RULES
FOR THE CLASSIFICATION AND CONSTRUCTION OF MOTOR BOATS

PART VI
MATERIALS

February
2012

GDAŃSK

RULES FOR THE CLASSIFICATION AND CONSTRUCTION OF MOTOR BOATS consist of the following, separately edited, parts:

Part I – Classification Regulations
Part II – Hull
Part III – Equipment and Stability
Part IV – Machinery Installations
Part V – Electrical Installations
Part VI – Materials

Part VI – Materials – February 2012, was approved by the PRS Board on 25 January 2012 and enters into force on 1 February 2012.

From the entry into force, the requirements of the present Part of the *Rules* apply to:
- motor boats under construction – within the full scope,
- motor boats in service – at their conversion and general overhaul, as well as in each justified case.

For other motor boats in service, the *Rules* requirements valid at the assignment of PRS class to a boat, apply.

* *Polish Register of Shipping means Polski Rejestr Statków S.A., seated in Gdańsk, al. gen. Józefa Hallera 126, 80-416 Gdańsk, Poland,* registered in the Register of Entrepreneurs of the National Court Register, under entry number 0000019880. Polish Register of Shipping, its affiliates and subsidiaries, their respective officers, employees or agents are, individually and collectively, referred to as Polish Register of Shipping or as PRS for short.

PRS/RP, 09/2024

CONTENTS

Page

1 GENERAL

1.1 Application

1.1.1 *Part VI – Materials* is applicable to materials intended for motor boat hulls, machinery and equipment.

1.1.2 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.*

1.1.3 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.

1.2 Selection of Materials

1.2.1 When using various metal alloys for the manufacture of motor boat 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.

1.2.2 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.

1.2.3 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.

2 GRP LAMINATES

2.1 Polyester Binders

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.*

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.

2.1.3 The cured structural binders shall have the properties as specified in Table 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 2.1.3

Property of the cured binder	Value	Test based on
Ultimate relative elongation at break	min. 1.5%	EN ISO 527-1, -4
Tensile strength	min. 45 MPa	EN ISO 527-1, -4
Young's modulus at tension	min. 3000 MPa	EN ISO 527-1, -4
Temperature of deflection under load	min. 60 °C	EN ISO 75-1, -3
Hardness	min. 35 °Barcol	EN 59
Water absorptivity after 28 days	max. 100 mg	EN ISO 62

2.1.4 It is recommended that the relative elongation of gelcoat resins should be not less than 2.5%.

2.1.5 The structural binders exposed to initiator – accelerant combination shall polymerise at an ambient temperature, without heating.

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.

2.2 Resin Additives

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.

The above components shall initiate polymerisation of the resin at the temperature above 16 °C.

2.2.2 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%.

2.2.3 The tixotroping agents used in structural binders shall not impair polymerisation 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.

2.2.4 Pigments and tixotroping agents used in a gelcoat shall not stop the polymerisation process, excessively extend the curing time or reduce the binder waterproofness.

The content of fillers in the gelcoat shall not be greater than 11%, with the tixotroping agents constituting not more than 5% of the binder mass.

2.2.5 Proportioning and mixing the additives with the binder shall be made with particular care and only by persons having adequate experience in this field.

2.2.6 Particular care shall be taken to ensure that water will not get into the resin during its storage and processing.

2.3 Glass Reinforcement

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.

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.

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.

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).

2.3.5 The glass reinforcement cannot be wet. Wet glass mats cannot be used even after they have been dried.

3 STEELS

3.1 The structures of the motor boat hull, machinery and equipment shall be constructed of structural steel having the properties specified in Table 3.1.

Table 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

*) According to *Part IX – Materials and Welding* of the *Rules for the Classification and Construction of Sea-going Ships.*

3.2 For the construction of boat equipment and for fasteners, the following corrosion-resistant steels having the properties specified in Table 3.2 are recommended.

Table 3.2
Corrosion-resistant steels

Type of steel	Steel grade		Mechanical properties		
	acc. to 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

For propeller shafts, chromium steel, e.g. X17CrNi16-2 can be used.

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.

3.4 The fasteners made of structural steel shall be hot galvanised. Small screw fasteners and screws, which cannot be hot galvanised properly, can be electro-galvanised, provided a coating of not less than 24 μm is achieved.

3.5 Steel pipings shall be manufactured of seamless pipes, steel grade: R35 or R45 in accordance with the *Rules for the Classification and Construction of sea-going Ships, Part IX – Materials and Welding*.

4 ALUMINIUM ALLOYS

4.1 The hulls and other items of a motor boat structure 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.

4.2 The aluminium alloys recommended for the construction of boat hulls are specified in Table 4.2.

Table 4.2
Aluminium alloys for the construction of boat hulls

Alloy grade			Delivery condition *) acc. to EN 515	R_m [MPa]		$R_{0,2}$ [MPa] min	A_5 [%] min
according to EN 573-3		type of product according to PN-H-88026					
numerical	abbreviated 1)			min	max		
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	–	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	–	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.

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).

4.4 For structural items of deck equipment the use of aluminium alloys, specified in Table 4.4, is recommended.

Table 4.4
Aluminium alloys for deck equipment

Alloy grade			Delivery condition *) according to EN 515	R_m [MPa] min.	$R_{0,2}$ [MPa] max.	A_5 [%] min.	HB approx. values
according to EN 573-3		type of product according to PN-H-88026					
numerical	abbreviated 1)						
EN AW-6101A	6101A	PA 38 pipes	T6 T5	200 180	140 130	12 12	65 60
		PA 38 bars, sections	T4 T6 T1 T5	140 220 120 200	80 160 60 140	14 10 15 12	33 55 30 55
EN AW-7020	7020	PA 47 pipes	T1 T5	310 350	200 270	10 8	90 100
		PA 47 bars sections	T5	350	270	10	95
		PA 47 plates	T5 T6	350 350	270 270	10 10	95 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.

5 COPPER ALLOYS

5.1 The structure items of boat machinery and equipment, as well as fasteners (rivets, screws, pins) shall be manufactured of wrought copper alloys having the properties specified in Table 5.1.

Table 5.1
Wrought copper alloys

Alloy type	Alloy grade (examples)	Marking	According to the relevant Polish standard	Approximate values R_m, [MPa], min.
Brass	CuZn37 CuZn39P62 CuZn38Sn1 CuZn20Al2	M63 MO59 MC62 MA77	PN-92/H-87025	290(r) 440(z16) 410(z4) 320 340(r), 390(z4r)
Bronze	CuSn6 CuAl10Fe3Mn2 CuSi3Mn1	B6 BA1032 BK31	PN-92/H-87051 PN-92/H-87060	440(z6), 510(z8) 590 340(r), 590(z6)

Designation of delivery conditions:
r – recrystalised,
z4 – semi-hard,
z4r – hard,
z6 – semi-hard recrystalised,
z8 – elastic.

5.2 The cast items of boat 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 5.2.

Table 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	BM128	640
	Superston	BM157	690
	Nikalium	BA1055	600

*) Brass MM55 is recommended for propellers.

6 WOOD

6.1 Solid Wood and Plywood Sorts

The boat hull structure and equipment items shall be constructed of solid wood and plywood sorts, listed in Tables 6.1.a and 6.1.b. The application of other sorts of wood or facing boards is subject to special consideration of PRS.

Table 6.1.a
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	15000
2	Black alder	N	L	L	550	90	90	40	9000
3	Beech	N	L	L	690	120	135	60	14000
4	Leaf stalk oak (durmast)	T	T	L	670	95	90	52	11000
5	Leaf stalkless oak	T	T	L	720	110	90	60	13000
6	Ash	N	L	L	680	120	130	52	13400
7	Witch elm	N	D	L	680	80	80	56	11000

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]
8	Elm	N	D	L	680	80	80	56	11000
9	Fir	D	L	L	450	68	84	40	10000
10	Larch	D	D	L	590	93	107	53	12000
11	Spruce	N	L	L	470	68	80	43	10000
12	Common pine	D	L	L	520	82	104	47	12000
13	Pitch pine	D	D	D	670	102		50	12000
14	Douglas fir	D	D	L	510	82	105	47	12000
15	Peroba	T	T	D	700	108		63	12500
16	Tiama, Gedu nohor	D	D	L	550	78		48	10000
17	Sapele	D	D	L	640	69	85	57	9800
18	Sipo, Utile	T	D	L	630	100	110	58	11000
19	Guarea, Bosse	T	T	L	600	94	52		11000
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	13000
23	Gabon Okoume	N			430	72	58	39	3000
24	Makore	W	T	L	620	103	85	53	11000
25	Agba, Tola	T	D	L	490	62	52	40	6500
26	Afrormosea, Kokrodua	W	T	L	700	120	60		11600
27	Idigbo, Framire	T	D	L	550	74	42		8000
28	Meranti	T	D	L	560	105	129	53	12000
29	Yang	D	D	L	760	125	140	70	16000
30	Red cedar	T	D	L	390	53	50	32	7500
31	Iroko, Kampala	W	D		620	95	79	55	11000
32	Balsa	N			160	19	40	10	2600

Table 6.1.b
Wood application

Item*)	Keel, slab keel	Dead wood	Stem, stern	Longitudinals	Floors	Glued frames	Bent frames	Plating below designed waterline	Plating above designed waterline	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++	–	–	–	–	–	–

Item*)	Keel, slab keel	Dead wood	Stem, stern	Longitudinals	Floors	Glued frames	Bent frames	Plating below designed waterline	Plating above designed waterline	Deck plating	Deck beams	Vertical knees	Horizontal knees	Deck stringers	Deckouse walls	Plywoods	Moulded plywoods
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 6.1.a

Notes to Tables 6.1.a and 6.1.b

.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:
- L – easy to obtain the resistant glued joint,
- D – easy enough to obtain the resistant glued joint,
- T – difficult to obtain the resistant glued joint.

6.2 Balsa

Sandwich planking of decks and walls of superstructure and deckhouses may be constructed of balsa wood, cut transversely to the wood rings. The wood humidity cannot exceed 12%. The strength of the cloth used for joining the balsa wood shall be sufficient for processing and the adhesive shall be polyester resin soluble. The shear strength of the balsa wood shall be not less than that given in Table 6.2.

Table 6.2

Apparent density [kg/m^3]	Approximate shear strength [MPa]
95	1.10
130	1.80
175	2.00

6.3 Quality of Solid Wood

The wood intended for the structural elements of the boat 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.

Moreover, the wood shall, in general, be free of knots; however, rare, isolated and good growed-in knots, do not disqualify the material.

The wood intended for stern frame components shall be seasoned with particular care; where the external conditions can be a cause of its overdrying, the wood shall be preserved with the use of linsed oil or varnish immediately after mounting the stern frame components.

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.

The wood to be used in the boat construction shall be submitted to the PRS Surveyor for acceptance. The wood not accepted by the PRS Surveyor cannot be used.

6.4 Quality of Plywood

The plywood intended for the outer planking or deck 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.

The plywood sheets shall be stored in a dry room, laid down horizontally on the even foundation, with ensured good air conditioning.

The plywood to be used in the boat construction shall be submitted to the PRS Surveyor for acceptance. The plywood not accepted by the PRS Surveyor cannot be used.

6.5 Wood Humidity

Wood shall be stored in conditions ensuring its proper seasoning and its humidity measured before construction of the boat structural elements shall not exceed 20%. During the boat construction, appropriate means shall be taken to prevent overdrying of the wood. Where glues of resorcinol type are used, the wood humidity above 15% is recommended; where glues of phenol or urea-formaldehyde type are used – the wood humidity below 15% is recommended. Where epoxy glues are used, the wood humidity shall be up to 12%.

It is recommended that the wood intended for the elements glued of layers should be dried artificially.

The humidity of wood intended for the outside or deck planking to be subsequently covered with reinforced plastic laminate shall be as low as possible and in no case can exceed 15%.

The humidity of plywood cannot exceed 15%.

6.6 Impregnation of Wood

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 6.1.a as non-durable or durable enough.

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.

When choosing fungicides, the effect of fungicides on the means of surface (paints) preservation or laminate (if the outside planking is to be covered with the laminate) shall be considered.

6.7 Glues for Wood

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.

The urea-formaldehyde glues may be used for connecting structural parts which are not permanently exposed to water and have good ventilation (e.g. parts of superstructures, deckhouses and elements of the inner equipment which are situated far from the bilge). The joints made using this type of glue shall be covered with several layers of the waterproof coatings.

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.

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 RUBBER OR PLASTIC COATED FABRICS

7.1 The requirements of the present Chapter apply to fabrics coated with rubber or plastics, intended for the structure elements subject to PRS' survey.

7.2 Decision on approval of the coated fabrics intended for the floating objects is made by PRS on case by case basis at documentation approval.

8 INSULATING MATERIALS

8.1 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.

8.2 It is recommended that the insulating materials should comply, depending on their application, with the requirements of ISO 9094-1 and -2.

9 FOAMED PLASTICS

9.1 General Requirements

9.1.1 All foamed plastics shall be resistant to crude oil products and sea water.

9.1.2 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.

9.1.3 The foamed plastics applied in the laminate boats shall not be resin soluble.

9.2 Structural Foams

9.2.1 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.

9.2.2 The structural foam materials shall have the shear strength and the compression strength not less than that specified in Table 9.2.2. The use of structural polyurethane foams requires PRS' consent.

Table 9.2.2

Material	Apparent density[1] [kg/m^3]	Approximate shear strength[2] [MPa]	Approximate compression strength[3] [MPa]
Polyvinyl chloride modified by isocyanate	50 60 70 80	0.65 0.95 1.30 1.50	0.60 ÷ 1.20
Thermoplastic polyvinyl chloride	80 100	0.70 1.60	0.58 ÷ 1.00

1) Testing according to EN ISO 845.
2) Testing according to ISO 1922.
3) Testing according to ISO 844.

9.3 Displacement Foams

9.3.1 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.

9.3.2 The water absorption of the displacement foam after it has been immersed completely for 8 days shall not exceed 8% by its volume.

9.3.3 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.

10 FLEXIBLE HOSES

10.1 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.

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.

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 10.1.

Table 10.1

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	Delivery and return – diesel engine	A1, A2	A1, A2
4	Delivery and return – petrol engine	A1	A1
5	Outboard petrol engine	–	A1, A2
6	Outboard diesel engine	–	A1, A2, B1,B2

10.2 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.

10.3 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.

10.4 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.

11 CHAINS

11.1 For anchor chains, the technical chains electrically welded with short chain links shall be used. The chain on the boat 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.

If a ship chain has been applied, the requirements specified in *Part IX – Materials and Welding* of the *Rules for the Classification and Construction of Sea-going Ships* shall be complied with.

It is recommended that anchor chains should be hot galvanised or shall be made from corrosion-resistant steel.

11.2 The breaking loads of technical chains are specified in Table 11.2.

Table 11.2

Size (dimeter) [mm]	Breaking load [kN]
5	12.5
6	16
7	25
8	32
9	40
10	50
11	63
13	80

12 ROPES

12.1 Steel Ropes

12.1.1 Rudder chains shall be made of corrosion-resistant or galvanised 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 galvanised ropes are specified in Table 12.1.1. For corrosion-resistant steel ropes calculations, the same values shall be taken.

Table 12.1.1

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.

12.1.2 Stormrails shall be manufactured of corrosion-resistant or galvanised steel ropes of rope construction 1x19, 6x7 or 6x19. The ropes breaking loads are given in Table 12.1.1.

12.2 Fibre Ropes

12.2.1 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 12.2.1.

Table 12.2.1

Rope diameter [mm]	Minimum rope breaking load, [kN]		
	Polyamide (Steelon) EN ISO 1140	Polypropylene PP3 EN ISO 1346	Polyester (Torlen) 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