Waterways Vessels* with respect to inland waterways houseboats and the requirements of *Part VII – Electrical Installations and Control Systems* of the *Rules for the Classification and Construction of Small Sea-going Ships*.

6.1.1.3 In well-justified cases, PRS may give consent to the departure from the requirements of the present *Part* or may extend the scope of the requirements in the case of, for example, novel or untypical designs application.

6.1.1.4 It is recommended that the electrical equipment, used on board, should comply with the requirements of the relevant harmonized standards under Directive 2013/53/EU or other national or international standards, indicated by PRS.

6.2 General requirements

6.2.1 Operating conditions

6.2.1.1 Electrical equipment installed on a houseboat shall be capable of reliable operation in the following conditions:
- ambient air temperature in spaces: from 0 to +30°C;
- ambient temperature on open deck: from -25 to +30°C;
- continuous heel of up to 15°;
- short time heel of up to 30°;
- short time longitudinal inclination of up to 20°.

6.2.1.2 The electrical equipment placed in locations subject to heavy vibrations shall be so designed as to be capable of normal operation under such conditions or shall be mounted on suitable shock absorbers.

6.2.2 Materials

6.2.2.1 The structural parts of electrical equipment shall be made of metal or not readily ignitable insulating materials, resistant to marine atmosphere and oil vapours effects or they shall be reliably protected against such effects.

6.2.2.2 All current-carrying parts of electrical equipment shall be made of copper, copper alloys or other materials having equivalent qualities.

6.2.2.3 Studs, nuts, washers and clamps used for cable connection shall be made of materials resistant to corrosion and shall not cause cable electrochemical corrosion. They shall not be made from aluminium alloy or unplated steel.

6.2.3 Arrangement of electrical equipment

6.2.3.1 Electrical equipment shall be installed in such a manner as to provide easy access to control elements and to all parts that require maintenance, inspection and replacement.

6.2.3.2 Electrical equipment shall be efficiently protected against temperature rise caused by external sources of heat so that the permissible temperature limit will not be exceeded.

6.2.3.3 Electrical equipment shall be fixed in position in such a manner that the fastening method does not reduce the strength and watertightness of hull plating, deck or bulkhead.

6.2.3.4 Electrical equipment shall not be installed closer than 75 mm to the fuel tanks walls.

6.2.3.5 Generators, starters and other electrical equipment driven by internal combustion engine shall be so installed as to be above the expected bilge water level and spaced, as far as practicable, from the fuel system.

6.2.4 Marking of electrical equipment and conductors

6.2.4.1 It is recommended that all consumers installed on the houseboat operating at a voltage higher than the safety voltage should be provided with EC marking in accordance with Low Voltage Directive 2014/35/EU.

6.2.4.2 Electrical apparatus and equipment installed on the houseboat shall be provided in a visible place with plates stating the rated voltage and the rated current. For AC equipment, frequency and the number of phases shall be additionally given.

6.2.4.3 Enclosures and shielding of electrical equipment intended for generating, converting and distribution of electrical power, operating at a voltage higher than the safety voltage shall be marked with a high voltage electric shock hazard warning.

6.2.4.4 Electrical equipment for which specific polarization of power supply connection and earthing is required shall be appropriately marked.

6.2.4.5 Accumulator batteries shall be visibly marked with polarity and ratings: voltage, capacity and the starting current.

6.2.4.6 All electrical conductors which are part of the electrical system (direct current and alternating current) shall be identified by colour of insulation, colour or marking of ends, or shall be identified, in an explicit and legible manner, using other means. The following colour identification of conductor insulation is recommended:
- live conductors: black or brown;
- neutral conductors: white or light blue
- protective conductors: green or green with a yellow stripe.

It is recommended that on houseboats with AC and DC systems, the use of brown, white or light blue insulation colour in DC system should be avoided unless the conductors are clearly separated from AC conductors and identified.

Yellow, green or green with a yellow stripe insulation shall not be used for live conductors or neutral conductors of AC system.

6.2.5 Degrees of enclosures protection

6.2.5.1 Electrical equipment shall be provided with appropriate protective enclosures depending on their location or other suitable measures shall be taken to protect the equipment from harmful effect of the environment.

6.2.5.2 The minimum degree of protection of electrical equipment installed on the houseboat shall be chosen in accordance with Table 6.2.5.2.

Table 6.2.5.2

Item	Location of electrical equipment	Equipment location charactristics	Designation of degree of protection
1	Sheltered spaces below deck	Dry spaces	IP 20
2	Parts of spaces and rooms close to entrances to open deck	Possibility of liquid drops or sprays	IP 23
3	Engine compartments, galleys, bathrooms	Danger of liquid occurrence and mechanical damage	IP 44
4	Decks, holds	Danger of water spray and mechanical damage	IP 56
5	Open decks	Immersion of short duration	IP 67

6.2.6 Electrical equipment in explosion hazardous spaces

6.2.6.1 Electrical equipment installed in spaces containing petrol engines and petrol cylinders, LPG cylinders spaces or in other spaces where flammable gases may accumulate shall be of flameproof type in accordance with PN-EN 28846 or IEC60079-0 Standard.

6.2.7 Earthing and equipotential bonding

6.2.7.1 Exposed metal parts of electrical equipment which are touched during service and which may become live under fault conditions shall be connected to earth. Earthing connection is not required in the case of:

.1 electrical equipment supplied at safe voltage;
.2 electrical equipment provided with double or strengthened insulation.

6.2.7.2 The active area of earthing plate shall be not less than 0.1 m^2; the thickness of the earthing plate shall be not less than 2 mm. It is recommended to use earthing plates made of porous copper alloys. Earthing plate shall not be installed in the vicinity of propeller and log converters or echo sounder. In lieu of earthing plate, a metal part of the permanently submerged houseboat structure (e.g. rudder blade, shaft bracket) may be used.

6.2.7.3 The connection of: earthing, bonding or protective conductor to the houseboat's metal hull or to earthing plate shall be made at a location above the anticipated bilge water level.

6.2.7.4 On power driven non-metallic houseboats, it is recommended that bonding conductors should be used between blocks of propulsion or auxiliary engines and metal parts of the fuel system. The bonding conductor shall be connected to earth plate or a permanently submerged metal part of the hull structure.

6.2.7.5 On houseboats fitted with petrol engines, the fuel metal cylinder, the stub pipe and any other metal part of the fuel flow pipe, which may be in contact with fuel, shall be connected by bonding conductor and earthed. The end of bonding conductor shall not be inserted between the elastic pipe and the branch pipe.

6.2.7.6 Earthing shall be made using copper conductor with the cross-section not less than that given in Table 6.2.7.6.

Table 6.2.7.6

The cross-section of cable conductor connected to item of equipment **[mm²]**	The cross-section of equipment earthing conductor, minimum **[mm²]**
Up to 2.5	Single-wire conductor 2.5 **Multi-wire-conductor 1.5**
above 2.5 to 120	Half the cross-section of a cable conductor connected, but not less than 4
above 120	**70**

6.2.7.7 The resistance of connection between any part of enclosure of equipment which shall be earthed, any part of the bonding or protective connection and earthing plate or metal hull shall not exceed 1 Ohm.

6.2.7.8 Screens and the metal sheath of cables, if applied, shall be earthed. The earthing shall be made at both ends of a cable, except cables in final sub-circuits which are permitted to be earthed on the supply end only.

6.2.7.9 Superstructures of aluminium alloys fastened to the houseboat's steel hull, but insulated therefrom, shall be earthed with at least two conductors having a cross-section not less than 16 mm².

6.2.7.10 To prevent electrolytic corrosion, it is recommended that a galvanic isolator complying with the requirements of PN-EN ISO 13297 should be installed in the shore power supply protective conductor. The galvanic isolator resists stray galvanic current flow while permitting the passage of alternating current, if present.

6.2.7.11 The bonding and earthing conductors shall be made with copper conductors with yellow-green insulation.

6.2.7.12 Connections of bonding and earthing conductors shall be executed in accessible places, easy to be visually inspected.

6.2.8 Lightning Protection

6.2.8.1 It is recommended that houseboats should be provided with lightning protection complying with the requirements of ISO 10134 Standard.

6.2.8.2 It is recommended that the lightning spike should be connected to a separate earth plate or a separate earthing pin.

6.3 Sources of electrical power

6.3.1 General requirements

6.3.1.1 The source of electrical power on the houseboat may be:

- an accumulator battery,
- the propulsion engine driven generator (altenator)
- a generator with an independent prime mover (e.g. a generating set)
- a solar battery,
- supply from the shore.

6.3.1.2 The capacity of the electrical power source shall be sufficient for supplying all electrical equipment on board under all operating conditions.

6.3.1.3 For the propulsion engine starting system on self-propelled houseboats, at least one starter accumulator shall be provided, of sufficient capacity for ensuring 6 consecutive starts of 5 seconds duration. Where two or more engines are fitted, the capacity of the accumulator shall be sufficient to ensure at least 3 starts of each engine.

6.3.1.4 One of the starter accumulators may also serve as service accumulator, i.e. may be used for supplying the houseboat's electrical services. The battery shall have sufficient capacity for supplying the equipment affecting the boat safety during at least 8 hours, without recharging.

6.3.1.5 The generator, installed on board, shall be capable of supplying all electrical equipment and simultaneously be capable of charging the accumulator batteries within a time not exceeding 8 hours.

6.3.1.6 Electric power balance and the capacity of starter batteries shall be made according to PN-W-89509.

6.3.1.7 The selection of starter batteries according to the engine manufacturer's recommendations is permissible.

6.3.1.8 Where more than one starter is supplied from the same accumulator battery, the battery capacity shall be not less than the sum of the capacity calculated for the starter with the highest power output and 50% of the capacity calculated for each additional starter.

6.3.2 Electrical power parameters

6.3.2.1 During charging accumulator batteries or where the electric installation is supplied by accumulator batteries only, the permissible long-term deviation from the rated voltage shall not exceed +25% to -15%.

6.3.2.2 The length and cross-sectional area of conductors shall be such that the voltage drop, with every appliance in the circuit switched on at full load, does not exceed:

- 3 % in accumulator charging circuits and in circuits supplying the main switchboard, in navigation lights, navigation equipment and bilge pumps circuits,
- 7 % in power circuits, lighting circuits and the remaining circuits.

The method of selecting cable cross-sections is given in sub-chapter 6.12.2.

6.3.3 Electromagnetic interference

6.3.3.1 It is recommended that generating sets, isolation transformers, as well as voltage and frequency converters, installed on houseboats, should comply with the requirements of Directive 2014/108/EC relating to electromagnetic compatibility.

6.3.4 Electrical power sources supplied at a voltage higher than safe voltage

6.3.4.1 Generating sets, voltage and frequency converters, as well as transformers shall be located at least 500 mm above the anticipated bilge water level.

6.3.4.2 Only dry-type transformers shall be used.

6.3.4.3 An indicator shall be provided in an easily visible place on AC or the main switchboard control panel to indicate the operation state of all electrical power sources supplied at a voltage higher than safe voltage.

6.4 Accumulator batteries

6.4.1 General requirements

6.4.1.1 It is recommended that non-service accumulator batteries (valves regulated) should be used.

6.4.1.2 It is recommended that service accumulator batteries should be traction batteries (deep-discharge batteries), marked "marine".

6.4.2 Installation requirements

6.4.2.1 A battery isolation switch shall be installed in the positive conductor of the battery/group of batteries, connected to the supply system voltage in a readily accessible location, as close as practicable to the battery/group of batteries. For DC distribution systems where both positive and negative conductors are isolated from earth, double pole isolation switches shall be used.

6.4.2.2 The above requirement does not apply to outboard-powered houseboats with circuits for engine starting and navigation lights only.

6.4.2.3 The minimum continuous rating of the battery/group of batteries isolation switches shall be not less than the full-load current and operating voltage of the circuit. The rating of isolation switches, through which the voltage is supplied to the starter, shall be suitable for momentary starting current.

6.4.2.4 The following systems, individually protected by a fuse or circuit-breaker, may be connected between the isolation switch and the battery:
- bilge pumps;
- engine alarm and monitoring signal;
- exhaust ventilation from engine and fuel tank compartments, as well as accumulator batteries compartment;
- instruments monitoring batteries charge;
- other appliances subject to PRS' acceptance in each particular case.

6.4.2.5 The following conductors are allowed to be connected to the battery/group of batteries terminals:
- main supply conductors;
- the rectifier or other charging devices conductors;
- conductors connecting batteries into a group of batteries;
- conductors supplying the equipment listed in 6.4.2.4.

6.4.2.6 The battery connection and charging system shall preclude the batteries from being discharged due to charging device voltage drop or decay. It is recommended that diode separation

or VSR relay should be used between starter batteries and service batteries, as well as other accumulator batteries.

6.4.2.7 The houseboat battery/batteries charging system shall ensure continuous charging of all batteries during propulsion engine operation.

6.4.2.8 Battery charging devices shall be appropriately selected and adjusted to the type and capacity of the installed batteries.

6.4.2.9 Where isolation switch is placed in accumulator batteries box or inside the accumulator batteries compartment, it shall be of explosion-proof construction.

6.4.2.10 Accumulator batteries shall not be used for supplying consumers operating at a rated voltage lower than the total voltage of all cells of the batteries.

6.4.2.11 Where the propulsion engine starting system is designed for a voltage higher than the rated voltage of the houseboat's electrical installation, a short-time connection of batteries in series for the purpose of starting the engine is permitted. Suitable change-over switches shall be used for the connection of batteries.

6.4.2.12 Accumulator batteries, except batteries intended for starting internal combustion engine, shall be protected against short-circuits by fuses located as close as practicable to batteries terminals, but outside the battery container/box.

6.4.2.13 In starter batteries circuits, short-circuit and overload protection shall not be used.

6.4.2.14 It is recommended that charging devices should be fitted with instruments for monitoring charging of batteries.

6.4.2.15 It is recommended that electric motors should be installed far from the bilges and in locations where they will not affect the operation of other equipment (the temperature of the engine housing, vibrations).

6.4.2.16 Unless specially designed, electric motors and other devices fitted with brushes, commutator or rings shall be installed outside spaces, in which flammable vapors may accumulate.

6.4.2.17 Provision shall be made for the local starting and stopping of each electric and hydraulic motor.

6.4.2.18 Provision shall be made for remote switching on and switching off ventilation fans and pumps from outside the engine compartment.

6.4.2.19 Electric bilge pumps shall comply with the requirements of the PN-EN ISO 8849 Standard.

6.4.2.20 Fans installed on houseboats should meet the requirements of PN-EN ISO 9097 Standard.

6.4.2.21 It is recommended that windlasses, capstans and other high power consumers should be supplied by separate accumulator batteries.

6.4.2.22 Permanently installed inverters and inverter/chargers shall supply less than 250V at a frequency of 50 Hz or 60 Hz, and shall:
- be designed to operate up to an ambient temperature of 50 °C and withstand an ambient temperature of 70 °C without damage;
- be automatically controlled;
- provide isolation of the AC output from the DC supply circuit;

- have controls which are readily accessible;
- be located in a ventilated, dry, readily accessible site where ambient temperatures will not exceed 50 °C;
- be mounted away from heat sources such as engine exhaust system components and other heat-producing devices;
- be mounted not less than 500 mm above foreseeable levels of bilge water.

6.4.2.23 Inverter outlet circuits shall be protected in accordance with chapter 6.9.

6.4.3 Arrangement of accumulator batteries

6.4.3.1 Accumulator batteries shall be installed above the anticipated bilge water level, in a dry, easily accessible, ventilated location, not exposed to the effect of external factors, such as unacceptably high or low temperature, water spray and mechanical damage. The batteries shall be so located that escaping gases or electrolyte cannot constitute hazard.

6.4.3.2 The accumulator batteries shall be so arranged and installed as to allow to check their condition without the necessity to dismantle the structural parts of the houseboat.

6.4.3.3 Accumulator batteries shall be installed in such a manner that they will not move more than 10 mm in any direction when exposed to a force corresponding to twice the battery weight.

6.4.3.4 Lead-acid batteries and alkaline batteries shall not be placed in the same box or compartment. The containers and instruments intended for the batteries with different electrolytes shall be placed separately.

6.4.3.5 The inside part of the battery compartment or box, as well as structural parts which may be subjected to harmful effect of electrolyte or gas shall be made of appropriate material or shall be suitably protected.

6.4.3.6 Accumulator batteries shall be installed and protected so that metallic objects cannot come into unintentional contact with any battery terminal.

6.4.3.7 Terminals of accumulator battery cable shall not depend on spring tension for mechanical connection to them and they shall not be subjected to mechanical strain.

6.4.3.8 Terminals of accumulator batteries which are not located in boxes or separate compartments shall be covered with a protective cover made of dielectric material.

6.4.3.9 Accumulator batteries shall not be installed directly below rectifiers (chargers) or converters, above and below fuel tanks, fuel filters and any other metallic components of the fuel system.

6.4.3.10 Starter batteries shall be located as close as possible to the propulsion engine.

6.4.3.11 Accumulator batteries shall not be installed in the same compartment in which petrol engines, petrol cylinders or gas cylinders are located. This requirement does not apply to accumulator batteries with valves (closed), including gel batteries.

6.4.3.12 It is recommended that batteries/group of batteries having a capacity of up to 2 kW, calculated from the 8 hour charging current and rated voltage, should be located in naturally ventilated boxes or lockers inside the houseboat hull, in well-ventilated spaces, except accommodation spaces.

6.4.3.13 Where, owing to the distance to main consumers, accumulator batteries are placed in accommodation area, they shall be placed in closed containers, boxes or separated lockers fitted with ventilation ducts led to the open deck.

6.4.3.14 Batteries/group of batteries having a capacity of over 2 kW, calculated from the 8 hour charging current and rated voltage, shall be located in closed boxes or separate compartments fitted with ventilation system complying with the relevant requirements specified in *Part VI – Machinery and Piping Systems* of the *Rules for the Classification and Construction of Small Sea-going Ships.*

6.4.3.15 Accumulator batteries ventilation system shall not be common with other ventilation systems.

6.5 Distribution of electric power

6.5.1 General requirements

6.5.1.1 The electrical system shall be designed in accordance with Polish Standards, rules for: fire protection, environment protection and occupational hygiene and safety and shall ensure:
- power supply of appropriate technical parameters to consumers, according to needs,
- protection against electric shock, connecting and atmospheric surge, fires, explosions and other damages,
- protection against vibration and noise above permissible level and harmful effects of electro-magnetic field.

6.5.1.2 In houseboats fitted with both DC and AC electrical systems, these systems shall be clearly separated.

6.5.1.3 The cables of the DC and AC electrical systems shall be installed on separate trays. When single conductors are installed, the DC and AC conductors shall be separated by at least 100 mm.

6.5.1.4 The DC and AC electrical systems shall be supplied from separate switchboards. A common switchboard may be permitted if a partition or other positive means is provided to separate clearly the DC and AC sections from each other.

6.5.1.5 After removal of the switchboard casing and panels, the terminals shall be accessible and marked in such a way at to allow easy identification of the circuits.

6.5.1.6 The AC and DC conductors, as well as conductors operating at different voltages shall not be connected to the same terminal block. The positive and negative pole terminal blocks shall be explicitly marked.

6.5.1.7 The protections of the lighting final circuits of spaces shall be designed for the rated current not exceeding 10 A. The cabin fans and other minor consumers may be supplied from the lighting final circuits.

6.5.2 DC distribution systems

6.5.2.1 The DC equipment shall function in accordance with the requirements of PN-EN ISO 10133 Standard over a voltage range at the battery terminals as follows:
- for a 12 volt system: 9 V to 16 V;
- for a 24 volt system: 18 V to 32 V.

6.5.2.2 On DC installations, the following distribution systems may be used:
- two-wire insulated;

– two-wire with negative earth.
For houseboats having aluminium hulls, two-wire insulated system is recommended.
The houseboat's hull shall not be used as return conductor. In propulsion engine electric system, the engine block may be used as an earthing conductor.

6.5.2.3 Systems with multiple battery banks shall have a common negative connection.

6.5.2.4 The cross-sectional area of negative pole conductor, connected to earthing plate or to the houseboat hull, shall be the same as the cross-sectional area of the positive pole main conductor connecting an accumulator battery with a starter or the main switchboard, whichever is the greater.

6.5.2.5 The use of other distribution systems or other rated voltages will be specially considered by PRS.

6.5.3 AC distribution systems

6.5.3.1 The permissible rated voltage of 50 Hz across the terminals of the sources of electrical power shall not exceed 230 V at the single-phase alternating current (for 60 Hz – 250 V).

6.5.3.2 On AC installations, the following distribution systems may be used:
– single-phase, two-wire insulated (IT);
– single-phase, three-wire with neutral insulated and directly earthed (TN-S);

On houseboats having aluminium hulls, it is recommended to use electrical installation fitted with isolation transformer or to install galvanic isolator in PE conductor.

When an optional galvanic isolator is fitted in the protective conductor to resist imported stray galvanic current flow while permitting the passage of AC current, failure of the isolator shall not result in an open circuit.

In no of the above systems the hull can be used as return conductor. The use of other distribution systems, as well as the values of the voltage and frequency shall be agreed with PRS.

6.5.3.3 Insulated distribution systems shall be provided with devices to monitor the insulation level to earth.

6.5.3.4 In earthed systems, in addition to overcurrent circuit breaker, a residual-current protective device with sensitivity of 30 mA shall be fitted in the main supply circuit to automatically disconnect the supply.

6.5.3.5 The houseboat AC system circuits shall not be capable of being energized by more than one source of electrical power at a time. Each shore power inlet, generator set or inverter shall be regarded as a separate source of electrical power.

6.5.3.6 The transfer from one power source circuit to another shall be made by a means which opens all current-carrying conductors, before closing the other source circuit.

6.5.3.7 The applied power sources change-over switch shall prevent electric arc between contacts and shall be interlocked by mechanical and electromechanical means to prevent power supply by both sources.

6.5.4 Power supply from an external source of electrical power

6.5.4.1 Where provision has been made for the supply of the houseboat's network from an external source, a shore supply inlet shall be installed on the boat.

6.5.4.2 Shore power supply terminal shall be a "male" socket-outlet, protected against mechanical damage and flooding with water; the degree of enclosure protection shall be in accordance with 6.2.5.2, but not less than IP 44.

6.5.4.3 Shore power supply terminal installed directly on the open deck shall have the enclosure protection IP 56.

6.5.4.4 The inlet shall be installed in a place suitable for the connection of the flexible cable to the shore supply socket outlet and shall be provided with a plate stating the supply rated voltage, frequency and the permissible rated current.

6.5.4.5 The main circuit of power supply from an external source shall be protected onboard the houseboat against short circuits and overloads and shall be provided with voltage presence indicator at the main switchboard or other switchboard/panel.

6.5.4.6 The overcurrent protective device shall simultaneously open all current-carrying conductors. During power supply from the shore, the houseboat installation protective conductor shall be connected with PE of the shore system, except cases when the shore power is supplied through an isolation transformer so connected that complete isolation of the houseboat installation from the shore system is ensured.

6.5.4.7 The shore power supply signaling system should allow to check the polarity of the incoming supply in relation to the houseboat system. This does not apply to houseboats fitted with isolation transformers in which case the whole installation is equally polarized and when double-pole circuit breakers are installed.

6.5.4.8 The shore power shall be supplied by flexible external cable for portable consumers, having the cross-sectional area suitable for the prescribed power input and the length not exceeding 25 m. It is recommended that the cable should be made in accordance with PN-EN 60092-507 Standard.

6.5.5 Socket outlets

6.5.5.1 Socket outlets installed in circuits with different voltages shall be so designed as to prevent insertion of a plug intended for one voltage into a socket intended for another voltage.

6.5.5.2 Socket outlets installed on open decks shall be suitably protected against mechanical damage and flooding with water, in accordance with 6.2.5.2.

6.5.5.3 Socket outlets in systems for a voltage higher than safe voltage should be equipped with a terminal provided for the protective conductor.

6.5.6 Switchboards

6.5.6.1 On houseboats fitted with AC and DC electrical systems, the switchboards shall comply with the requirements specified in 6.5.1.4 and 6.4.1.6.

6.5.6.2 The switchboard casings, brackets and connecting elements shall be made of metal or other fire-retardant material having low flame-spread characteristics.

6.5.6.3 The degree of switchboards enclosure protection shall depend on their location as specified in 6.2.5.2.

6.5.6.4 Switchboard shall be so installed as to allow easy reading of parameters and switchgear operation.

6.5.6.5 Switchboards shall be installed in such a way that controls, indicators, switches and fuses are readily accessible. Access to terminals shall be provided.

6.5.6.6 It is recommended that switchboards should be fitted with measuring instruments indicating the basic parameters of the electric power generating system, i.e. voltage and current, as well as monitoring the accumulator batteries charge, generating set load, the direction of electric power transfer from voltage converters. The rated values shall be indicated on the instruments scale.

6.5.6.7 Where measuring instruments are not available, charging (alternator operation) signal lamp and voltage drop alarm shall be installed.

6.5.6.8 Liquid-carrying pipes shall not be led above switchboards and consoles. Pipes may be led in front and at side of the switchboards and consoles, at a distance not less than 200 mm, provided that dismountable joints are not installed there.

6.5.6.9 It is recommended that the main switchboard shall be provided with at least 2 auxiliary circuits for connecting additional electrical consumers, including protective devices.

6.5.6.10 Doors and other swing elements of switchboards shall be fitted with interlocking arrangements preventing them from being automatically closed when maintenance work is carried out during voyage.

6.6 Electric lighting

6.6.1 General requirements

6.6.1.1 It is recommended that, depending on the size and designation of the houseboat, the boat general lighting, the lighting of machinery spaces, as well as spaces in which people may be employed, should be separated into two circuits fitted with independent protective devices.

6.6.1.2 Lighting fixtures shall be installed in such a manner as to prevent the heating of cables and adjacent materials up to a temperature exceeding the permissible temperature.

6.6.1.3 It is recommended that on each lighting fixture, the rated voltage and the permissible luminance level of a light source should be durably indicated.

6.6.2 Navigation lights

6.6.2.1 The arrangement of the houseboat navigation lights, depending on the boat's length and purpose, shall comply with the relevant requirements of the requirements of *CEVNI Regulations* with respect to inland waterways boats.

6.6.2.2 Navigation lights shall be supplied from the main switchboard or from a separate navigation lights distribution board so located as to be visible by the helmsman or the houseboat user.

6.6.2.3 Where navigation lights are so located that they cannot be seen by the helmsman, they shall be provided with visual indicators showing the operation of each navigation light.

6.6.2.4 Each navigation light shall be supplied by a separate circuit protected by a circuit-breaker. It is recommended that each navigation light shall be fitted with its own switch. However, it is permitted to use one switch for a group of navigation lights always operating simultaneously.

6.6.3 Emergency escape lighting

6.6.3.1 The emergency escape lighting shall be used:

– in spaces lighted only by artificial light,
– in escape routes leading from the above spaces.

6.6.3.2 The emergency escape lighting shall be designed and constructed in accordance with PN-EN 1838 Standard.

6.6.3.3 In electric power balance prepared for emergency conditions, provision shall be made for accumulator battery reserve capacity ensuring the lighting of passageways for 1 h.

6.6.3.4 Where independent escape fixtures are used, they shall ensure 1 hour battery operation.

6.7 Electric propulsion system

6.7.1 The installation of the unit's electric drive system will be individually considered by PRS for compliance with the requirements of the currently valid PN-EN ISO 16315 Standard.

6.8 Saunas and heating appliances

6.8.1 Space heaters

6.8.1.1 The permissible leakage current for hot heating appliances of stationary type shall not exceed 1 mA per 1 kW rated input of any separately connected heating element and not more than 10 mA for the appliance taken as a whole.

6.8.1.2 Heating appliances and space heaters shall be so designed that the temperature of their components which are to be handled by the personnel or which can be touched accidentally does not exceed the values stated in Table 6.8.1.2.

Table 6.8.1.2

Item	Specification		Permissible temperature [°C]
1	Control handles and other parts to be handled during substantial periods of time	metallic non-metallic	55 65
2	Enclosures of electric space heaters at 20°C ambient temperature		80
3	Air coming out from space heaters		110

6.8.1.3 Electric heaters intended for space heating shall be of stationary type. The electric heaters shall be provided with a suitable system to disconnect the supply source when the temperature rise exceeds the permissible limits for the heater enclosures. Automatic restarting without manual reset of the system shall be precluded.

6.8.1.4 If built-in switches are not provided in the heating appliances, such switches shall be installed in the rooms in which these appliances are located. Switches shall disconnect power supply at all poles or phases.

6.8.1.5 The enclosures of electric space heaters shall be so constructed as to prevent the possibility of placing any objects on them.

6.8.1.6 Stationary space heating appliances rated at voltage higher than safe voltage shall be protected against access to live parts except with the aid of special tools. The enclosures shall have notices giving the voltage value.

6.8.2 Saunas and steam baths

6.8.2.1 All houseboats housing a sauna or a steam bath or an infrared sauna shall comply with the requirements of the *Rules*, and protection shall be ensured against fire caused by electric appliances.

6.8.2.2 Sauna heaters shall be equipped with a time switch disconnecting supply to heating elements after the preset time.

6.8.2.3 All sauna circuits, except the heater circuits, shall be equipped with one or several protective residual current devices of rated residual current not exceeding 30mA.

6.8.2.4 Any electrical appliances installed in the sauna room shall have the degree of enclosure protection in accordance with 6.2.5.2 and shall be suitable for operation at temperatures expected in sauna.

6.8.2.5 A control console or thermostat for setting inside temperature, shall be placed inside or outside the sauna room.

6.8.2.6 A safety switch shall be provided in the sauna room to disconnect the heating circuit, and for Finnish sauna – an additional thermal switch fitted beyond thermostat (or electronic control console) set in accordance with manufacturer's recommendations.

6.8.2.7 Plug sockets shall not be installed in the sauna spaces.

6.8.2.8 The switchgear, other than safety switches and control consoles, for other circuits, e.g. the lighting circuits, shall be installed outside the sauna and cabin room.

6.8.2.9 All cables used inside the sauna room shall be suitable for operation at a temperature accepted by the manufacturer. The cross-sections of conductors shall be chosen in accordance with manufacturer's recommendations and Chapter 6.12 of these Rules.

6.8.2.10 In addition to the requirements given in this Chapter, the rooms and cabins housing sauna heaters shall comply with the requirements of PN-HD 60364-7-703 Standard.

6.9 Control and automation systems

6.9.1 Each control and automatic system shall be so designed as to prevent the automatic restart of the controlled machinery after voltage decay or the machinery stopping by the safety system.

6.9.2 The simultaneous control of the main propulsion, auxiliary machinery and associated equipment, as well as steering of the houseboat shall be possible from one control station only.

6.9.3 Transfer of control from one station to another shall be possible only after it has been accepted by the station taking over the control.

6.9.4 Manual local control shall be independent of automatic or remote control.

6.10 Alarm signals

6.10.1 Visual and audible alarms shall be provided for:
- sewage level in sanitary tank,
- high bilge water level

Visual alarms shall be located within the eyesight of the person operating the houseboat.

It is recommended that self-propelled houseboats shall have installed the alarm system of main drive.

6.11 Protective devices

6.11.1 General Requirements

6.11.1.1 Protective devices shall be selected in accordance with the Polish Standards, especially with the multi-sheet PN-EN 60364 Standard.

6.11.1.2 Protective devices shall be so matched with the current-voltage characteristics of the equipment under protection and the equipment work as to operate at all inadmissible overloads.

6.11.1.3 Every circuit in the switchboard shall be protected, in at least the positive or phase conductor, against overcurrent and short-circuit by a fuse or a trip-free circuit breaker. The circuits of equipment or a group of equipment whose operation affects the safety of the houseboat and human life shall be individually protected.

6.11.1.4 A manually reset trip-free circuit breaker or a fuse shall be installed within 200 mm of the source of DC power for each circuit or conductor of the system, measured along the conductor.

If the conductor is connected directly to the battery terminal and is contained throughout its entire distance in a sheath or enclosure such as a conduit, junction box, control box or enclosed panel, the overcurrent protection shall be placed as close as practicable to the battery, but within a distance not greater than 1.8 m.

If the conductor is connected to a source of power other than a battery terminal and is contained throughout its entire distance in a sheath or enclosure such as a conduit, junction box, control box or enclosed panel, the overcurrent protection shall be placed as close as practicable to the point of connection to the source of power, but within a distance not greater than 1 m.

Those requirements do not include cranking motor conductors.

6.11.1.5 For AC supply, a manually reset trip-free circuit breaker shall be installed within 0.5 m of the source of power or, if impractical, the conductor from the source of power to the panelboard circuit breaker shall be contained within a protective covering or within conduit or cable trunk or equivalent protective covering.

6.11.1.6 If the location of the main shore power inlet circuit breaker exceeds 3 m from the shore power inlet connection, additional circuit breakers or fuses shall be provided within 3 m of the inlet connection, measured along the conductor.

6.11.1.7 The protection system shall be discriminative both with regard to overload currents and to the prospective short-circuit currents.

6.11.1.8 On houseboats having hulls made of conductive materials, fitted with insulated installation, the protective devices and switchgear, referred to in 6.11.1.2, shall be provided for both poles/all current-carrying conductors. In the case of the safety voltage installation, this requirement is applicable only to the main protective device and a switch.

6.11.1.9 For houseboats with hulls of non-conductive materials, fitted with insulated installation, the protective devices and switchgear, as specified in 6.11.1.7, is recommended.

6.11.1.10 It is recommended that all protected circuits shall be additionally fitted with switches.

6.11.1.11 In circuits in which separate protective devices and switches are fitted, the fuse shall be installed between the busbar (or power supply source) and a switch.

6.11.1.12 Short-circuit protective devices shall be set to operate at not less than 200 per cent of the rated current.

6.11.1.13 Overload protective devices shall be so selected that the value of the protective device operating current will not exceed 150 per cent of the overload specified in Table 6.12.2.1 for conductor cross-sectional area of the protected circuit.

6.11.1.14 The rated short-circuit breaking current of the protective devices shall be not lower than the anticipated short-circuit current at the place of their installation.

6.11.2 Protection of power consumers

6.11.2.1 For each electric motor rated at 0.5 kW and over, provision shall be made for a separate supply circuit protected against short-circuit and overload.

6.11.2.2 Each DC consumer rated at 1 kW and over shall be fitted with individual short-circuit and overload protection.

6.11.2.3 The overload protective devices for continuously loaded motors shall be set to disconnect the protected motor in a range of 105 and 125 per cent of the rated current.

6.11.2.4 It is recommended that the following equipment installed on board: thrusters, capstans and windlass/mooring winches should be provided with protective devices supplied by the equipment manufacturers. Otherwise, protection with time delay shall be installed.

6.11.3 Protection of generators

6.11.3.1 Generators shall be provided with means of protection against short-circuits and overloads. Alternators may be fitted with built-in overload protection.

6.11.3.2 The overload protective device shall disconnect the generator (generating set) or an alternator at overload exceeding 120 per cent of the rated current.

6.11.4 Protection of transformers

6.11.4.1 Overcurrent protection shall be provided for isolation and polarization transformers. Each transformer shall be protected by an individual overcurrent device on the primary side, rated at not more than 125 % of the rated primary current of the transformer.

6.11.5 Protection against electric shock in AC systems

6.11.5.1 Where a risk of personal contact with live conductive parts may exist, a residual current protective devices shall be fitted to automatically disconnect the supply exceeding 50 V r.m.s in the event of a fault between a live part and an exposed non-current carrying conductive part and to provide protection against dangerous pathophysiological effects from electric shock.

6.11.5.2 Circuits supplying socket outlets installed in camboose, toilet, the engine compartment or on the open deck shall be fitted with residual current protective devices with sensitivity not greater than 10 mA or a single RCD which will disconnect the supply. The RCD devices shall have an internal circuit for manual testing of the trip function.

6.11.5.3 For houseboats fitted with a single electrical equipment operating at a voltage exceeding 50 V, supplied from external source of electrical power only, it is recommended that in

addition to the main short-circuit and overload protection, RCD device with a sensitivity of 30 mA disconnecting the supply should be installed.

6.12 Conductors

6.12.1 General requirements

6.12.1.1 Conductors shall be multi-wire copper conductors, of flame-retardant type and having low flame-spread characteristics (e.g. cross-linked polyethylene compound, butyl rubber compound, ethylene-propylene rubber compound, silicone rubber compound) according to national or international standards agreed with PRS, with cross-sectional area not less than 1.5 mm^2 (0.75 mm^2 min control and signaling units).

6.12.2 Selection of cables for loads required

6.12.2.1 Permissible continuous loads on single-core cables, with the minimum number of wires in the cable, at the ambient air temperature of +30°C, shall be taken in accordance with Table 6.12.2.1, depending on the maximum temperature of conductor.

Table 6.12.2.1

Nominal cross-sectional area of conductor [mm^2]	Permissible continuous loads on single-core cables [A]				
	60 °C	**70 °C**	**85 ÷ 90 °C**	**105 °C**	**125 °C**
0.75	**6**	**10**	**12**	**16**	**20**
1	**8**	**14**	**18**	**20**	**25**
1.5	**12**	**18**	**21**	**25**	**30**
2.5	**17**	**25**	**30**	**35**	**40**
4	**22**	**35**	**40**	**45**	**50**
6	**29**	**45**	**50**	**60**	**70**
10	**40**	**65**	**70**	**90**	**100**
16	**54**	**90**	**100**	**130**	**150**
25	**71**	**120**	**140**	**170**	**185**
35	**87**	**160**	**185**	**210**	**225**
50	**105**	**210**	**230**	**270**	**300**
70	**135**	**265**	**285**	**330**	**360**
95	**165**	**310**	**330**	**390**	**410**
120	**190**	**360**	**400**	**450**	**480**
150	**220**	**380**	**430**	**475**	**520**

Note:

The permissible current capacity specified in Table 6.12.2.1 relates to an ambient temperature of + 30 ° C. In rooms where the expected ambient temperature is higher than + 30 ° C, cables intended for operation at elevated temperatures should be used. The permissible current-carrying capacity for cables and wires for different insulation temperature limits and different ambient temperatures are included in Publication No. 15/P.

6.12.2.2 Conductor insulation temperature ratings in engine spaces shall be 70° C minimum, and the conductor insulation shall be oil-resistant and resistant to other aggressive media, or shall be protected by insulating conduit or sleeving.

6.12.2.3 For cables installed in the engine compartment (ambient temperature of +60 °C), correction factors shall be taken in accordance with the below Table.

Table 6.12.2.3

Maximum conductor temperature **[°C]**	Correction factors
70	**0.75**
85 ÷ 90	**0.82**
105	**0.86**
125	**0.89**

6.12.2.4 Where more than 6 cables installed in one bunch may be simultaneously loaded by the rated current, the values of the permissible current ratings for the relevant cross-sectional areas shall be reduced by 15% (factor 0.85 shall be applied).

6.12.2.5 Irrespective of conductor selection in accordance with Tables 6.12.2.1 and 6.12.2.3, the nominal cross-sectional area of conductor, *s*, depending on the permissible voltage drop, shall be not less than that calculated from the formula:

$$s = 2kPl\ [\text{mm}^2] \qquad (6.12.2.5)$$

k – factor of the permissible voltage drop, in accordance with Table 6.12.2.3,

P – the maximum carrying current in the circuit, [W],

l – the length of cable from the power supply to the power consumer, [m].

Table 6.12.2.5

Rated voltage	3% of voltage drop for battery charging circuits, supplying navigation lights, bilge blowers, bilge pumps, control consoles, circuits supplying the main switchboard and other vital to safety	7% of voltage drop for the remaining circuits
12 V	**$4.0 \cdot 10^{-3}$**	**$1.71 \cdot 10^{-3}$**
24 V	**$1.0 \cdot 10^{-3}$**	**$0.43 \cdot 10^{-3}$**

6.12.2.6 When selecting the conductors, account shall be taken of the equipment manufacturers' requirements. This applies, in particular, to the cross-section of the conductor supplying IC starter, which shall be in accordance with the engine manufacturer's requirements.

6.12.2.7 If, in technical documentation, the engine manufacturer does not specify the cross-section of the engine starter power supply conductors depending on the distance from starter accumulator batteries, the applied conductors shall comply with the requirements of PN-W-89509 Standard.

6.12.2.8 The cross-sectional areas of conductors supplying equipment operating under load for a short time: winches, capstans, thrusters, may be less than those given in Table 6.12.2.1.

6.12.2.9 Where not specified by the manufacturer, the conductors supplying:

- capstans and windlass/mooring winches shall be selected as for 60 min short-duty operation;
- thrusters shall be selected as for 30 min short-duty operation.

Permissible loads, according to Table 6.12.2.1, may be increased by correction factors given in Table 6.12.2.9.

Table 6.12.2.9

Conductor nominal cross-section [mm²]	30 min operation	60 min operation
1 to 10	1.06	1.06
16	1.09	1.06
25	1.19	1.08
35	1.33	1.14
50	1.55	1.25
70	1.85	1.43

6.12.3 Installation of cables

6.12.3.1 Conductor runs shall be, as far as possible, straight and shall pass through locations where they will not be exposed to the effect of fuel, oil, water and excessive heating. Conductor runs shall be installed not closer than 100 mm (250 mm from dry exhaust components) to the source of heat unless adequate thermal insulation has been provided.

6.12.3.2 Conductors installed in locations in which they may be exposed to mechanical damage shall be suitably protected.

6.12.3.3 Conductors not provided with short-circuit and overload protection shall be as short as practicable and shall be specially protected against mechanical damage to insulation which may cause short-circuit. Such protection will be ensured by metal armoured conductors or running the conductors in conduits.

In the safe voltage installations, the use of non-armoured conductors is permitted over short sections of conductor (e.g. connection of accumulator batteries, to the main switch) if they are insulated and sheathed.

6.12.3.4 The length of a cable connecting accumulator batteries with the main switchboard, starter, alternator shall be as short as practicable.

6.12.3.5 The cables shall be properly secured by means of holders, clamps and other similar elements made of metal or other non-combustible material or not-readily combustible material or shall be run in protective insulation pipes.

6.12.3.6 Conductors and cables shall be supported throughout their length in conduits, cable trunks or trays, or by individual supports at maximum intervals of 450 mm.

6.12.3.7 Cables shall not be directly laminated and inserted into a laminate.

6.12.3.8 Protective insulation or metal pipes, in which the cables are run, shall be so installed as to preclude condensation of water.

6.12.3.9 The cable holders shall be of adequate width, free of sharp edges and protected against corrosion. The holders shall be so selected that the cables are fastened in position securely but without damage to their protective coverings.

6.12.3.10 Cables shall be fastened in such a manner that mechanical strains in cables are not transmitted to their inlet connections.

6.12.3.11 When installing the cables through non-watertight bulkheads or elements of the houseboat structure not exceeding 6 mm in thickness, lining or bushings that will prevent damage to cables shall be provided in cable penetrations.

6.12.3.12 Installation of cables under the flooring shall be avoided, except the cables supplying outboard equipment and end sections of cables supplying bilge pumps. It is recommended that cables should be installed in cable ducts and their machinery connections shall not reduce the enclosure protection degree of supplied machinery.

6.12.3.13 Penetration of watertight bulkheads and decks shall be made tight. Packing of cable penetrations through the bulkheads and decks shall be so made as to maintain their tightness.

6.12.3.14 Connection of cables at places of tapping shall be effected in junction boxes or covered strips by means of clamps.

6.12.3.15 All conductors shall have suitable terminals installed and be prepared for securing in clamps. At screw clamps cable terminals shall be applied. The friction-type connectors may be used in circuits not exceeding 20 A if the connection does not separate when subjected to a force of 20 N.

6.12.4 Survey of electrical installation

6.12.4.1 On houseboats fitted with AC electrical power sources other than shore power supply connection, the measurements of the effectiveness of protection against electric shock shall be carried out at every Class Renewal Survey.

6.12.4.2 On houseboats fitted with shore power supply connection as AC electrical power source, the measurements of the effectiveness of protection against electric shock shall be carried out every 5 years.

6.12.4.3 The insulation resistance of circuits and equipment shall not be lower than the values given in Table 6.12.4.3.

Table 6.12.4.3

Item	Circuit designation	Minimum insulation resistance , [MΩ]	
		Installation voltage up to 50V	Installation voltage up to 500V
1	Lighting, communication and signaling circuits	**0.3**	**1.0**

2	Power circuits	**1.0**	**1.0**

6.12.4.4 Continuity of earthing and bonding conductors, as well as the effectiveness of cathodic protection shall be checked at least every 5 years.

6.12.4.5 The earthing resistance shall not be greater than 1.0 Ω.

7 MATERIALS

7.1 General requirements

7.1.1 This Chapter of the *Rules* is applicable to materials intended for houseboat hulls, erection, machinery and equipment.

7.1.2 The requirements concerning the materials, referred to above, are specified directly in the present Part of the *Rules* or through reference to *Part IX – Materials and Welding* of the *Rules for the Classification and Construction of Sea-going Ships.*

7.1.3 The application of materials, which, due to their chemical composition and mechanical properties, do not comply with the requirements specified in the present *Part* (directly or through reference to *Part IX – Materials and Welding* of the *Rules for the Classification and Construction of Sea-going Ships*), is subject to special consideration of PRS in each particular case.

7.1.4 When using various metal alloys for the manufacture of houseboat hull and equipment items, the possibility of electrochemical corrosion shall be considered. To prevent the electrochemical corrosion, the materials shall be appropriately selected and insulating spacers shall be used.

7.1.5 Where the hull or equipment items are to be manufactured using materials having considerably different mechanical properties (strength, Young's modulus), provision shall be made to prevent creation of strength notches and loss of tightness through:
- appropriate structural and technological solutions,
- the application of appropriate fasteners and sealing compounds.

7.1.6 The use of glass reinforced plastic (GRP) laminate for the protective coating of solid wood or plywood may be allowed only upon approval of such laminating process.

7.2 GRP laminates

7.2.1 Polyester Binders

7.2.1.1 The structural polyester binders (resins or their mixtures) shall ensure the required chemical and physical, as well as mechanical properties of laminates defined in *Part II – Hull.*

7.2.1.2 The viscosity of a non-cured structural binder shall be appropriate for the method of forming the laminate. In the case of manual forming, the binder viscosity at the temperature of 25 °C, according to ISO 2555, shall not be less than 600 mPa·s and not greater than 1000 mPa·s.

If the viscosity of the structural resin is lower than the required one, a tixotroping agent may be used. Reduction of the viscosity can be achieved by the addition of styrene.

7.2.1.3 The cured structural binders shall have the properties as specified in Table 7.2.1.3 in accordance with EN ISO 12215-1. If the structural resin does not comply with these requirements, then, upon agreement with PRS, an adequate quantity of modifying resins may be added to achieve the required properties of the binder.

Table 7.2.1.3

Property of the cured binder	Value	Test based on
Ultimate relative elongation at break	min. 1,5%	PN-EN ISO 527-1, -4
Tensile strength	min. 45 MPa	PN-EN ISO 527-1, -4
Young's modulus at tension	min. 3000 MPa	PN-EN ISO 527-1, -4
Temperature of deflection under load	min. 60°C	PN-EN ISO 75-1, -3
Hardness	min. 35°Barcol	PN-EN 59
Water absorptivity after 28 days	max 100 mg	PN-EN ISO 62

7.2.1.4 It is recommended that the relative elongation of gelcoat resins should be not less than 2.5%.

7.2.1.5 The structural binders exposed to initiator – accelerant combination shall polymerize at an ambient temperature, without heating.

7.2.1.6 Each batch of resins shall be provided with the manufacturer's certificate containing the following particulars:
- resin brand name,
- batch number and manufacture date,
- date before which maintenance of the properties of the resin, when stored under conditions recommended by the manufacturer, is guaranteed

7.2.2 Resin additives

7.2.2.1 The ratio of the combined initiator – accelerant mass to the binder mass shall comply with the manufacturer's recommendations. Any departure from the manufacturer's production technology is allowed only when the conducted tests and experiments show that a laminate of better or equivalent properties can be produced.

7.2.2.2 The above components shall initiate polymerization of the resin at the temperature above 16 °C.

7.2.2.3 The quantity of styrene, which is added to the binder to reduce its viscosity, shall not exceed the values recommended by the manufacturer. In no case can the reduction of the binder viscosity decrease waterproofness and mechanical properties of the laminate and increase the binder dripping and shrinkage during the curing process. The addition of styrene shall not exceed 5%.

7.2.2.4 The tixotroping agents used in structural binders shall not impair polymerization conditions nor reduce the binders mechanical properties. The content of tixotroping agents cannot exceed 5% of the binder mass. The structural binder cannot be dyed.

7.2.2.5 Particular care shall be taken to ensure that water will not get into the resin during its storage and processing.

7.2.3 Glass reinforcement

7.2.3.1 An "E" type non-alkaline glass fibre manufactured in accordance with ISO 2078 shall be used as reinforcement. The content of alkaline metal oxides shall be less than 1% (in terms of Na_2O). The diameters of single fibres shall range between 9 μm and 20 μm.

7.2.3.2 Roving can be used for the manufacture of reinforcement in the form of mats, fabrics or bands. At the mats manufacture, roving stripes shall be cut into the lengths not shorter than 50 mm.

7.2.3.3 Glass fibres shall be covered with a chemically active preparation ensuring proper binding of reinforcement with the resin. Fabrics of fat preparation shall not be used. The binder for roving stripes in mats shall be resin-soluble and its quantity shall not exceed 6% of the mat mass.

7.2.3.4 Each batch of glass reinforcement shall be provided with the manufacturer's certificate containing the following particulars:
- the manufacturer's name,
- material name, type and unit mass, in g/m^2,
- type of glass,
- kind of preparation or binder type and its unit mass (for mats).

7.2.3.5 The glass reinforcement cannot be wet. Wet glass mats cannot be used even after they have been dried.

7.3 Steels

7.3.1 The structures of the houseboat hull, machinery and equipment shall be constructed of structural steel having the properties specified in Table 7.3.1.

Table 7.3.1
Structural steels

Type of steel	Steel grade	Mechanical properties		
		R_m [MPa]	R_e [MPa]	A_5 [%]
Normal strength hull structural steel*)	A, B, D, E	400–520	min. 235	min. 22
Higher strength hull structural steel	AH32, DH32, EH32	440–570	min. 315	min. 22
	AH36, DH36, EH36	490–630	min. 355	min. 21
	AH40, DH40, EH40	510–660	min. 390	min. 20
Structural steel for general purposes according to EN 10025-1	S235JR	380–470	min. 235	min. 26

7.3.2 For the construction of houseboat equipment and for fasteners, the following corrosion-resistant steels having the properties specified in Table 7.3.2 are recommended.

Table 7.3.2
Corrosion-resistant steels

Type of steel	Steel grade		Mechanical properties		
	acc. to PN-EN 10088-3	acc. to AISI*)	R_m [MPa]	$R_{0,2}$ [MPa]	A_5 [%]
Austenitic chromium-nickel steel	X6CrNiNb18-10	321	510–740	190	min. 40
	X2CrNiMo17-12-2	316L	500–700	200	min. 40
	X2CrNi19-11	304L	460–680	180	min. 45

*) American Iron and Steel Institute.

7.3.3 Where the actual value of the given material tensile strength is not provided, the following values can be taken for calculations:

– R_m = 400 MPa – for structural steel,
– R_m = 550 MPa – for chromium-nickel steels.

7.3.4 The fasteners made of structural steel shall be hot galvanized. Small screw fasteners and screws, which cannot be hot galvanized properly, can be electro-galvanized, provided a coating of not less than 24 μm is achieved.

7.4 Aluminium alloys

7.4.1 The hulls and other items of a houseboat structure, as well as its machinery and equipment shall be manufactured of wrought aluminium alloys of Al-Mg system (hydronalium), with a limited copper content (impurities content up to 0,1%), resistant to sea-water action.

7.4.2 The aluminium alloys recommended for the construction of houseboat hulls are specified in Table 7.4.2.

Table 7.4.2
Aluminium alloys for the construction of houseboat hulls

Alloy designation			Delivery condition*) acc. to PN-EN 515	R_m [MPa]		$R_{0,2}$ [MPa] min	A_5 [%] min
acc. to PN-EN 573-3		type of product according to PN-H-88026		min	max		
numerical	abbreviated[1)]						
EN-AW 5754	5754	PA 11 plates	O	190	230	80	17
			H14	240	280	190	5
			H24	240	280	160	10
		PA 11 pipes, bars, sections	F	180	[illegible]	80	14
EN-AW 5083	5083	PA 13 plates	O	270	350	120	17
			H32	300	370	220	10
			H34	340	410	270	5
EN-AW 5019	5019	PA 20 pipes, bars, sections	F	250	[illegible]	120	13

[1)] Applied at product marking

*) Designation of delivery conditions:
F – fabricated (raw),
H14 – semi-hard, hardened,
H24 – semi-hard, hardened and partially annealed,
H32 – quarter-hard, hardened and stabilized,
H34 – semi-hard, hardened and stabilized,
O – annealed.

7.4.3 For the construction of hull items, which are not parts of the structure (e.g. tanks which do not form an integral part of the hull), the following aluminium alloys are recommended (acc. to EN 573-3):

EN AW-3103–PA 1,

EN AW-5251–PA 2,

EN AW-5005–PA 43.

These materials can be used as pipes (extruded condition), plates (conditions: O, H14, H24) or sections (without heat treatment).

7.4.4 For structural items of deck equipment the use of aluminium alloys, specified in Table 7.4.4, is recommended.

Table 7.4.4
Aluminium alloys for deck equipment

Alloy designation			Delivery condition *) acc. to PN-EN 515	R_m [MPa] min	$R_{0,2}$ [MPa] max	A_5 [%] min	HB approx values
acc. to PN-EN 573-3		type of product according to PN-H-88026					
numerical	abbreviated[1)]						
EN AW-6101A	6101A	PA 38 pipes	T6	200	140	12	65
			T5	180	130	12	60
		PA 38 bars, sections	T4	140	80	14	33
			T6	220	160	10	55
			T1	120	60	15	30
			T5	200	140	12	55
EN AW-7020	7020	PA 47 pipes	T1	310	200	10	90
			T5	350	270	8	100
		PA 47 bars, sections	T5	350	270	10	95
		PA 47 plates	T5	350	270	10	95
			T6	350	270	10	95

1) Applied at product marking.

*) Designation of delivery conditions:
T1 – naturally aged,
T4 – solution heat-treated and naturally aged,
T5 – artificially aged,
T6 – solution heat-treated and artificially aged.

For welded items the strength properties shall be taken as for non-cured condition (soft after welding).

7.5 Copper alloys

7.5.1 The structure items of houseboat machinery and equipment, as well as fasteners (rivets, screws, pins) shall be manufactured of wrought copper alloys having the properties specified in Table 7.5.1.

Table 7.5.1
Wrought copper alloys

Alloy type	Alloy grade (examples)	Marking	acc. to Polish Standard	Approximate values R_m, [MPa], min.
Brass	CuZn37	M63	PN-92/H-87025	290(r) 440(z16)
	CuZn39P62	MO59		410(z4)
	CuZn38Sn1	MC62		320
	CuZn20Al2	MA77		340(r), 390(z4r)
Bronze	CuSn6	B6		440(z6), 510(z8)
	CuAl10Fe3Mn2	BA1032	PN-92/H-87051	590
	CuSi3Mn1	BK31	PN-92/H-87060	340(r), 590(z6)

Designation of delivery conditions:
r – recrystalised,
z4 – semi-hard,
z4r – hard,
z6 – semi-hard recrystalised,
z8 – elastic.

7.5.2 The cast items of houseboat machinery and equipment, including propellers, shall be manufactured of cast copper alloys according to EN 1982, having the chemical composition and properties comparable with those given in Table 7.5.2.

Table 7.5.2
Cast copper alloys

Alloy type	Alloy grade	Marking	Approximate values R_m, [MPa], min.
Brass	CuZn40Mn3Fe1	MM55 *)	450
	CuZn38Al2Mn1Fe	MA58	400
	CuZn39Pb2	MO59	250
	CuZn16Si3,5	MK80	300
Bronze	CuSn10P	B101	220
	CuSn10Zn2	B102	240
	CuSn5Zn5Pb5	B555	200
	CuSi3Zn3Mn1	BK331	280
	CuAl10Fe3Mn2	BA1032	500
Bronze for propellers	**Novoston Superston Nikalium**	BM128	640
		BM157	690
		BA1055	600

*) Brass MM55 is recommended for propellers.

7.6 Wood

7.6.1 Solid wood and plywood sorts

The houseboat hull structure and equipment items shall be constructed of solid wood and plywood sorts, listed in Tables 7.6.1.1 and 7.6.1.2. The application of other sorts of wood or facing boards is subject to special consideration of PRS

Table 7.6.1.1
Wood properties

Item	Trade name	Decay resistance	Impregnation ability	Gluing ability	Mean density [kg/m^3]	Bending strength [MPa]	Tensile strength [MPa]	Compression strength [MPa]	Young's modulus at bending [MPa]
1	Birch	N	L	L	650	120	137	43	15 000
2	Black alder	N	L	L	550	90	90	40	9000
3	Beech	N	L	L	690	120	135	60	14 000
4	Leaf stalk oak (durmast)	T	T	L	670	95	90	52	11 000
5	Leaf stalkless oak	T	T	L	720	110	90	60	13 000
6	Ash	N	L	L	680	120	130	52	13 400
7	Witch elm	N	D	L	680	80	80	56	11 000
8	Elm	N	D	L	680	80	80	56	11 000
9	Fir	D	L	L	450	68	84	40	10 000
10	Larch	D	D	L	590	93	107	53	12 000
11	Spruce	N	L	L	470	68	80	43	10 000
12	Common pine	D	L	L	520	82	104	47	12 000
13	Pitch pine	D	D	D	670	102		50	12 000
14	Douglas fir	D	D	L	510	82	105	47	12 000
15	Peroba	T	T	D	700	108		63	12 500
16	Tiama, Gedu nohor	D	D	L	550	78		48	10 000
17	Sapele	D	D	L	640	69	85	57	9800
18	Sipo, Utile	T	D	L	630	100	110	58	11 000
19	Guarea, Bosse	T	T	L	600	94	52		11 000
20	African mahogany	D	T	L	500	75	75	43	9500
21	American mahogany	T	T	L	540	82	90	45	9500
22	Teak	W	T	T	670	100	115	60	13 000
23	Gabon Okoume	N			430	72	58	39	3000
24	Makore	W	T	L	620	103	85	53	11 000
25	Agba, Tola	T	D	L	490	62	52	40	6500
26	Afrormosea, Kokrodua	W	T	L	700	120	60		11 600
27	Idigbo, Framire	T	D	L	550	74	42		8000
28	Meranti	T	D	L	560	105	129	53	12 000
29	Yang	D	D	L	760	125	140	70	16 000
30	Red cedar	T	D	L	390	53	50	32	7500
31	Iroko,Kampala	W	D		620	95	79	55	11 000
32	Balsa	N			160	19	40	10	2600

Table 7.6.1.2
Wood application

Item*)	Keel, slab keel	Dead wood	Stem, stern	Longitudinals	Floors	Glued frames	Bent frames	Plating below designed	Plating above designed	Deck plating	Deck beams	Vertical knees	Horizontal knees	Deck stringers	Deckouse walls	Plywoods	Moulded plywoods
1	–	–	–	–	–	–	–	–	–	–	–	C	C	–	–	B	B
2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	B	–
3	–	–	–	–	–	–	B	–	–	–	–	C	C	–	–	B	–
4	B+	BB	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	–	–	–
32	Application: core material for sandwich laminates .																

*) The item number corresponds to the items of Table 7.6.1.1.

Notes to Tables 7.6.1.1 and 7.6.1.2

.1 Wood usability determined using 3-point scale:
A – the most proper,
B – proper,
C – admissible.

.2 The sorts of wood marked with + (in the column of keels, frames and deck beams) qualify to be used both in natural form and as being glued of layers. However, sorts of wood marked with ++ can be applied only when being glued of layers.

.3 Mean density shown in the Table refers to dried wood containing 15 ÷ 20% of water.

.4 Wood durability determined using 4-point scale:
N – non-durable,
D – durable enough,
T – durable,
W– exceptionally durable.

.5 Ease of impregnation, to which the relevant sort of wood is subjected, is determined using 3-point scale:
L – absorbing the impregnant easily,
D – absorbing the impregnant easily enough,
T – absorbing the impregnant with difficulty.

.6 Ease of gluing the wood by means of synthetic glues is determined using 3-point scale:
Ł – easy to obtain the resistant glued joint,
D – easy enough to obtain the resistant glued joint,
T – difficult to obtain the resistant glued joint.

7.6.2 Quality of solid wood

7.6.2.1 The wood intended for the structural elements of the houseboat shall be of good quality: shall be properly seasoned and free of such defects as: heart of tree, alburnous wood (with respect to deciduous trees), decay, parasite traces, shakes and other defects which could adversely influence the strength and durability of the material.

7.6.2.2 Moreover, the wood shall, in general, be free of knots; however, rare, isolated and good growed-in knots, do not disqualify the material.

7.6.2.3 The material intended for the outside and deck planking shall be plain-ringed and the sawn wood intended for deck planking shall originate from radial sawing. Side boards shall be eliminated.

7.6.3 Quality of plywood

7.6.3.1 The plywood intended for the deck or erection planking shall be made of veneer of good quality in both outside and inside layers. The veneer shall be manufactured of hard and durable sorts of wood and the process of manufacture shall ensure the plywood water resistance. The plywood made of wood of lower durability can be accepted, provided it is preserved against decay using appropriate means.

7.6.3.2 The plywood sheets shall be stored in a dry room, laid down horizontally on the even foundation, with ensured good air conditioning.

7.6.4 Impregnation of wood

7.6.4.1 The facing surfaces of such structural parts as frames, beams, longitudinals and floors shall be impregnated with fungicides and insecticides. These means shall also be used for impregnation of all surfaces of the structural parts made of those sorts of wood, which are defined in Table 7.6.1 as non-durable or durable enough.

7.6.4.2 It is recommended to impregnate all surfaces of elements made of wood, including even the sorts described as being durable or exceptionally durable.

It is recommended to use fungicides and insecticides which are either:
– aqueous solutions of chromium-cupric salines or cupric-chromium arsene salines, or
– organometallic and organic solutions, such as zinc and copper naphthenes, as well as pentane chlorophenol in the organic dissolvents

At wood impregnation, the methods recommended by the manufacturer shall be applied.

7.6.4.3 When choosing fungicides, the effect of fungicides on the means of surface (paints) preservation or laminate shall be considered.

7.6.5 Glues for wood

7.6.5.1 Glues used for connecting wooden structural parts or layers of glued elements shall be suitable for filling gaps, that is they shall be of resorcinol, phenol, epoxy or other similar type and similar durability, ensuring resistance of the joints to boiling water.

7.6.5.2 Epoxy glues may be used, provided appropriate curing agents, ensuring elastic and durable joints, are used. The use of polyamide or polyamic amide curing agents (PAC, PAT, saduramid) is recommended. The aliphatic polyamines curing agents (e.g. Z-1) are not recommended as they give a brittle joint which is less resistant to the effect of water.

7.6.5.3 The glues shall be prepared and spread according to the manufacturer's instructions, with particular attention paid to ambient temperature and humidity. The manufacturer's instructions concerning the method of spreading the glues, depending on the kind of wood, shall also be followed carefully, taking into account the instructions concerning kinds of wood that are not easily gluable and the possible destructive effect of impregnates on the quality of the glued joint.

7.7 Insulating materials

7.7.1 The insulating materials used in engine rooms shall be non-combustible. The insulation coating, together with the applied adhesives, shall have low flame- spread characteristics and shall be impenetrable to vapours and moisture, as well as to fuel and engine oils.

7.7.2 It is recommended that the insulating materials should comply, depending on their application, with the requirements of ISO 9094.

7.8 Foamed plastics

7.8.1 All foamed plastics shall be resistant to crude oil products and sea water.

7.8.2 The foamed plastics shall have closed cell structure and, in the course of time and when exposed to temperatures below 65 °C, they shall not show shrinkages exceeding linear dimensional tolerances.

7.8.3 The foamed plastics applied in the laminate houseboats shall not be resin soluble.

7.8.4 Structural foams

7.8.4.1 The foam materials used in sandwich structures shall have apparent density not less than 40 kg/m^3. The foam absorbability (by volume) shall not to be greater than:
– after 24 hours – 0.6%,
– after 7 days – 1.0%.

The absorbability test shall be carried out in accordance with ISO 2896.

7.8.4.2 The structural foam materials shall have the shear strength and the compression strength not less than that specified in Table 7.8.4.2. The use of structural polyurethane foams requires PRS' consent.

Table 7.8.4.2

Material	Apparent density[1] [kg/m^3]	Approximate shear strength [2] [MPa]	Approximate compression strength [3] [MPa]
Polyvinyl chloride modified by isocyanate	50	0.65	0.60 ÷ 1.20
	60	0.95	
	70	1.30	
	80	1.50	
Thermoplastic polyvinyl chloride	80	0.70	0.58 ÷ 1.00
	100	1.60	

[1] Testing according to ISO 845.
[2] Testing according to ISO 1922.
[3] Testing according to ISO 844.

7.8.5 Displacement foams

7.8.5.1 The displacement foams can have a form of finished elements, such as blocks and panels. The displacement tanks can also be filled with a foam consisting of two components which react directly inside the tanks, provided they fill up the tank interior completely.

7.8.5.2 The water absorption of the displacement foam after it has been immersed completely for 8 days shall not exceed 8% by its volume.

7.8.5.3 The displacement foam shall, in general, be resistant to crude oil products. The foam which does not meet this requirement is allowed to be used, provided it is protected against contact with such products.

7.9 Flexible hoses

7.9.1 The flexible hoses applied in the fuel system shall be adequately strengthened, oil and fire resistant, manufactured in accordance with the requirements of EN ISO 7840 and durably marked: „ISO 7840-A1" or „ISO 7840-A2". The flexible hoses manufactured according to SAE standard, approved by the US Coast Guard and marked: „USCG Type A1" or „USCG Type A2", can also be used.

7.9.2 The flexible hoses used in the fuel system outside the engine room need not meet the fire resistance requirements. In such case they shall be manufactured in accordance with EN ISO 8469 and durably marked: „ISO 8469-B1" or „ISO 8469-B2". The flexible hoses manufactured according to SAE standard, approved by the US Coast Guard and marked: „USCG Type B1" or „USCG Type B2", can also be used.

7.9.3 The requirements concerning the application of the appropriate type of flexible hoses in the fuel system, depending on the piping purpose, kind of fuel and the piping location, are specified in Table 7.9.3.

Table 7.9.3

Item	Piping purpose	Pipings in the engine room	Pipings outside the engine room
1	Fuel inlet	A1, A2	A1, A2, B1, B2
2	Tank air venting	A1, A2	A1, A2, B1, B2
3	Outboard petrol engine	–	A1, A2
4	Outboard diesel engine	–	A1, A2, B1,B2

7.9.4 The flexible hoses used in gas exhaust system at "wet exhaust" shall comply with the requirements of ISO 13363 or SAE J2006 standard. It is recommended that the flexible hoses should be supplied by the engine manufacturer or dealer.

7.9.5 The flexible hoses used in the cooling water system and bilge water system, as well as for the drainage from cockpits shall be resistant to temperature of 60°C and shall be made of rubber with fabric strengthening or of polyvinyl chloride (PVC) with spiral reinforcement. The use of PVC hoses reinforced with steel spiral is recommended. It is also recommended that the flexible hoses applied in the above systems, situated in the engine room, as well as the flexible hoses used for the drainage from cockpits should be fire resistant, of A1 or A2 type.

7.9.6 In the propane-butane gas system, rubber hoses with fabric reinforcement intended for acetylene or oxygen, made according to EN 1763-1 and EN 1763-2 standards or equivalents, shall be used.

7.10 Chains

7.10.1 For anchor chains, the technical chains electrically welded with short chain links shall be used. The chain on the houseboat fitted with anchor winch shall be calibrated. The chains shall comply with the requirements of DIN 766 standard. The chains of nominal diameter: 6, 8, 10 and 12 mm can be manufactured in accordance with EN 24565 standard.

7.10.2 It is recommended that anchor chains should be hot galvanized or shall be made from corrosion-resistant steel.

7.10.3 The breaking loads of technical chains are specified in Table 7.10.3.

Table 7.10.3

Size (dimeter) [mm]	Breaking load [kN]
5	12.5
6	16
7	25
8	32
9	40
10	50
11	63
13	80

7.11 Ropes

7.11.1 Steel ropes

7.11.1.1 Rudder chains shall be made of corrosion-resistant or galvanized steel ropes, of wire nominal tensile strength not less than 1570 MPa and rope construction 6x19 or 6x37. The use of other construction ropes requires PRS' consent. The breaking loads of galvanized ropes are specified in Table 7.11.1.1. For corrosion-resistant steel ropes calculations, the same values shall be taken.

Table 7.11.1.1

Rope diameter [mm]	The rope breaking load (wire strength 1570 MPa), [kN]			
	T 1x19 PN-69/M-80203	6x7 + A_0 PN-69/M-80206	*T* 6x19 + A_0 PN-69/M-80207	*T* 6x37 + A_0 PN-69/M-80208
4.0	14	9	9	–
5.0	21	14	14	14*)
6.3	31	23	19	20*)
8.0	55	34	30	32
10.0	86	57	51	45

*) Wire strength 1770 MPa.

7.11.1.2 Stormrails shall be manufactured of corrosion-resistant or galvanized steel ropes of rope construction 1x19, 6x7 or 6x19. The ropes breaking loads are given in Table 7.11.1.1.

7.11.2 Fibre ropes

7.11.2.1 Towropes, anchor and mooring lines shall be made from polyamide or polypropylene twisted or plaited fibre ropes. The use of other construction ropes and ropes made of other materials (e.g. of polyester), as well as the use of bands requires PRS' consent. The minimum breaking loads of polyamide, polypropylene and polyester twisted three-strand ropes are given in Table 7.11.2.1.

Table 7.11.2.1

Rope diameter [mm]	Minimum rope breaking load, [kN]		
	Polyamide (Steelon) PN-EN ISO 1140	Polypropylene PP3 PN-EN ISO 1346	Polyester (Torlen) PN-EN ISO 1141
6	8	7	6
8	14	12	11
10	21	18	16
12	30	25	23
14	40	33	31
16	52	42	40
18	64	53	49
20	79	64	61
22	94	76	73
24	112	90	86
26	129	104	101
28	149	119	116

7.12 Concrete

7.12.1 General provisions

7.12.1.1 The designed concrete specification shall include the requirement of conformity with PN-EN 206-1, compression strength class, class of exposure to environmental effect, maximum rated upper limit of aggregate size, chloride content class (for lightweight concrete, density class or assumed density, for heavy concrete – the assumed density) and consistence class or assumed consistence.

7.12.2 Classes of concrete exposure to environmental effect

7.12.2.1 The class of exposure – a description of environmental effect on the structural concrete; the effect, of chemical or physical nature, may influence the concrete or reinforcement or other metallic elements therein, which have not been considered as loads in the structure design.

7.12.2.2 The requirements for the composition and fixed properties of concrete are defined for each class of exposure and pertain to:
- maximum water/cement (w/c) ratio,
- minimum cement content,
- minimum compression strength class,
- minimum air content,
- permitted types and classes of constituents.

7.12.3 Selection of cement for concrete

The general suitability of cement shall be defined in accordance with PN-EN 197-1:2012 Standard Cement. Part 1: Composition, specifications and conformity criteria for common cements.

The type and class of cement for concrete shall be chosen depending on:

- concrete structure performance conditions: ambient temperature (laying concrete in lowered and raised temperatures), curing conditions, e.g. heat treatment, concrete treatment method, rate of elements demoulding, concrete mix transportation distance, volume of the element to be concreted;
- required properties of concrete: classes of concrete strength, tightness, frost resistance, potential aggregate reactivity with alkalis, concrete purpose and environmental conditions the structure will be exposed to.

7.12.4 Selection of aggregate for concrete

General suitability of an aggregate for concrete shall be defined in accordance with PN-EN 12620+A1:2010 Standard ”Aggregates for concrete” for commonly used and heavy aggregates.

7.12.5 Selection of admixtures for concrete

General suitability of an admixture for concrete shall be defined in accordance with PN-EN 934-2:2009 Standard ”Admixtures for concrete, mortar and grout – Part 2: Concrete admixtures”.

In accordance with PN-EN 943-2:2009, the concrete admixture is a material added during the mixing process of concrete in a quantity not more than 5 % by mass of the cement content of the concrete, to modify the properties of the mix in the fresh and/or hardened state.

In accordance with PN-EN 206:2014, the admixtures described in the PN-EN 934-2:2009 Standard may be used for concrete.

7.12.6 Requirements for concrete:

- w/c ratio below 0.5,
- frost resistance min. 150,
- air content in the mix from 3.5 to 6.5%,
- watertightness min. W8,
- water absorptivity below 5%,
- compression strength above 30 MPa (C30/37).

8 LIVING CONDITIONS

8.1 Accommodation spaces

8.1.1 The accommodation space means every space appropriated for people's stay, serving to fulfil housing needs, such as bedrooms, living rooms, lounges, dining rooms and kitchens, kitchenettes, bathrooms, sanitary units.

8.1.2 The accommodation spaces shall be so designed, executed and equipped to ensure to the users appropriate safety, comfort and health conditions. Therefore they shall have:
- an easy and safe access,
- thermal insulation appropriate for the season of use,
- ventilation which operates efficiently also with closed doors,
- day lighting and appropriate artificial lighting,
- the view to outside if the space is intended for permanent stay.

8.1.3 Dimensions of spaces

8.1.3.1 The cubic volume of each accommodation space shall amount to at least 7 m^3, whereas:
- for bedrooms, the volume of free space shall amount to at least 5 m^3 for the first person and at least 3 m^3 for each next person,
- for other rooms, the volume of their free space shall amount to at least 3.5 m^3 per one person which can be present in the room.

8.1.3.2 The toilet cubicle which is not a bathroom, equipped with toilet bowl and washbasin, shall be at least 750 mm wide and 1100 mm long, with the minimum area in front of the toilet bowl of 600x750 mm.

8.1.3.3 The dimensions of bathrooms equipped with washbasin, shower or bath, toilet bowl, and any other items such as washing machines, dryers, cabinets, shall ensure a free access for at least one person to this equipment.

8.1.3.4 Free height of spaces, except technical spaces, may not be less than:
- 2.00 m in objects to be occupied simultaneously by a maximum of 6 persons,
- 2.20 m in objects to be occupied simultaneously by at least 7 persons,

where free height means the distance from the floor to the ceiling not obstructed by items of equipment and structure (overhead beams, installation, lighting, ventilation). If the required height of the space is ensured only in its free part intended for persons movement, the above requirement is considered fulfilled, under the condition that the possibility of free use of all the space to the purpose it is intended for, is maintained.

8.1.3.5 The dimensions of sleeping berths shall be not less than specified in the *Rules for the Classification and Construction of Sea-going Yachts*, *Part III – Stability and Equipment*.

8.1.4 Entries to/exits from the spaces

8.1.4.1 The accommodation spaces intended for simultaneous stay of at least 6 persons shall have two exits, one of them being an emergency exit. Easily accessible windows or skylights with clear opening of at least 0.36 m^2 and the shortest side at least 500 mm long may serve as the emergency exit.

8.1.4.2 Other spaces intended for people's stay without direct exit to an open area (deck) shall have an exit to corridors being the escape route, which have at least two exits to open area, as far apart as possible. One of the exits may be designed as an emergency exit with an easy access and

clear opening of minimum 360 mm^2 and the shortest side at least 500 mm long. Windows and skylights may be considered emergency exits.

8.1.4.3 The clear dimensions of door opening frame and of the floor shall be:

- for inner doors – min. 2000 mm high and min. 700 mm wide, with permissible width of 600 mm for entries to a room intended for one person,
- for the entry (outer) doors to the houseboat – at least 1950 mm high and 900 mm wide, with a sill of height 50 mm; for objects designed for simultaneous use of max. 6 persons, the opening may have clear width of 800 mm.

8.1.4.4 The doors shall be capable of being open from both sides and be opened outwards or be of sliding structure. The doors in the rooms of area at least 5 m^2, other than sanitary, cooking, technical or storage spaces, may open inwards.

8.1.4.5 The bottom part of doors leading to sanitary spaces shall be provided with ventilation holes, the combined clear area of which shall be at least 220 cm^2.

8.2 Trafic areas and safeguards

8.2.1 Corridors

8.2.1.1 Corridors shall have clear width of at least 700 mm, unless their length exceeds 6.0 m and/or they serve as escape route for more than 6 persons. The minimum clear width of other corridors shall be 900 mm, with one narrower part of not less than 800 mm permitted on the length of maximum 1000 mm per each 6 running meters of corridor.

8.2.1.2 The clear height of corridors may not be less than:

- 2.00 m for objects intended for simultaneous stay of not more than 5 persons,
- 2.20 m for objects intended for simultaneous stay of 6 and more persons.

8.2.1.3 It is recommended that corridors should not be stepped. They, however, may end with steps at the exit outside or with stairs leading to other tiers.

8.2.2 Stairs and ladders

8.2.2.1 Stairs shall be permanently fixed to the structure and shall have:

- clear width of min. 800 mm, with minimum clear width of 600 mm permitted for objects designed for simultaneous stay of not more than 6 persons,
- steps of height from 140 to 200 mm and depth at least 200 mm, however, for the quarter-turn stairs and winding stairs, the above conditions shall be complied with already from the internal guiderail of the railing or – where a railing does not exist– from the internal end of stepped area, which extends to at least a half of its width,
- anti-skid surface.

8.2.2.2 The stairs having more than three steps shall be equipped with at least one handle or handrail and shall have a balustrade at the open side or other protection against fall.

8.2.2.3 Ladders or brackets fixed permanently to the structure and providing access to technical spaces are permitted outside and inside the object. The width of the mentioned ladders or brackets shall be at least 350 mm and spacing between rungs must not exceed 300 mm for ladders and the brackets row of length above 2.5 m.

8.2.3 External balustrades

8.2.3.1 Porte-fenetre windows, terraces, balconies shall have safe balustrades of minimum height of 1000 mm and a gap between elements not more than 300 mm.

8.3 Escape routes

8.3.1 For the seasonal use houseboats intended for commercial purposes, it is assumed that they shall comply with the condition of ensuring safe escape route, if designed and constructed in accordance with these *Rules* and they shall be provided with visible graphical marking of evacuation routes in accordance with PN-EN ISO 7010 Standard and additionally, for objects intended for simultaneous use by at least 6 persons, also with escape route lighting.

8.4 Stoves and gas fueled appliances

8.4.1 Stoves

8.4.1.1 If the houseboat is provided with a stove equipped with open flame burners, the equipment mounted in the close vicinity of the burner (zone 1 in Fig. 8.4.1.2) shall be of non-combustible materials.

8.4.1.2 In zone 2, structural materials with non-combustible covering may be used.

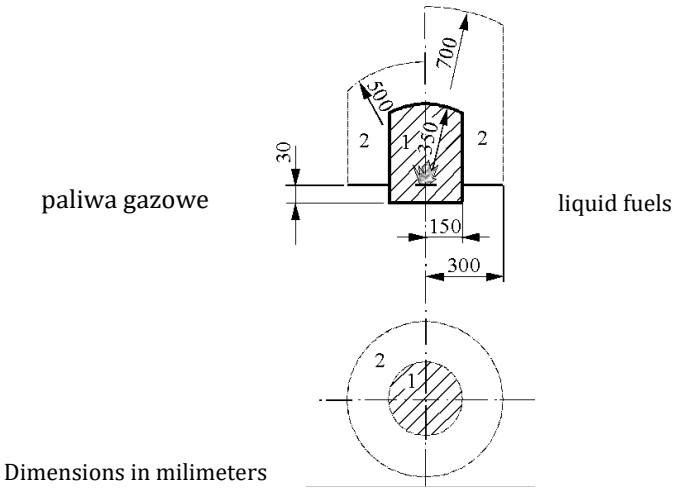


Fig. 8.4.1.2

8.4.1.3 Stoves fueled with liquid of flash point not lower than 55 C (petrol in any form is not allowed) may be applied, provided that they are able to be used at heels up to 15° to any side.

8.4.1.4 A tray of min. 20 mm depth shall be installed under burners of liquid fueled stove, for the event of fuel leakage.

8.4.1.5 The liquid fueled stove and its system shall comply with PN-EN ISO 14895 Standard.

8.4.1.6 The liquid gas fueled stoves shall be installed to enable their use at heels up to 5° to any side. The liquid gas system shall comply with the requirements of 8.7. The stove shall be capable of operating at working pressure in the system.

8.4.1.7 Each burner of the liquid gas fueled stove shall be equipped with a flame control device.

8.4.1.8 A warning plate of height not less than 4 mm shall be permanently fitted close to each stove, to read:

NOTE
DANGER OF SUFFOCATION DUE TO LACK OF OXYGEN
ENSURE VENTILATION DURING THE USE OF THE STOVE
DO NOT USE THE STOVE FOR HEATING THE SPACE

8.4.1.9 Means preventing movement or falling out of kitchen utensils when the houseboat moves, shall be provided on the stove plate.

8.5 Ventilation, air conditioning and heating of spaces

8.5.1 Ventilation and air conditioning

8.5.1.1 Each houseboat shall be provided with an efficient natural and/or forced ventilation system, ensuring air change in all closed spaces, particularly in peaks.

8.5.1.2 The ventilation system in accommodation spaces shall be so constructed that no fire or fume can spread to other spaces in the event of fire.

8.5.1.3 The ventilation systems construction shall fulfil the below conditions:

- the ventilation ducts shall be made of non-combustible or flame-retardant material, securely connected and fixed to the houseboat structure;
- the exhaust ducts of stoves and machinery compartments shall be separated from the same ducts of other spaces;
- stoves shall be provided with ventilation; it is recommended that the stove should be provided with an exhaust duct;
- the exhaust ducts shall be fitted with inspection flaps, for inspection and cleaning.

8.5.1.4 The powered houseboats of length exceeding 10 m shall have emergency shut-down button for fans, fitted in a safe, generally accessible place, beyond the accommodation spaces in an optimum region for evacuation and fire-fighting.

8.5.1.5 The ventilation openings shall be adequately protected against water ingress below deck, and arranged to be in line with air circulation when the houseboat is in move.

8.5.1.6 The ventilation of engine room/petrol tank room shall comply with the requirements specified in Chapter 5 – *Machinery*.

8.5.1.7 Galleys and toilet spaces shall be equipped with exhaust ventilation fitted as high as practicable in the given space and with ventilation inlet openings fitted as low as practicable.

8.5.1.8 A duct or vent of cross-section not less than 4000 mm^2, providing the possibility of discharging gases above deck, shall be provided above each stove or other open flame appliance.

8.5.2 Heating

8.5.2.1 In order to ensure defined thermal conditions, houseboats may be equipped with a heating system for spaces with monitoring devices, providing the possibility of temperature adjustment.

8.5.2.2 The heating system shall be designed considering its operational conditions. The heat output of the heating appliance shall be suitable for the space where the appliance is intended to be installed.

8.5.2.3 Heating of any type shall be installed in accordance with manufacturer's installation manual and technical conditions appropriate for the given type of system shall be ensured. All components and materials being part of the heating system shall withstand high temperatures and shall have non-combustibility certificate.

8.5.2.4 Elements surrounding the heating appliance shall be flame-retardant (shall have high flash point) or be non-flammable.

Fire protection shall comply with the requirements of Chapter 9 – *Fire protection*.

8.5.2.5 In accommodation spaces, the use of steam heating and water-based heating systems of heating medium temperature exceeding 90°C is not allowed.

8.5.2.6 Houseboats may be provided with heating systems supplied with liquefied gas LPG.

8.5.2.7 Heat exchangers and heating system shall be protected from excessive increase of pressure and temperature and shall comply with the requirements of relevant standards. The heating system shall be locally air vented.

8.5.2.8 The water-based closed heating system is an arrangement of connected cables, fittings circulation pumps, heaters, valves separating heat source and other appliances; The system equipped with automatic control fittings shall have local venting appliances, in accordance with the requirements of the Polish Standard for air venting water-based heating systems. Heat losses in delivery and return pipings of the water-based central heating system shall be reasonably low.

8.5.2.9 During installation of equipment provided with exhaust ducts or exhaust ducts with exhaust pipings, the guidelines contained in the manufacturer's operation manual shall be observed. If the exhaust ducts are located close to combustible materials, they shall be insulated or shielded, so that the temperature of the combustible material does not exceed 85°C.

8.5.2.10 The exhaust duct shall be led directly to atmosphere through outlet duct, to avoid letting in exhaust gasses to the houseboat.

8.5.2.11 It is recommended that the exhaust duct, its tightness and passage and exhaust ventilation of the houseboat should be inspected annually. The inspection should be carried out and documented by the chimney sweeper.

8.5.2.12 It is recommended that each houseboat should be provided with smoke detectors fitted in each accommodation space.

8.5.3 Fueled air heating systems

8.5.3.1 Fuel-air heating system is an arrangement of an air generating unit and connected air ducts and pipes with air inlets and outlets, and air jet temperature and power control elements, located between the air heating source and heated spaces.

8.5.3.2 For the liquid fueled heating machinery, requirements defined for fuel system contained in Chapter 5 – *Machinery* shall be accepted.

8.5.4 Heating systems supplied with electrical energy

8.5.4.1 The electrical heating shall be properly protected, in accordance with Chapter 6 – *Electrical installations*. The electrical heating system is an electric supply system from the point of power delivery to the points of electrical energy conversion to heat energy, including converting machinery (radiators, heaters, heat curtain, etc.) and valves and fittings for the control of network parameters and measuring and monitoring equipment and protection devices.

8.5.4.2 The volume of the space where the heating appliances and boilers are installed shall be not less than 3m^3. The space shall be located at the external wall of the houseboat erection.

8.5.4.3 Consideration shall be given to proper selection of the batteries power, electrical protection and the arrangement and selection of appropriate cross-section of cables for the heating system supply by heat pump.

8.5.5 Heating system supplied by liquefied gas LPG

8.5.5.1 The heating systems supplied by liquefied gas LNG or LPG are permitted for use only on the houseboats constructed of non-combustible elements (classes A1 or A2), such as made of steel or aluminium. The internal walls and ceilings in accommodation spaces shall be made of flame-retardant materials (classes B, C or D).

8.5.5.2 In respect of heating systems supplied by LNG, the requirements specified in the current version of PN-EN 1160 Standard shall be observed.

8.5.5.3 Gas heating appliances and gas systems shall be permanently fixed to the houseboat structure to prevent their collapse or displacement. The method of securing shall be in accordance with manufacturer's instructions.

8.5.5.4 Technical conditions for gas ovens and other gas appliances, exhaust pipes, air-exhaust ducts provided onboard the houseboat, as well as technical conditions of spaces where gas appliances are installed shall comply with the requirements defined in the Polish Standards and shall ensure that:

- the gas appliances, which are not subject to permanent supervision when used, such as gas boilers or space heaters, are equipped with automatic devices for protection against pressure drop or interrupted gas supply. This requirement does not apply to the appliances supplied from single liquid gas bottles of capacity up to 11 kg,
- the gas appliances with an open combustion chamber are not installed,
- the volume of the space where gas appliances are installed is not smaller than 6.5 m^3 for the appliances with closed combustion chamber,
- the gas heating boilers are not installed in spaces of height less than 220 cm,
- connection of appliances with gas system pipings may be executed as fixed (rigid) connection or by means of flexible metal hoses. In both cases, the gas appliance is fixed to the houseboat structure to preclude any movements of the appliance caused by houseboat movements,
- the gas boilers of heat power exceeding 40 kW are not installed onboard houseboats,
- more than one gas boiler is not installed onboard houseboats.

8.5.5.5 Only the gas appliances with closed combustion chamber, irrespective of the type of their ventilation system, may be installed on a houseboat, provided concentric air-exhaust pipes are used.

8.5.5.6 In spaces where installed gas appliances use ambient air for combustion, fresh air supply shall be ensured through vent openings having clear cross-section at least 220 cm^2.

8.5.5.7 Gas lines shall be carried on the wall surface or overhead, or in dedicated wall recesses and channels.

8.5.5.8 The pipelines of gas system shall be carried considering the following requirements:
- the gas system pipes are not allowed to be carried through spaces where, due to operational reasons, the system integrity may be breached or gas operational parameters may be affected;
- the gas system pipelines are allowed to be carried through accommodation spaces, under the condition that copper pipes are used, complying with the Polish Standard for gas copper pipes, which are connected by brazing, or seamless and welded steel pipes complying with the Polish Standard for welded pipes for pipelines;
- the gas system pipelines shall be located to ensure their operational safety. Spacing between gas system pipes and other pipes shall enable carrying out maintenance works;
- horizontal sections of gas system shall be situated at least 0.1 m above other installation pipes, while if the carried gas density is greater than air density – below the electrical cables and sparking devices;
- the distance between gas system pipes and other installation pipes they cross shall be at least 20 mm.

8.5.5.9 The pipes shall not be encased or permanently shielded, except the below cases:
- for penetrations of walls and ceilings, the gas pipes shall be carried in shielding pipes permanently fixed to the structure of partitions, with internal diameter of the shielding pipes at least 2 times greater than external diameter of the gas pipe;
- in spaces with aesthetic appearance, pipes may be shielded with light, readily dismountable covers;
- where risk of mechanical damage exists, the gas pipes shall be carried under shield, which is properly chosen for efficient protection and readily dismountable.

Where shields fully covering gas pipes are used, they shall be of openwork, partly openwork structure or shall have at least two holes or ventilation gaps (>5 cm^2) in each space. The route of shielded gas pipes shall be marked or distinguished by means clearly indicating the gas pipeline route.

8.5.5.10 Prior to commissioning the system and its re-commissioning after any serious change or repair, the system shall be subjected to the following tests:
- pressure test, with the use of air, inert gas or liquid under pressure of 20 bars above the atmospheric pressure, for medium pressure delivery pipings, between the closing device of the first pressure reducing device and cut-off valves installed before the end pressure reducing device,
- tightness test, carried out with the use of air or inert gas under pressure of 3.5 bars above the atmospheric pressure, for medium pressure delivery pipings, between the closing device of the first pressure reducing device and cut-off valves installed before the end pressure reducing device,
- tightness test, carried out with the use of air or inert gas under pressure of 1 bar above the atmospheric pressure, for working pressure delivery pipings, between the closing device of the single or end pressure reducing device and cut-off valves installed before the gas consumers,
- tightness test under pressure of 0.15 bar above the atmospheric pressure, for delivery pipings, between the closing device of the single or end pressure reducing device and the gas consumer regulation system.

8.5.5.11 The pipes are considered gastight if, after the time needed for temperature equalization, no drop of test pressure is observed within 10 minutes.

8.5.5.12 It is recommended that each houseboat provided with gas system and/or gas heating system should have gas detectors.

8.5.5.13 The gas heating system shall be subjected, on regular basis, to inspections of tightness and performance, in accordance with manufacturer's recommendations. Each inspection shall be documented.

8.5.6 Heating systems supplied with solid fuel (wood)

8.5.6.1 The heating systems supplied with solid fuel, such as wood, are permitted for use only onboard houseboats whose structure is constructed of non-combustible elements (classes A1 or A2), such as steel or aluminium. The external walls and ceilings of the accommodation spaces shall be manufactured of flame-retardant materials (classes B, C or D).

8.5.6.2 Solid fuel fireplaces shall have closable steel hatch with glass front part or a furnace made of other heatproof non-combustible material with glass front part.

8.6 Water and sewage systems

8.6.1 Domestic water systems

8.6.1.1 Houseboats shall be supplied with potable water and, respectively to the object purpose, with water intended for other purposes, in quantities necessary to cover current needs.

8.6.1.2 Houseboats provided with bathtubs or showers shall have individual or central heat water system.

8.6.1.3 The connections for outer potable water system or filling openings to potable water tanks of the houseboat shall be installed on deck and be properly marked as intended exclusively for potable water.

8.6.1.4 Houseboat is allowed to be equipped with connection to external water supply system or other water source.

8.6.1.5 The connections or filling openings used for the houseboat provision with water not intended for human consumption shall be properly marked and so located as not to be mistakenly used for potable water.

8.6.1.6 The houseboat having connection to land-based water supply network shall be equipped with an easily accessible valve cutting out water supply to the system, located as close as possible to the network connection. The potable water systems shall be made of non-corrosive health safe material.

8.6.1.7 The potable water systems shall have protection against overheating.

8.6.1.8 The systems shall be equipped, in their lowest points, with release valves for complete emptying of water. The whole system shall be so constructed that it is capable of being completely emptied of water.

8.6.1.9 The water supply systems onboard houseboats of class **R**, including connectors, shall be equipped with means preventing water freezing.

8.6.1.10 Potable water pipings may not be carried through tanks containing other liquids. Potable water systems may not be connected to systems carrying other liquids.

8.6.1.11 A place for installation of water meter set and, possibly, water filters shall be provided close to the connection to an external water supply system. It shall be considered that the main water meter set will be generally located onshore.

8.6.1.12 If the houseboat is temporarily connected to the shore water supply system, flexible joints shall be used, so chosen that they do not suffer damage in result of possible displacements and rolling of the houseboat due to its securing and changes of water level in the harbour. It is recommended that the joints should be suspended under the gangway ladders connecting the houseboat with quay, to protect them from damage.

8.6.2 Water tanks

8.6.2.1 Houseboats shall be equipped with water tanks with combined water volume necessary for normal use. The water may be stored in independent tanks, tanks permanently built in the houseboat structure or tanks being an integral part of hull structure.

8.6.2.2 Potable water tanks shall have closable inspection opening for internal cleaning and disinfection of the tank.

8.6.2.3 Tanks shall be equipped with filling level indicators, which particularly enable full control of the tank filling. A cut-off valve for water inflow shall be mounted on the water delivery branch from the tank, for quick closing of the flow.

8.6.2.4 Tanks with gravitational or mechanical discharging/filling shall be provided with air vents with appropriate filters.

8.6.3 Sewage systems

8.6.3.1 A houseboat shall have onboard permanent water closet mounted in the bathroom or in a separate room, with permanently installed sewage tank and a system for sewage discharge to port reception facilities through deck branch piece. No harmful chemicals may be used in the sewage system.

8.6.3.2 The sewage tank capacity V shall not be less than:

$$V = 15nd\ ,\ [\mathrm{dm}^3] \qquad (8.6.3.2)$$

n – maximum number of persons,
d – number of days of sewage keeping, not less than 3.

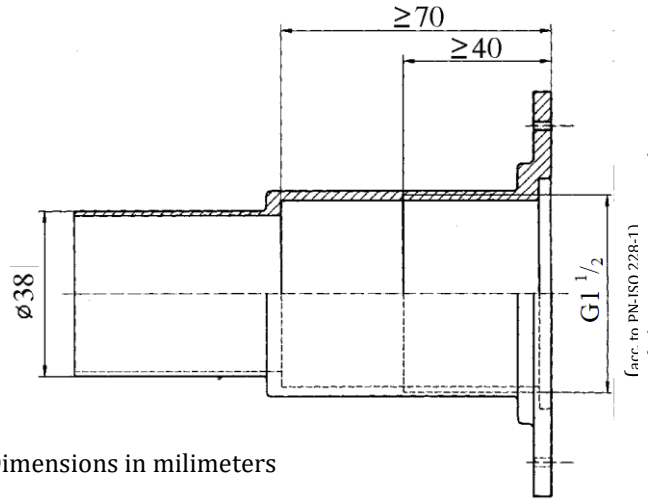
8.6.3.3 The use of portable chemical toilets and portable sewage tanks of capacity not exceeding 20 dm^3 is permitted.

8.6.3.4 The sewage tank shall have:

- technical arrangements and a system preventing tank overfilling;
- technical arrangements ensuring tank tightness and access for periodical cleaning and disinfection;
- air venting arrangements;
- technical arrangements ensuring tank emptying to external reception facilities.

The sewage system, including tank structure and its fittings, pipelines and air vents, shall comply with the requirements of PN-EN ISO 8099 Standard.

8.6.3.5 The structure of the deck branch piece shall be in accordance with Fig. 8.6.3.5-1. The branch piece may not be located in the vicinity of fuel and fresh water inlets and it shall be marked with a pictograph shown in Fig. 8.6.3.5-2.



Dimensions in milimeters

Fig. 8.6.3.5-1

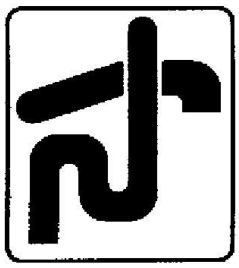


Fig. 8.6.3.5-2

8.6.4 Wastes handling

8.6.4.1 A houseboat shall be equipped with containers for collection and segregation of wastes.

8.6.4.2 Onboard all houseboats, well visible plates shall be fitted to inform the crew and passengers on obligatory requirements in respect of wastes discharge overboard. It is recommended that the dimensions of the information plates should be not less than 125×200 mm, and the plates should be made of durable material and read:

DISCHARGE OF WASTES OVERBOARD IS STRICTLY FORBIDDEN

The ban pertains to plastics (including bags and garbage bags, synthetic ropes), paper, rags, glass, metal, wood, etc.

8.6.4.3 Containers used for temporary collecting solid wastes shall be secured to prevent their collapse, displacement or falling overboard when the houseboat is in rolling. Wheeled containers shall be additionally provided with wheel blockades and arrangements for temporary securing to fixed elements of houseboat structure.

8.7 Liquid gas system

8.7.1 General requirements

8.7.1.1 The requirements of Chapter 8.7 conform to the requirements of PN-EN ISO 10239 and PN-EN ISO 15609: 2012 Standards and define the conditions for liquid gas (LPG) system (propane, butane or their mix) operating at constant pressure nor exceeding 5 Pa (50 mbar), supplied from the cylinder of gas mass not more than 11 kg and with no more than two simultaneously operating gas appliances. More complex systems are subject to separate consideration by

PRS. The requirements do not cover cookers supplied directly from the cylinders and portable gas lamps.

8.7.1.2 The LPG system and all of its elements shall withstand the storage temperature of 30 °C to +60 °C.

8.7.1.3 All LPG appliances installed onboard a houseboat shall be designed for the same working pressure.

8.7.1.4 The LPG system shall be equipped with pressure gauge indicating pressure of the pressure reducing device on the side of cylinder, which enables verifying the system tightness before each use.

8.7.2 Gas cylinders and their storage

8.7.2.1 The gas cylinders shall have valid confirmation of technical supervision acceptance.

8.7.2.2 Gas cylinders and pressure reducing devices shall be placed outside accommodation spaces, on deck or in a gas-tight locker in the cockpit or recess of the houseboat, opened only from the deck.

8.7.2.3 A drain of internal diameter not less than 19 mm or of equivalent cross-section shall be provided in the lower part of the space or locker. The drain shall be led overboard, below the bottom of the space or locker, however, not lower than 75 mm above the waterline of the loaded houseboat at heel of 15°.

8.7.2.4 Cylinders, valves and pressure reducing devices shall be properly fixed and easily accessible.

8.7.2.5 It is recommended that the below legible warning plate should be placed directly at the cylinders:

LPG GAS CYLINDER

THE VALVE MAY BE OPEN ONLY WHEN GAS APPLIANCE IS OPERATED
THE VALVE TO BE CLOSED PRIOR TO PUTTING OUT THE FLAME.

8.7.2.6 It is recommended that close to the cylinder valve the below description should be placed of the procedure of checking the system tightness prior to each use of the appliance:

CHECK THE SYSTEM TIGHTNESS

1. Open the cylinder valve at closed valves of the appliance.
2. Close the cylinder valve and wait until the pressure gauge readings stabilize.
3. Observe the pressure on the gauge for 3 minutes.
4. If the pressure is constant, it means that the system is tight. The pressure drop indicates a leak. The leakages shall be removed prior to the equipment operation.

8.7.2.7 Spare or empty cylinders shall be stored in the same room or locker as the cylinders connected or in another room or locker complying with the same requirements.

8.7.3 Cut-off valves

8.7.3.1 Only the fittings provided particularly for LPG gas shall be applied. The valves shall be clearly marked with positions ”open” and “closed”. The valves shall be located to preclude the possibility of being open by accident.

8.7.3.2 Each LPG system shall be provided with main cut-off valve installed before the pressure reducing device on the side of cylinder and manually controlled and easily accessible. It may be a cylinder fitted valve.

8.7.3.3 For systems consisting of two cylinders, except the cut-off valves on each cylinder, a three-way valve shall be installed to ensure the system operation in the case of disconnecting one cylinder.

8.7.3.4 At each gas appliance, a cut-off valve shall be installed, easily accessible and located to avoid reaching above the appliance burner during its operation.

8.7.4 Pipelines

8.7.4.1 Fixed gas pipelines shall be made of drawn copper pipes or drawn stainless steel pipes, of wall thickness not less than 0.8 mm – for external dimeters of pipes equal to or less than 12 mm, and of thickness 1.5 mm for greater diameters.

8.7.4.2 The gas pipeline shall be fastened by means of appropriate fasteners in the form of pipe rings, spaced not more than 0.5 m apart.

8.7.4.3 The pipeline passing through the engine compartment shall be shielded by a duct or channel, or be secured by fasteners spaced not more than 0.3 m apart.

8.7.4.4 The pipeline passing through engine compartment shall have no joints and connections.

8.7.4.5 The pipeline joints and connections shall be made by: brazing, bite type rings, clamping rings made from copper on copper pipelines and from stainless steel on stainless steel pipelines, or being in accordance with PN-EN 560 Standard.

8.7.4.6 All threaded connections which are substantial for the tightness of gas pipeline, shall be provided with pipe tapered threads.

8.7.4.7 The number of joints shall be reduced to a minimum. The joints shall be easily accessible.

8.7.4.8 Flexible hoses manufactured in accordance with EN 1763-1 and EN 1763-2 Standards or their equivalents are permitted to be used in the gas system. The hose shall not be carried through the engine compartment and its length shall be reduced to a minimum. The hose shall be accessible for inspection over its whole length, fastened by holders in the form of pipe rings, spaced not more than 1 m apart.

8.7.4.9 A hose shall have no joints, except connection of metal pipeline to a cooker hose with a gimbal.

8.7.4.10 The gas pipeline shall not touch metal elements of the houseboat structure and shall be carried:

– not less than 100 mm off the engine exhaust system and uncovered terminals of electrical appliances;
– not less than 30 mm off electrical cables; this requirement does not concern a shielded pipeline without connections and electrical cables routed in a pipe or cabling channel, in accordance with the requirements of PN-EN ISO 10133 or PN-EN ISO 13297 Standards;
– as high as practicable above the bilge water level.

8.7.4.11 The pipeline passing through watertight bulkheads shall be properly protected from damage and sealed or bulkhead penetration channels shall be applied.

8.7.4.12 Hose clamps on flexible hose on the drain from cylinder room shall comply with the requirements specified in *Part IV – Machinery*.

8.7.4.13 Any joints and connections of fixed pipelines and flexible hoses shall be made to avoid excessive strains.

8.7.5 System tests

8.7.5.1 Prior to connecting LPG gas to the system, tightness test thereof shall be carried out from the connecting point of the pressure reducing device (with the device disconnected) to closed burner valves on the gas appliances, with the use of compressed air at test pressure equal to three times working pressure, however, not exceeding 15 kPa (150 mbar). If after 5 minutes, necessary for pressure equalizing, the test pressure remains constant with accuracy of ±0,5 kPa (5 mbar) for the next 5 minutes, the system may be considered tight.

8.7.5.2 It is recommended to use leakage detection devices for detection of any leakage in the system joints.

8.7.5.3 When checking tightness of joints with the use of soap or detergents, no agents containing ammonia may be used.

8.7.5.4 Upon the tightness test, the system shall be checked in operation.

8.7.6 Installation of electrical appliances

8.7.6.1 The electrical appliances installed in a room or locker intended for gas cylinders and in spaces where LPG system valves or joints or gas consumers, such as water heaters, refrigerators or radiators, operating without permanent supervision, are located, shall comply with the requirements of PN-EN 28846 Standard, for the protection against ignition of present flammable gases.

8.7.6.2 The above requirement does not apply to electrical appliances installed in crew and passenger spaces and in spaces open to weather, where not less than 0.34 m^2 of permanently open surface is per each 1 m^3 of the net volume of the space.

9 FIRE PROTECTION

9.1 General requirements

9.1.1 It is recommended that structure of a houseboat should be made of non-combustible (A1 or A2 Class) or flame-retardant elements (classes B, C or D).

9.1.2 Walls of engine room, heating appliances room, galleys and flammable material stores adjacent to accommodation spaces shall be made of non-combustible or flame-retardant materials.

9.1.3 Insulation materials used in the spaces shall be flame-retardant.

9.1.4 Exposed external surfaces of walls, floors and ceilings in accommodation spaces shall be constructed of materials having low flame spread (LFS) properties. These materials, in the event of fire, should not emit excessive quantities of toxic gases nor smoke.

9.1.5 The equipment of spaces (furniture, floor coverings, textiles, decorative elements, etc.) shall be, as far as practicable, made of flame-retardant materials or their surfaces shall have LFS properties.

9.1.6 Paints, varnishes and other finishing materials, used on surfaces inside accommodation spaces shall not give off dangerous amounts of toxic gases or smoke.

9.1.7 All materials of used machinery shall be adequately durable and non-combustible. In order to fulfil the requirement, the machinery manufacturer instructions may be observed, under the condition that the machinery has been temperature tested in accordance with EN 16510-1[1] or UL 1100[2].

9.1.8 Each fire-extinguishing appliance on the houseboat shall be attached with its service manual issued by the manufacturer.

9.2 Ventilation systems

9.2.1 Each houseboat shall be provided with an efficient natural and/or forced ventilation, allowing air change in all closed spaces.

9.2.2 Ventilation system in accommodation spaces shall be designed in such a way that in the event of fire it does not cause the spread of fire and smoke to other spaces.

9.2.3 Ventilation ducts shall be properly insulated. The ventilation inlets shall be protected against water ingress and arranged to respect air circulation during the houseboat movement.

9.2.4 If the houseboat has a room with stationary fuel tanks and electrical appliances, other than fuel level sensor, or the room is intended for the storage of portable petrol tank, each compartment which is not open to atmosphere shall have its natural ventilation system.

9.2.5 Ventilation of fuel tank spaces shall comply with the requirements defined in Chapter 5 – *Machinery*, as regards ventilation of fuel tank spaces and the requirements of ISO 11105 Standard.

9.2.6 The ventilation system shall prevent passage of air from galley and toilet/bathroom to accommodation spaces.

9.2.7 Galleys and toilets shall be equipped with air extraction ventilation, located as high as practicable and with air intake openings situated as low as possible.

9.2.8 Over each cooker or other open flame appliance, a ventilation duct or opening shall be located, the cross-section of which is at least 4000 mm^2, to allow gas extraction over the deck.

9.2.9 The houseboat ventilation openings and air extraction openings shall be closed to the open space from outside the spaces.

9.2.10 Ventilation of electrical motors rooms and accumulator batteries room shall be ensured. The batteries shall comply with the requirements of IEC 62040-1, in accordance with Chapter 6 – *Electrical installations.*

9.3 Open fire appliances – cookers

9.3.1 Cookers supplied by liquid fuel (except petrol supplied cookers) having the flash point below 55°C and their installations shall comply with the requirements of PN-EN ISO 14895 Standard. Below the liquid fuel cookers, a tray of minimum depth 20 mm shall be mounted, to collect any fuel leak.

9.3.2 The liquid fuel shall be placed in metal fuel tanks resistant to external and internal corrosion. The tank connections, except seams, shall be welded or brazed.

9.3.3 Cookers shall be provided with non-metallic monitoring devices for each burner flame. This requirement does not apply to camping stoves mounted directly onto gas cylinder.

9.3.4 The room intended for fuel storage shall have ventilation in accordance with the requirements of 9.2 *Ventilation systems*.

9.3.5 Close to each cooker, a warning plate of height not less than 4 mm shall be permanently fitted, to read:

NOTE
DANGER OF SUFFOCATION DUE TO LACK OF OXYGEN
ENSURE VENTILATION DURING THE USE OF THE COOKER
DO NOT USE THE COOKER FOR HEATING THE SPACE

9.3.6 In the vicinity of each cooker, within 300 mm, only non-combustible materials shall be used.

9.3.7 No combustible permanent elements and other equipment, except the floor and its coverings, neither combustible materials, such as curtains or louvers, may be located within the limits specified by the manufacturer or, if the limits are not specified, within 600 mm from the nearest end of the element/equipment.

9.3.8 Open fire appliances shall not be placed above the escape route of the houseboat. Neither escape route may run directly above the open fire appliance or heat radiator.

9.3.9 The outlet/extract duct shall be carried directly to an open area, to prevent ingress of any gas to the houseboat.

9.3.10 Other fuel systems of machinery are subject to a separate consideration by PRS.

9.3.11 It is recommended that houseboats housing open fire appliances should be equipped with fire-extinguishers of total fire-extinguishing capability not lower than 8A/68B or with fire blanket and a fire-extinguisher of fire-extinguishing capability 5A/34B. It is recommended that the fire-extinguishers be placed within 2 m from the cooker or other open fire appliance and be accessible in the event of fire.

9.4 Fire detection and alarm systems

9.4.1 It is recommended that each houseboat should be provided with fire detection and fire alarm systems with the use of at least sound system.

9.4.2 The fire detection and alarm system shall consist of e.g. smoke detectors and/or heat detectors complying with appropriate international standard and, optionally, of manually operated call points.

9.4.3 Fire detectors shall be distributed in each accommodation space.

9.4.4 Fire detection devices shall be supplied directly from the onboard electrical supply system and, where applicable, from a stand-by electrical system.

9.4.5 For houseboats of increased cubic capacity, i.e. having more than one tier, the fire detection and alarm system shall transmit the fire alarm to control position.

9.4.6 For proper selection of appliances, the area of protected space shall be considered. Each houseboat shall have an approved fire protection system.

9.4.7 The appliances shall be maintained and installed in accordance with the instructions of manufacturer's manual.

9.5 Fire-fighting equipment – portable extinguishers

9.5.1 Each houseboat shall be equipped with fire-fighting equipment and systems adequately to its size, installed propulsion and equipment, including open fire appliances.

9.5.2 It is recommended to use portable extinguishers and additionally fixed fire-extinguishing systems for extinguishing accommodation spaces and other closed spaces.

9.5.3 Portable fire-extinguishers used on houseboat shall be in accordance with EN 3-7 or ISO 7165 Standard or equivalent standards.

9.5.4 It is recommended that fire-extinguishers intended for A/B group fires should have fire-extinguishing capability not lower than 5A/34B.

9.5.5 It is recommended that extinguishing fires on open decks be effected by the use of water fire main system or buckets with line.

9.5.6 CO_2 extinguishers may be placed only in spaces where live electrical appliances or flammable liquids are located. The capacity of the extinguishers shall be not more than 2 kg. In one room, not more than one such extinguisher may be placed.

9.5.7 Fire-extinguishers shall be mounted on holders which allow for their quick use. An extinguisher may be kept in a locker or in another closed space, provided the storage space is marked with an ISO symbol complying with PN-EN ISO 9094 standard.

9.5.8 Fire-extinguishing opening, intended for extinguishing closed spaces with a portable extinguisher, shall be open or opendable, being of size adjusted to the extinguishing nozzle and situated to enable full release of extinguishing medium. The extinguishing opening shall be well marked.

9.5.9 It is recommended that one fire-extinguisher should be placed within 1 m from the houseboat control position in the case of a houseboat of hull length less than 12 m and within 2 m from the control position for the houseboat of hull length from 12 to 24 m.

9.5.10 In each space onboard a houseboat, portable fire-extinguishers shall be easily accessible and be placed to enable immediate response to fire. The use of warning plates and graphical symbols is recommended.

9.5.11 At least one fire-extinguisher of fire-extinguishing capability 5A/34B shall be placed per each 20 m^2 of accommodation space.

9.5.12 Where accommodation spaces are protected by a fixed fire-fighting system in accordance with 9.6, only one portable extinguisher shall be provided for such space. The extinguisher may comply with more than one of the requirements.

9.5.13 The houseboat provided with accommodation spaces with sleeping berths for more than 6 persons, shall have at least one 6 kg powder extinguisher for fighting A, B and C group fires, complying with PN-EN 3-8 Standard.

9.5.14 Each houseboat with a space where cooking or heating appliances are placed, shall be protected by a portable fire-extinguisher, in accordance with 9.5.15 and Table 9.5.15.

9.5.15 The houseboat shall have also a bucket and a fire blanket.

If required by Table 9.5.15, the fire blanket, in accordance with EN 1869, shall be secured close to any open fire cooking appliance or deep fat cooking appliance, arranged to be easily accessible and ready for immediate use in the event of fire.

Table 9.5.15

Protection of accommodation spaces with cooking and heating appliances

Kind of cooking appliance	Protection
no open fire	One portable extinguisher of fire-extinguishing capability 5A/34B or fixed system in accordance with 9.6.
with open fire	Portable extinguisher(s) of minimum combined capacity 8A/68B or a fire blanket plus one portable extinguisher 5A/34B or a fixed system in accordance with 9.6 and one portable fire extinguisher of group F.

Note:
The fire-extinguishing capabilities of portable extinguishers required in Table 9.5.15 correspond to those defined in EN 3-7. Attachment C contains information from the EN Standard on characteristics of typical fire-extinguishing capability depending on the mass or volume of extinguishing medium and on equivalence with other regulations.

9.6 Fixed fire-extinguishing system

9.6.1 Fixed fire-extinguishing systems shall have properly chosen fire-extinguishing devices and shall be installed in accordance with the instructions of the system manufacturer and of the supplier of extinguishing medium appropriate for the protected space.

9.6.2 No fire-extinguishing media may be used which cause toxic concentrations in the space they are released to.

9.6.3 Fire-extinguishing media which contain halons 1211, 1301 and 2402 and perfluorocarbons are not allowed to be used.

9.6.4 No fixed CO_2 fire-extinguishing systems should not be used on houseboats.

9.6.5 Fixed fire-extinguishing systems shall be capable of operating at temperatures the houseboat is intended to operate.

9.6.6 Three types of the fixed fire-extinguishing system are distinguished:

- Hand-operated fire- extinguishing system – operated by hand from the houseboat control position. If the control position is situated more than 5 m from the protected space, a local releasing unit shall be placed in the vicinity of this space.
- Automatic fire-extinguishing system – is initiated automatically after operation of high temperature or smoke sensor of the protected space.
- Manual and automatic fire-extinguishing system – arranged to enable neglecting automatic operation by the person in charge.

9.6.7 The fire-extinguishing capability of the fixed fire-extinguishing system shall be determined based on net volume of the protected space, i.e. its air volume plus 20%.

9.6.8 Arrangement of nozzles shall be such as to ensure an efficient extinguishing of the protected space.

9.6.9 The space where a fixed fire-extinguishing system is installed shall be structurally separated, such as boiler room, in order to minimize the flow of extinguishing medium to accommodation space.

9.6.10 If the fixed system uses suffocating gas in a harmful concentration, then:
- it shall be provided with a cut-off valve, clearly indicating open or closed status, installed as close as practicable to gas cylinder and separate from the operating system;
- the protected spaces, sufficiently large for even occasional presence of one person, shall be equipped with visual and sound alarm, initiated before release of extinguishing medium.

9.6.11 Components of the fixed fire-extinguishing system shall be securely fixed to the houseboat structure, to withstand rolling, shakes and vibrations due to normal operational conditions of the houseboat.

9.6.12 Extinguishing medium cylinders, distributing pipes and control elements shall be arranged to avoid exposure to temperatures beyond the design working range, when the houseboat is operated.

9.6.13 In order to minimize corrosion, cylinders shall be mounted far from the expected level of bilge water and above the surface where water may gather.

9.6.14 Cylinders shall be accessible for dismantling. The control elements and dials of indicators shall be easily accessible and visible.

9.6.15 Non-metallic items of distributing lines, including their fittings which is not expected to melt as a part of installed fire-extinguishing system, shall be fire-resistant, in accordance with PN-EN ISO 7840 Standard or other way protected from fire.

9.6.16 Solder or brass used for metal cables or shapes shall have melting temperature not lower than 600 °C.

9.6.17 Operating of the system

9.6.17.1 For automatic systems, a remote indicator of release of extinguishing medium shall be installed, which shall be clearly visible and audible at main control position.

9.6.17.2 Manual releasing device, if installed, shall be easily accessible and operated with maximum force 100 N. The label showing the method of releasing of the extinguishing medium shall be placed directly near the releasing device and shall identify protected space(s). Means shall be ensured to prevent accidental release of the extinguishing medium.

9.6.17.3 Fixed systems using gas for protection of spaces, such as boiler room, shall be equipped with a hand-operated or automatic device, which shuts down heating appliances (cuts the power) before or during releasing extinguishing medium or activating the system.

9.6.17.4 Fixed systems using gas for protection of spaces shall be provided with means ensuring maintenance of the minimum design concentration of extinguishing medium until the fire is suppressed.

9.6.17.5 Before and during releasing of the extinguishing medium, manual and/or automatic shutdown of engines shall be ensured for heating appliances, generators, forced ventilation or other permanently installed equipment, which could negatively affect the level of extinguishing medium in the protected space.

9.7 Fire protection of engine and fuel tanks room

9.7.1 The houseboats with an outboard engine of power less than 25 kW and with fuel tank located in an open place need not be provided with fire-extinguisher used for the engine extinguishing.

9.7.2 Depending on the outboard engine(s) power, its fire protection shall be effected by the type of fire-extinguisher complying with the criteria contained in Table 9.7.2.

Table 9.7.2
Protection of engines

Position of engine	Criterium	Protection method:
Outboard engine(s)	P [a] ≤ 25 kW	The extinguisher not required
	P > 25 and ≤ 220 kW	One portable extinguisher 34 B
	P > 220 kW	Poratble extinguisher(s) of combined capacity B = 0.3 P [b]

a) P means power rating in kW of the engine or engines (total value) .
b) Example: for an outboard engine 220 kW, the required capability is 220 × 0.3 = 66B, which is equivalent to two extinguishers 34B.

9.7.3 For the protection of fuel tanks room, a portable fire-extinguisher shall be provided of the size and type appropriate for filling the space with extinguishing medium through a fire-fighting opening made in the space wall or casing if outboard petrol engine(s) has(have) fuel tank in a closed space (fire-extinguishing of fuel tanks room).

10 TECHNICAL DOCUMENTATION

10.1 Classification documentation of the houseboat under construction

Prior to the commencement of houseboat construction, technical documentation, within the required scope taking into account the houseboat's type and size, its machinery and equipment shall be submitted to the PRS Head Office for consideration and approval.

The items of technical documentation specified in 10.2 to 10.6 may be properly combined and presented in one drawing, provided that all the required information is indicated.

10.2 General documentation

.1 Houseboat specification, including the type, its main dimensions, other basic characteristics, the equipment number, operation area, symbol of class to be assigned, number of occupants, design speed, description of machinery and systems, which as provided in the next paragraphs of the present list do not require the drawings to be submitted for approval, as well as a description of anchoring and mooring equipment.
.2 General arrangement plan.
.3 Body lines (for reference), indicating the design displacement and the position of the centre of buoyancy.
.4 Stability analysis within the scope required by the *Rules.*
.5 Unsinkability analysis within the scope required by the *Rules.*

10.3 Hull documentation

.1 Midship section.
.2 Longitudinal section.
.3 Drawings of deck, superstructures and deckhouses.
.4 Description of hull construction working procedures.
.5 Shell expansion – for metal houseboats.
.6 Hull and deck laminating plan – for laminate houseboats.
.7 Drawing of main engine seating.

10.4 Hull equipment documentation

.1 Arrangement plan of openings in hull, superstructures and deckhouses, indicating the height of coamings and the structure of closing appliances for openings.

.2 Plan of steering gear.

.3 Plan of anchoring and mooring equipment; for equipment number W less than 90 m^2, information given in the boat specification is sufficient.

.4 Side and bottom openings arrangement and fittings plan.

.5 Drawing of bulwark rails and other protective arrangements for the crew safety on deck.

.6 Ventilation plan – for simple installations, indicating ventilation openings on the general arrangement plan, together with the relevant information in the *Boat specification* is sufficient.

.7 Diagram of liquid gas system – for systems supplied by one cylinder containing less than 3 kg of gas, the relevant information in the *Boat specification* is sufficient.

.8 Evacuation Plan, if required by the *Rules*.

.9 Life-saving Appliances Arrangement Plan

10.5 Machinery documentation

.1 Engine room arrangement plan indicating particulars of machinery installations.

.2 Diagram or description of propulsion machinery remote control, showing measurement and control instrumentation as well as signaling devices.

.3 Diagram of bilge, fuel, cooling water, and exhaust gas systems.

.4 Drawings of fuel tanks, with fittings.

.5 Diagram of heating systems

.6 Diagram of fire-fighting systems.

10.6 Documentation of electrical installations

.1 Essential diagram of electrical installation including the specification of the circuits' data, protective measures applied and cross-sectional areas of cables.

.2 Diagram of the main switchboard, control panels and terminal switchboards.

.3 Energy balance and capacity calculations for the selection of batteries

.4 Drawing showing the method and location of the fixing of batteries.

.5 Drawing of electric consumers distribution.