RUSSIAN MARITIME REGISTER OF SHIPPING

CIRCULAR LETTER **No. 314-04-1810c** dated 29.08.2022

Re:

amendments to the Rules for the Classification and Construction of Sea-Going Ships, 2022, ND No. 2-020101-152-E

Item(s) of supervision:

fiber-reinforced plastics (FRP), FRP ships

Entry-into-force date:
15.09.2022

~~Cancels / amends / adds Circular Letter No.~~ ~~dated~~

Number of pages: 1 + 4

Appendices:

Appendix 1: information on amendments introduced by the Circular Letter

Appendix 2: text of amendments to Part XVI "Structure and Strength of Fiber-Reinforced Plastic Ships"

Director General Konstantin G. Palnikov

Text of CL:

We hereby inform that the Rules for the Classification and Construction of Sea-Going Ships shall be amended as specified in the Appendices to the Circular Letter.

It is necessary to do the following:

1. Bring the content of the Circular Letter to the notice of the RS surveyors, interested organizations and persons in the area of the RS Branch Offices' activity.
2. Apply the provisions of the Circular Letter during review and approval of the technical documentation and when performing technical supervision during manufacture of materials for ships contracted for construction or conversion on or after 15.09.2022, in the absence of a contract — according to 5.10 of Part II "Technical Documentation" of the Rules for Technical Supervision during Construction of Ships and Manufacture of Materials and Products for Ships, starting from 15.09.2022.

List of the amended and/or introduced paras/chapters/sections:

Part XVI: paras 1.2.2, 2.3.1.2, Tables 2.3.1.3, 2.3.2.2, paras 2.3.5.9, 2.3.5.11 and 2.3.5.12

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"Thesis" System No. 22-161035

Appendix 1 to Circular Letter
No. 314-04-1810c dated 29.08.2022

Information on amendments introduced by the Circular Letter
(for inclusion in the Revision History to the RS Publication)

Nos.	Amended paras/chapters/ sections	Information on amendments	Number and date of the Circular Letter	Entry-into-force date
1	Para 1.2.2	Definitions for FRP constituents have been introduced	314-04-1810c of 29.08.2022	15.09.2022
2	Para 2.3.1.2	FRP constituents have been specified	314-04-1810c of 29.08.2022	15.09.2022
3	Table 2.3.1.3	Physical and mechanical characteristics of basic fiber types used in ship structures have been specified	314-04-1810c of 29.08.2022	15.09.2022
4	Table 2.3.2.2	Physical and mechanical characteristics of main binder types used in ship structures have been specified	314-04-1810c of 29.08.2022	15.09.2022
5	Para 2.3.5.9	Table 2.3.5.9 and reference thereto have been deleted. The data have been transferred to Table 2.3.5.11	314-04-1810c of 29.08.2022	15.09.2022
6	Para 2.3.5.11	Basic physical and mechanical characteristics of glass and carbon fiber-reinforced plastics have been specified	314-04-1810c of 29.08.2022	15.09.2022
7	Para 2.3.5.12	Requirements for deterioration of elasticity and strength properties have been specified	314-04-1810c of 29.08.2022	15.09.2022

Appendix 2 to Circular Letter
No. 314-04-1810c dated 29.08.2022

RULES FOR THE CLASSIFICATION AND CONSTRUCTION OF SEA-GOING SHIPS, 2022,

ND No. 2-020101-152-E

PART XVI. STRUCTURE AND STRENGTH OF FIBER-REINFORCED PLASTIC SHIPS

1 GENERAL

1 **Para 1.2.2** is replaced by the following text:

"**1.2.2** For the purpose of this Part the following definitions have been adopted:

FRP means material with heterogeneous nature and consisting of reinforcement elements and polymer matrix.

Particles and fibers are applied as reinforcement elements. Using FRP with reinforcement elements not mentioned in this Part of the Rules is allowed provided that the relevant technical justification including strength tests and calculations of hull structures made of FRP is provided.

Homogeneous FRP means material made up with layers of reinforcement elements of the same type and the same chemical nature, with the same reinforcement scheme.

Non-homogeneous FRP means material made up with layers of reinforcement elements of different types but the same chemical nature.

Hybrid FRP means material made up with layers based on reinforcement elements of different chemical nature, or with individual layers, each made of reinforcement elements of the same chemical nature.

Fiber means glass, carbon or aramid type reinforcement element used in the form of the following:

woven rovings;

tapes;

woven fabrics;

multiaxial (non-crimp) fabrics.

Woven roving means numerous fibers connected to each other.

Roving means fiber material consisting of filaments, woven rovings gathered together into a parallel bundle with a slight or no twist.

Tape means numerous rovings transversally interconnected to each other.

Mat means FRP consisting of chops 3 – 20 mm long randomly arranged on the plane, on the basis of the polymer matrix, where microspheres may be added.

Sizing agent means a compound applied to the fibers to protect them from abrasion and to improve the adhesion of the fiber surface to a binder.

Appret means a substance (composition of substances) applied to reinforcement elements in order to attain required properties and ensure adhesive strength.

Multiaxial (non-crimp) fabric means material made up with layers of tapes with one-directional reinforcement, superimposed on each other at specified angles, and interconnected with each other.

Depending on the number of reinforcement directions, multiaxial (non-crimp) fabrics are classified into the following types:

biaxial fabrics with two reinforcement directions, generally 0° and 90° or + 45° and −45°;

triaxial fabrics with three reinforcement directions, mainly 0°, + 45° and −45°;

quadriaxial fabrics with four reinforcement directions, usually 0°, + 45°, −45° and 90°.

Woven fabric means material made by weaving twisted fibers or rovings according to a weaving technique used in the textile industry with different weave types (satin, plain, twill, etc.).

Prepreg means reinforcement elements such as tapes, woven fabrics or multiaxial (non-crimp) fabrics pre-soaked in thermosetting binder, which cures under certain conditions (temperature and/or pressure).

Particle means reinforcement element as a glass or polyester microsphere used in shipbuilding structures, in such materials as spheroplastic and mat.

Polymer matrix means a binder in cured state, on the basis of thermoset organic resin (polyester, vinylester, epoxy, etc.) with a curing system and various additives (a catalyst, an accelerant, thixotropic agent and colour pigment).

Spheroplastic means FRP consisting of microspheres and polymer matrix.

Adhesive means glue/filler, which is an organic matter intended for jointing structural members manufactured of FRP and filling clearances between them, compatible with a polymer matrix.

Foam plastic means material with the lower density than that of water, having a porous structure, mainly close-cellular one, compatible with a polymer matrix of load-bearing layers.

Sandwich construction means a structure consisting of outer load-bearing layers manufactured of FRP and a core, where foam plastics, spheroplastics, mats, and such structural members as honeycombs, ribs, corrugations of various configurations may be applied. The latter may be used separately or in combination with foam plastics and spheroplastics filling the free space between these members.

Contact moulding technique means a method including laying the reinforcement material (fabric, mat) soaked on binder into a matrix or on a punch, followed by its compaction and removal of air bubbles.

Spraying technique means a version of the contact moulding technique when moulding is performed by laying-up of chopped fibers with binder on the matrix or punch surface, followed by ply- down and compaction of material.

Closed moulding techniques means a common name for the techniques of impregnation of the dry reinforcement material in a closed plane with a liquid binder moving through this material.

Infusion technique means one of the closed moulding techniques, when the reinforcement material is soaked in binder due to the vacuum created in a pressure-tight plane formed with a matrix where the dry reinforcement material is laid and with a leak-tight film adjacent tightly to the matrix.

RTM (Resin Transfer Moulding) technique means closed moulding techniques differing from the infusion technique by the fact that a pressure-tight plane is formed between a rigid matrix where the dry reinforcement material is laid and with a rigid punch adjacent tightly to it. The binder is forced to move over the reinforcement material by the pressure created therein, or due to simultaneous vacuum and pressure in the binder.".

2 MATERIALS

2 **Para 2.3.1.2** is replaced by the following text:

"**2.3.1.2** To ensure the adhesion strength between fibers and polymer matrix, a hydrophobic-adhesive (sizing agent, appret) shall be applied on the fiber surface, the adhesive being compatible with the binder type – polyester, vinylester or epoxy one.

A procedure of applying a hydrophobic-adhesive (sizing agent, appret) shall ensure coating resistance to mechanical impacts.".

3 **Table 2.3.1.3** is replaced by the following one:

"Table 2.3.1.3

Physical and mechanical characteristics of basic fiber types used in ship structures

Characteristic	Glass fibers		Carbon fibers	Aramid fibers
	Glass, grade E	Glass, grade S		
Density (reference data), in kg/m^3	2500 – 2600	2490 – 2580	1800	1420 – 1450
Young's modulus of elongation, in GPa	at least 70	at least 83	at least 230	at least 120
Ultimate tensile strength, in GPa	at least 2,0	at least 3,45	at least 3,5	at least 2,85
Ultimate tensile elongation, in %	3,8	4	at least 1,5	at least 2,2

".

4 **Table 2.3.2.2** is replaced by the following one:

"Table 2.3.2.2

Physical and mechanical characteristics of main binder types used in ship structures

Characteristic	Polyester binder	Vinylester binder	Epoxy binder
Density (reference data), in kg/m^3	1100 – 1300	1100 – 1180	1150 – 1280
Tensile strength, in MPa	at least 40	at least 55	at least 75
Young's modulus of elongation, in GPa	at least 2,7	at least 3,0	at least 2,6
Bending strength, in MPa	at least 50	at least 65	at least 80
Tensile elongation, in %	at least 1	at least 2,2	at least 2,5
Water absorption at a normal pressure within 24 h, in %	not more than 0,1	not more than 0,1	not more than 0,08

".

5 **Para 2.3.5.9** is replaced by the following text:

"**2.3.5.9** Moulding techniques shall ensure optimal ratio between the reinforcement material and binder to achieve the most balanced properties of the material.".

6 **Para 2.3.5.11** is replaced by the following text:

"**2.3.5.11** A list of basic characteristics given in Table 2.3.5.11 shall be defined for FRPs. For glass and carbon fiber based FRPs, these characteristics shall not be lower than those specified in Table 2.3.5.11.

Table 2.3.5.11

Basic physical and mechanical characteristics of glass, carbon fiber-reinforced plastics

FRP type	Reinforcement fiber	
	Carbon fiber	Glass fiber
Percentage content of reinforcement material by mass	at least 0,3	at least 0,25
Young's modulus, in GPa	at least 30	at least 4,5
Shear modulus in the reinforcement plane, in GPa	at least 2	at least 2
Tensile strength, in MPa	at least 85	at least 63
Compression strength, in MPa	determined by manufacturer	determined by manufacturer

".

7 **Para 2.3.5.12** is replaced by the following text:

"**2.3.5.12** Deterioration of elasticity and strength properties of FRPs after long-term exposure to operational factors shall be equal to:

for Young's modulus and shear modulus in laminate plane – less than 0,5 % per year;

for strength properties – less than 1 % per year.".