

**RULES
FOR THE CLASSIFICATION OF
SHIPS**

Part 24 - NON-METALLIC MATERIALS

2017

CROATIAN REGISTER OF SHIPPING

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By the decision of the General Committee of Croatian Register of Shipping,

RULES FOR THE CLASSIFICATION OF SHIPS
Part 24 – NON-METALLIC MATERIALS

have been adopted on 30th June 2017 and shall enter into force on 1st July 2017

REVIEW OF AMENDMENTS IN RELATION TO PREVIOUS EDITION OF THE RULES

RULES FOR THE CLASSIFICATION OF SHIPS *Part 24 – NON-METALLIC MATERIALS*

All major changes throughout the text in respect to the Rules for technical supervision of sea-going ships, Part 24 – Non-Metallic Materials, edition 2009, forming the basis for this edition of the rules are shaded.

Items not being indicated as corrected have not been changed.

The grammatical and print errors, have also been corrected throughout the text of subject Rules but are not indicated as a correction.

The subject Rules include the requirements of the following International Organisations:

International Maritime Organisation (IMO)

Conventions : International Convention for the Safety of Life at Sea 1974 (SOLAS 1974) and all subsequent amendments up to and including the 2006 amendments (MSC.Res. 216(82)) Protocol of 1988 relating to the International Convention for the Safety of Life at Sea 1974, as amended (SOLAS PROT 1988).

Resolutions: A.752(18), A.798(19), MSC.48(66), MSC.61(67)

International Association of Classification Societies (IACS):

Unified Requirements (UR): Z8 (Rev. 1 1995); Z9 (Rev. 2 199; Corr. 1997); **UR P 2.12 (Rev.2 Mar 2016)**

Unified Interpretations (UI): SC 122 (Rev.1, Aug 2008)

International Standard Organisation (ISO):

ISO 1751, ISO 3903, ISO 5779, ISO 5797-1, ISO 5780, **ISO 21005**, ISO 6345, ISO 614, ISO 3434, ISO 3904, ISO 3254, ISO 85011-4
HR EN ISO 527-4, **HR EN ISO 14125**, **HR EN ISO 14126**, ISO 1172, ISO 1675, ISO 2555 , ISO 2114, ISO/DIS 7028-2, **EN ISO 14130**
ISO 2535, ISO 75-2, ISO 62, ISO 527, ISO 1675, ISO 2114, ISO/DIS 17028-2, ISO 2535, ISO 1421, ISO 4674, ISO 1817, ISO 4675, ISO 3011, ISO 2286, ISO 3864, ISO 7203

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1 GENERAL REQUIREMENTS

1.1 APPLICATION

1.1.1 The present *Part of the Rules for the classification of ships* (hereinafter called the *Rules*) applies to inorganic non-metallic materials and products organic materials and products as well as to polymeric materials and products (hereafter called the *non-metallic materials*) intended for the construction, repair and equipping of ships, offshore installations and other structures and installations, which are manufactured in accordance with the *Rules* and under the supervision of the Croatian Register of Shipping (hereafter called the *Register*).

1.1.2 The requirements related to choice and application of non-metallic materials are specified in the relevant *Parts* of the *Rules*.

1.1.3 Where there are special grounds for so doing, the *Register* reserves the right to impose more comprehensive requirements with respect to the manufacture, properties and testing of materials and products, where these paper necessary in the light of more recent research or operational experience, and it likewise reserves the right to sanctions departures from these *Rules*, where these are technically justified.

1.1.4 Where the properties of special materials and products are not covered by requirements specified in these *Rules*, the provisions of the standards applicable to the material or product in question, or where appropriate to the material specifications, accepted by the manufacturer, shall apply.

1.1.5 The *Register* may permit application of other materials or products, in accordance with national or international standards or special specifications, if their properties are deemed equivalent to the properties of the materials and products specified in the present *Rules*.

1.1.6 If *Register* has issued the special approval for their application, under these circumstances, the relevant standards and specifications, are considered to be an integral part of this *Rules*.

1.1.7 Should differences exist between these *Rules* and relevant standards or specifications with regard to their requirements, more stringent requirements shall be applied.

1.2 SCOPE OF SUPERVISION

1.2.1 General Requirements

1.2.1.1 Supervision during manufacture of non-metallic materials includes the following:

- approval of technical documentation
- survey and approval of manufacturers
- type approval
- control and testing of materials during manufacture
- issue of relevant certificates after survey.

1.2.2 Approval of Manufacturers

1.2.2.1 Manufacturers of non-metallic materials shall be approved by the *Register* in accordance with the requirements specified in the *Rules, Part 1 - General Requirements, Section 4- Approval of Manufacturers, Testing Institutions and Service Stations*.

Register may accept manufacturer approved by other Recognized organisation (such as IACS member classification society), subject to special consideration by the Register in each particular case.

1.2.2.2 Evaluation and approval in accordance with the *Rules* shall be carried out in order to confirm that the manufacturer has sufficient capacity to achieve such quality of the products, as required by the *Rules*.

1.2.2.3 Evaluation and approval of the manufacturer relate to precisely determined products.

1.2.2.4 Evaluation and approval shall be conducted at the appropriate request of the manufacturer.

1.2.2.5 The *Register* may deviate from the requirements in 1.2.2 in case of the manufacture of materials, the items of which are to be built into engines and installations, that have been type tested and approved in accordance with the *Rules, Part 1 - General Requirements, Section 3 - Type approval of Products*.

1.2.3 Type Approval

1.2.3.1 Non-metallic materials subject to supervision by the *Register* shall comply with the requirements of the *Rules* and shall be type approved by the *Register*, in accordance with the requirements contained in the *Rules, Part 1 - General Requirements, Section 3 - Type approval of Products*.

1.2.3.2 Evaluation and type approval of non-metallic materials shall be carried out at the appropriate request of the manufacturers of such materials.

1.2.3.3 *Register* may deviate from the requirements of 1.2.3 for those materials, which have been already type tested by other relevant institution and may, after approval at technical documentation accept the type testing results, provided they with the *Rules* requirements.

1.2.4 Control and Testing of Materials during Manufacture

1.2.4.1 Acceptance tests shall normally be performed in the manufacturing works in the presence of the surveyor to the *Register*. For this purpose, the manufacturer shall give the surveyor access to all manufacturing and testing departments concerned and shall make available to him all records and information relating to quality control, in so far as this is necessary for the proper discharge of his duties. The surveyor is also entitled to witness the manufacturing process, although this shall not interfere with the workflow.

1.2.4.2 Non-metallic materials shall meet the requirements of this *Part of the Rules* or the technical conditions approved by the *Register*.

1.2.4.3 The *Register* shall not give any guarantee that the materials supplied to the customer satisfy in size and mass that are free from any defects, which may adversely affect the application of the material for the specified purpose.

1.2.4.4 Non-metallic materials, which prove defective in the course of subsequent application or processing, may be rejected notwithstanding satisfactory previous testing, in accordance with the requirements of the *Rules* or standards.

1.2.4.5 Quality control of the material shall perform with the manufacturer or at the testing institution, approved by the *Register*.

1.2.4.6 The material quality control shall be always carried out after the completed technological processing.

1.2.4.7 Where samples are manufactured separately, they shall be technologically processed jointly, with semi-finished products to which they relate (same batch, same charge or same heat).

1.2.4.8 The manufacturer shall introduce such a system of monitoring which shall enable identification of product after every stage of the manufacturing process (inter-stage), or after every stage of manufacturing process a product may be traced or every sample may be traced to its appropriate semi-product or determined batch, respectively.

1.2.4.9 Marking of semi-products and samples to be tested shall be generally carried out in the presence of the *Register* surveyor. A surveyor to the *Register*, taking account of defined conditions, may allow an appropriate member to the quality control of the approved manufacturer, to apply a personal stamp.

1.2.4.10 Prior to the material quality testing, the manufacturer shall submit to the *Register* surveyor at least the following data:

- quantity, product type, dimensions, types of material, conditions of delivery (supply) and weight,
- title (name) of purchaser together with number of contract and number of work order,
- number of newbuilding or name of ship (if known),
- application (purpose) where necessary.

1.2.4.11 For testing of mechanical and technological properties, the methods, samples and specimens shall be used, specified in Chapter 2. The requirements and test results shall be mentioned in SI units.

1.2.4.12 The tests not referred to in Chapter 2 shall be carried out in accordance with national or international standards, unless otherwise agreed.

1.2.4.13 The *Register* may require repeating of tests if either a confusion of specimens or test results has occurred or the test results do not define the quality of material with required degree of accuracy. Thus the *Register* may require additional tests.

1.2.4.14 Should the material properties slightly deviate from the requirements of the present *Part* of the *Rules*, the *Register* may approve their application, at request of the manufacturer, only upon special consideration of such deviation.

1.2.4.15 Where in exceptional cases, due to technical reasons, the tests cannot be performed in accordance with methods specified in the present *Rules*; equivalent methods or techniques shall be applied.

1.3 MARKING

1.3.1 General Requirements

1.3.1.1 The materials manufactured under the supervision of the *Register*, shall be marked with the appropriate *Register* marks.

1.3.1.2 The surveyor may have specified certificates for consideration, issued or approved by the *Register*, although the material is marked with the *Register* mark.

1.3.2 The Register Mark

1.3.2.1 For marking of materials and products, the *Register* surveyor shall apply steel seals, rubber stamps and brands, in accordance with the Guidelines for usage and storage of seals, stamps and brands.

1.3.3 Conditions of Marking

1.3.3.1 Prior to marking with the *Register* mark (stamp), the materials and products shall be marked with the trade mark, which unless otherwise stated in the present *Part* of the *Rules* or in the specifications approved by the *Register*, shall contain the following:

- grade or quality of material,
- figures or other designation to identify the material or product (e.g. number of product, number of heat, number of batch and the like),
- trade mark.

1.3.4 Method of Marking

1.3.4.1 As a rule, the marks shall be pressed on the places easily accessible for survey (inspection), after installation in the object.

1.3.4.2 On the materials subject to subsequent processing, the marks shall be possibly pressed on the places not subject to further processing.

1.3.4.3 The marking shall normally be impressed with a punch, unless such marking is precluded by materials with a sensitive surface or which are too thin. In such a case marking shall be done with low stress stamps, paint, rubber stamps, adhesive stickers or electric engraving.

1.3.4.4 Marking of material delivered in single pieces

- .1 In addition to data specified in 1.3.3, the following information shall be stamped on each semi-finished product or product:
 - date of final testing (identical with the date of the certificate on supervision and testing of material),
 - number of the *Register* certificate,
 - final stamp of the *Register*.

- 1.3.4.5** Marking of material tested in batches
- .1 Besides data specified in 1.3.3, the materials and products, which are tested in batches, shall have the following information impressed on the plates:
 - number of pieces per batch,
 - total mass (in kg), or length (in m), or surface (in m²), or volume (in m³),
 - test pressure or any other specific value, defined for testing in accordance with the *Rules* or specifications,
 - number of the *Register* certificate,
 - final stamp of the *Register*.
 - .2 The plates shall be attached to the bunches, drums and the like.

1.3.5 Transfer of Marks

1.3.5.1 The *Register* marks shall be preserved during processing, mounting, transportation or storage.

1.3.5.2 Where during processing of special parts, the *Register* marks have to be removed, they shall transferred to another place.

1.3.5.3 The marks shall be transferred in the presence of the *Register* surveyor.

1.3.5.4 The materials that are not fitted with the *Register* mark, are considered as not tested by the *Register* surveyor, unless otherwise proved.

1.3.5.5 Exceptionally, the *Register* surveyor may permit cancellation of the *Register* mark, under supervision of the quality control staff and transfer to another place. The responsible person of the quality control department shall make an appropriate record and impress a personal stamp.

1.3.5.6 On the basis of the record and stamp of the quality control department responsible person, the *Register* surveyor shall impress the *Register* stamp on the material.

1.3.6 Cancellation of the Mark

1.3.6.1 Should it be revealed during supervision over construction of the object that the material does not meet the *Register Rules*, such material may be rejected, irrespective of being previously tested and marked by the *Register* surveyor.

1.3.6.2 The *Register* marks shall be cancelled on refused materials, in the presence of the *Register* surveyor.

1.3.6.3 The marks that are impressed with a steel stamp shall be cancelled by grinding or punching, in a way that a stamp shall be marked with sign x.

1.3.7 Storage of Stamps, Seals and Brands

1.3.7.1 Steel stamps, seals and brands shall be stored by the *Register* surveyor in a way as to exclude any possibility of their misuse.

1.4 THE REGISTER CERTIFICATES

1.4.1 Manufacturer Approval Certificate

1.4.1.1 Upon completed procedure of the evaluation of analysis of performed survey and decision of approval of the manufacturers, the *Register* shall issue the Certificate on Approval of the Manufacturer for manufacture of determined products with validity term of four years. Approved manufacturer shall be enlisted in the annual List of type approved products, approved manufacturers, testing institutions and service stations.

1.4.2 Type Approval Certificate

1.4.2.1 Upon approval of the technical documentation, completed program of type testing, evaluation of obtained results and decision of type approval, the *Register* shall issue the Certificate on Type Approval of the material with validity term of four years.

1.4.2.2 Type approved product shall be enlisted in the annual List of type approved products, approved manufacturers, testing institutions and service stations.

1.4.3 Material Certificate

1.4.3.1 Where during testing, witnessed by the surveyor, the requirements of the *Rules*, standards and specifications are met, as a prove the *Register* shall issue the Material Certificate.

1.5 BASIC PROPERTIES OF NON-METALLIC MATERIALS

1.5.1 All non-metallic materials, unless otherwise specified in special sections to these *Rules*, shall have the following properties:

1.5.1.1 Non-metallic materials shall not be easily flammable and shall not give off more significant quantities of smoke, while burning and shall not produce toxic or explosive vapours at elevated temperatures.

1.5.1.2 Non-metallic materials shall maintain all own properties and shall enable normal work of the equipment or parts thereof within normal temperature limits:

- on the open deck: from -40°C to +70°C,
- within enclosed ship/s spaces: from -10°C to +70°C.

1.5.1.3 During application, non-metallic materials shall not produce detrimental elements, become brittle and their mechanical properties shall not be reduced for more than 30% from the starting values.

1.5.1.4 Non-metallic materials shall be resistant to fungi, mould, environmental influence and shall not affect other materials with which are in contact.

2 METHODS OF TESTING

2.1 GENERAL REQUIREMENTS

2.1.1 The present Section contains the requirements related to test methods of mechanical and technological properties of materials and to the necessary test specimen dimensions, which are to be applied for the material testing.

2.1.2 The fundamental requirement prescribes that all the tests are carried out in accordance with national and/or international standards and in accordance with the present *Part* of the *Rules*.

2.1.3 Deviations from the prescribed test specimen dimensions or deviations related to sampling and preparation of specimens, shall be permitted only in exceptional cases, which are technically justified and which enable that the material is adequately tested when the *Register* has given its consent as to the change.

2.2 TEST MACHINES (EQUIPMENT) AND PERSONNEL PERFORMING TESTS

2.2.1 All tests shall be performed by specially trained personnel, using calibrated test machines and equipment.

2.2.2 The test machines shall be maintained in good working condition and shall be calibrated in regular intervals by the institutions approved by the *Register*.

2.2.3 The calibration record shall be kept available for the inspection in the laboratory.

2.3 SAMPLING AND SPECIMEN PREPARATION

2.3.1 Definitions

2.3.1.1 Sample is a product (e.g. board or pipe) selected from the test unit or test batch for taking test specimens.

2.3.1.2 Test unit/test batch is a portion of consignment to which the test results apply.

This term may apply to a specific number of products having same dimensions, to products having different dimensions taken from one heat number or charge or to a single product.

2.3.1.3 Test section is a section of material (e.g. board or pipe) taken from the sample, intended for the preparation of one or more specimens.

2.3.1.4 Test specimen is a piece taken from the test section, which in processed or non-processed condition has prescribed dimensions and is subject to the relevant test.

2.3.2 Marking of Test Sections and Test Specimens

2.3.2.1 The test sections shall be taken as to present the product quality (see 1.2.4).

2.3.2.2 The test sections and test specimens shall be marked that after their removal and preparation it is evident from which section are taken as well as how are located and directed in the sample. Should during preparation of test sections and test specimens be impossible to avoid any erasing or deletion of marks, they shall be transferred to another place in due time.

2.3.2.3 Exceptionally, the surveyor may approve the transfer of marks and stamps by the other person, in accordance with 1.3.

2.3.3 Taking of Test Sections and Their Dimensions

2.3.3.1 The test sections shall be taken from a sample in precisely determined places. They shall have sufficiently large dimensions as to ensure enough material for all test specimens prescribed for the relevant test as well as additional material for carrying out additional tests.

2.3.3.2 In general, test sections may be taken from the sample only after completion of all mechanical and/or heat treatments, applied to a product prior to a delivery.

2.3.4 Manufacture of Test Specimens and Their Dimensions

2.3.4.1 The longitudinal axes of test specimens shall be positioned to the main direction of deformation, in accordance with special chapters of the present *Rules*. Nevertheless, in order to save the material and after agreement with a surveyor, the manufacturer may take transverse instead of longitudinal test specimens, provided there are prescribed requirements for transverse test specimens and provided the prescribed requirements for longitudinal specimens are met.

2.3.5 Preparation of Test Specimens

2.3.5.1 All test specimens shall be processed to the prescribed dimensions.

2.3.5.2 In case of taking of test sections or test specimens, deformations of materials shall be avoided as far possible.

2.4 RETESTS

2.4.1 General requirements

2.4.1.1 If the test sections or test specimens, intended for a test are not properly taken and prepared, the test results obtained with them shall be invalid. The tests shall then be repeated on properly prepared test specimens.

2.4.1.2 If, in properly performed tests, the requirements are not met, then prior to rejecting test unit, retest may be carried out, subject to conditions stated below. Retest shall not be allowed if a doubt arises that invalid material is concerned.

3 SHIP'S WINDOWS

3.1 GENERAL REQUIREMENTS

3.1.1 The requirements of this Section apply to ship/s windows intended to provide light and air and which are exposed to the effect of sea and/or atmospheric conditions.

3.1.2 The manufacturers of ship's windows shall be approved for the manufacture in question and the windows shall be type approved.

3.1.3 All materials from which individual parts of ship/s windows are manufactured, shall be resistant to corrosion in sea environment and shall not affect the corrosion resistance of other parts.

3.1.4 Mechanical properties of applied materials shall meet the requirements of ISO-1751, ISO-3903 and the *Rules, Part 25 - Metallic Materials*.

3.2 DEFINITIONS

3.2.1 Ship's window is any window regardless of shape, suitable for installation aboard ships and marine structures.

3.2.2 ISO ship's window is a window complying with all relevant ISO standards in existence at the time of its manufacture.

3.2.3 Opening ship's window is a window with a hinged or pivoted glassholder or with a sliding part.

3.2.4 Non-opening window is a fixed window without hinged or sliding part, whose frame of which the main frame and the glassholder form one common component.

3.2.5 Round ship's window is any ship's window of circular shape.

3.2.6 Ship's side scuttle is ISO standardised type of an opening hinged or non-opening round ship/s window with or without deadlight (Fig.3.1).

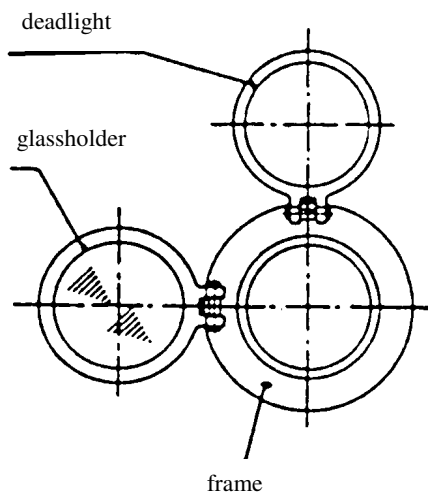


Fig. 3.1

3.2.7 Rectangular ship's window is any ship's window of rectangular or square shape having straight or arched edges and rounded corners.

3.2.8 Ordinary rectangular ship's window is ISO standardised type of an opening hinged or non-opening ship/s rectangular window (Fig.3.2).

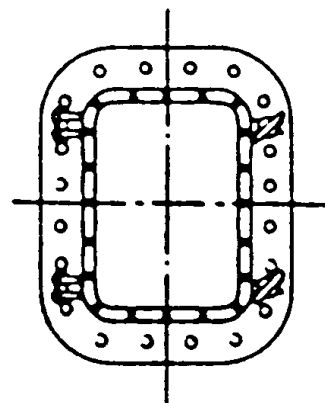


Fig 3.2

3.2.9 Main frame is a basic frame of ship's window which is fixed at the structure by means of bolts or welding. For non-opening ship/s windows, the main frame serves at the same time to take up the glass pane. (Fig.3.3).

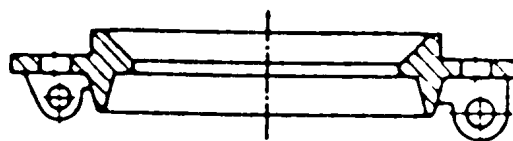


Fig. 3.3

3.2.10 Glassholder is a metallic component for taking up the glass pane for all kinds of opening ship's windows (Fig.3.4).



Fig. 3.4

3.2.11 Glass retaining frame is a light frame (round or rectangular) used for fixing the glass pane in the glassholder of opening ship's windows or in the main frame of non-opening ship's windows (Fig.3.5).



Fig. 3.5

3.2.12 Deadlight is a heavy hinged cover for protection against blows from the sea. (Fig. 3.6 a and b).

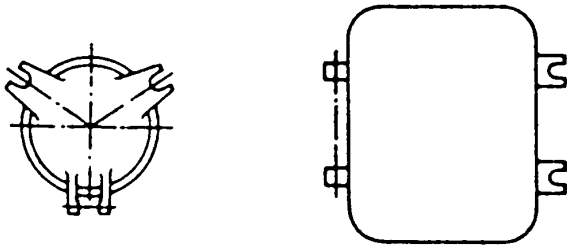


Fig.3.6

3.2.13 Ship's window nominal size is nominal dimension(s) of the clear light size of a ship's window. Fig.3.7 a and b).

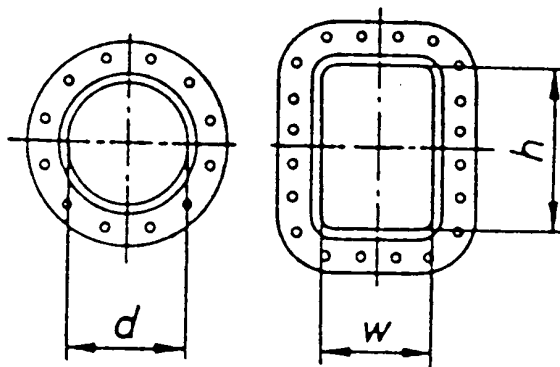


Fig. 3.7

3.3 DETERMINATION OF THE POSITION OF SHIP'S WINDOWS

3.3.1 Position of ship's windows shall be determined in accordance with the regulations and provisions of the international conventions and codes, national authorities and classification societies, namely:

- International Convention on safety of Life at sea, SOLAS 1974, as amended,
- IMO International Convention on Load Lines - 1966 (LL 1966),
- IMO FTP Code,
- ISO 5779, ISO 5780,
- *Rules, Part 3 - Hull equipment, Part 17 - Fire Fighting Equipment.*

3.4 SHIP'S SIDE SCUTTLES

3.4.1 General requirements

3.4.1.1 Ship's side scuttles shall meet the requirements of ISO 1751, as regards the dimensions and structural details, materials, manufacture, testing and marking.

3.4.1.2 Round ship's windows having various dimensions and structural details than those specified in ISO, may be accepted provided they meet the documentation, specially approved by the *Register*.

3.4.2 Classification

Ship's side scuttles shall be classified by series, types, models and nominal sizes.

3.4.2.1 Regular Series (N)

Side scuttles of the regular series shall contain a toughened safety glass pane that meets the requirements of **ISO 21005**.

3.4.2.2 Fire-Resistant Series (P)

- .1 Side scuttles of the fire-resistant series shall be provided for installation in "A" and "B" class divisions. These side scuttles shall contain glass panes that meet the requirements of ISO 5797-1.
- .2 Changes in structure and fitting of glass panes as well as additional test and marking shall be in accordance with ISO 5797-1.

3.4.2.3 Types

Ship's side scuttles may be of three types:

- Type A: Heavy-type side scuttle,
- Type B: Medium-type side scuttle,
- Type C: Light-type side scuttle.

3.4.2.4 Models

- .1 Models shall be designated according to the following principal characteristics:
 - opening or non-opening model,
 - with or without deadlight,
 - opening direction of glassholder,
 - type of fastening.
- .2 The various combinations of these, which are in accordance with the definitions of ISO 6345, are laid down in Table 3.1.

3.4.2.5 Nominal Sizes

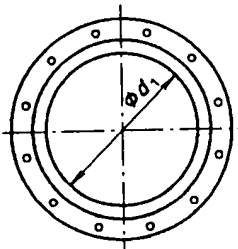
- .1 Nominal sizes are defined by the clear light diameter (d_1) of the ship's side scuttle, are laid down in Table 3.2.

Table 3.1
Principal Characteristics of Models

Opening or non-opening	With or without deadlight	Opening direction of glassholder	Fastening		Model designation code			
			bolted (B)	welded (W)	Type A B C			
Opening	with	left hand ¹⁾ (L)	B	-	LB		-	
			-	W	LW		-	
		right hand ¹⁾ (R)	B	-	RB		-	
	without	-	common hinged (S)	-	W	RW		-
				B	-	SB		-
		-	W	SW		-		
Non-opening	with	-	B	-	NB		-	
			-	W	NW		-	
	without		B	-			NB	
			-	W			NW	

1) The deadlight opening upwards.

Table 3.2
Nominal Sizes of Side Scuttles

Type	Nominal size d_1 mm						Illustration
A	200	250	300	350	400	-	
B	200	250	300	350	400	450	
C	200	250	300	350	400	450	

3.4.3 Requirements, Materials and Manufacture

3.4.3.1 Side scuttles of all series, types, models and nominal sizes shall be manufactured to the requirements (dimensions, materials, etc.) given in this ISO 1751. They shall be capable of meeting the test requirements specified in 3.4.4.

3.4.3.2 In addition, for side scuttles for fire-resistant construction, the glassholder and the main frame shall be made of a material that keeps its mechanical characteristics at the temperatures, given in ISO 5797-1.

3.4.3.3 They shall be designed so that temperature gradients do not develop stresses in the glass which could result in rupture.

3.4.3.4 Materials for manufacture of individual components shall be of adequate type and characteristics, according to the applicable standard or approved documentation.

3.4.3.5 Individual components for manufacture of main parts of the ship's side scuttles shall meet the requirements of the *Rules, Part 25 - Metallic Materials*, with respect to the type of material and nature of product.

3.4.3.6 The product shall be manufactured in accordance with the approved documentation or specification and shall be without defects in the material or those arisen due to manufacturing failure.

3.4.3.7 The manufacturer is fully responsible for compliance of the final product with ascertained requirements, regardless the testing and checks performed by the *Register*.

3.4.4 Testing

3.4.4.1 Watertightness Test

- .1 A prototype side scuttle shall be subjected to hydraulic test, using maximum allowa-

ble pressures as to the type, nominal size and glass thickness.

3.4.4.2 Mechanical Strength test

- .1 A prototype side scuttle without glass pane and with closed deadlight shall be subjected to a mechanical strength test by a punch method, using the test pressures given in Table 3.3.
- .2 This test shall be performed according to ISO 614. The punch shall be placed that pressures the side of the deadlight which could be subjected to direct contact with the sea.

Table 3.3
Test Pressures for mechanical strength

Side scuttle type	Test pressure kPa
A	240
B	120

Note:

The test pressures in Table 3 are the values assumed for the calculation of the proof loads to be applied.

3.4.4.3 Shop test

- .1 After visual tests of applied materials, dimensions, structural details, glass installation etc., according to ISO 1751, the side scuttled shall be subjected to the hydraulic test.
- .2 An equivalent hydraulic test shall be carried out by the manufacturer before dispatch, by means of batch tests approximately 10% of the delivery batch, with a minimum of two side scuttles, namely
- .3 The side scuttles shall be tested by being subjected to the hydraulic pressures given in Table 3.4, under the following conditions:

Procedure 1: with glass pane and open deadlight except for type A, with diameters of 350 mm and 400 mm, where the deadlight shall be closed..

Procedure 2: without glass pane and with closed deadlight.

Table 3.4
Test pressures for watertightness

Side scuttle type	Test pressure kPa	
	Procedure 1	Procedure 2
A	150	100
B	75	50
C	35	-

3.4.4.4 Board Test

- .1 To ensure that the side scuttles and packing are watertight when fitted, a hose test shall be carried out, comprising of hosing the side scuttle by means of at least 12,5 mm nominal size hose held at a distance of not more than 1,5 m from the side scut-

tle and with a water pressure of at least 25 kPa.

- .2 All tests shall be carried out according to ISO - 1751 requirements

3.4.4.5 Fire-Resistance Test

- .1 Side scuttles for fire-resistant constructions of series P shall have been subjected to prototype testing for fire-resistance, in accordance with the requirements of ISO-5797-1 or FTP Code, Part 3, respectively.

3.4.5 Marking

3.4.5.1 Regular Side Scuttles Series (N)

- .1 Marking of Body
 - a) The main frame or some other metallic main component part shall be marked with the letter for the type (A, B or C).
 - b) Further marking indications are optional, for example:
 - nominal size,
 - material class,
 - manufacturer's name or trade mark,
 - number of the International standard.
- .2 Marking of Glass Pane
The glass pane shall be marked in accordance with ISO 614.

3.4.5.2 Fire-resistant Series (P)

- .1 Marking of Body
Besides the indication given in 3.4.5.1, fire-resistant side scuttles shall be marked on the inside of the glassholder with the following indications:
 - fire-resistant class (B-O or B-15, or any other),
 - number of the test report.
- .2 Marking of Glass Pane
The fire-resistant glass pane shall be marked in accordance with ISO 5797-1.

3.5 ORDINARY RECTANGULAR SHIP'S WINDOWS

3.5.1 General Requirements

3.5.1.1 In general, the ordinary rectangular ship's windows shall meet the requirements of ISO 3903, as regards dimensions and structural details, materials, manufacture, testing and marking.

For passenger ships neither engaged in international navigation nor on domestic line service, which are carrying up to 36 cabin passengers or ships intended for one day excursions, navigating from April 1st to October 31st within the restricted area 6, 7 or 8, may have windows that meet the requirements of the *Rules, Part 3-Hull equipment, Annex A*.

3.5.1.2 Rectangular ship's windows having various dimensions and structural details than those specified in 3.5.1.1 may be accepted provided they meet the documentation, specially approved by the *Register*.

3.5.2 Classification

Rectangular windows shall be classified by series, types, models and nominal sizes.

3.5.2.1 Regular Series (N)

- .1 Rectangular windows of the regular series shall contain a toughened safety glass pane that meets the requirements of ISO 3254.

3.5.2.2 Fire-Resistant Series (P)

- .1 Rectangular windows of the fire-resistant series shall be provided for installation in "A" or "B" class divisions, containing a glass pane that meets the requirements of ISO 5797-1.
- .2 Modifications to the construction and installation of the glassholder and main frame as well as additional testing and marking, shall be in accordance with ISO 5797-1.

3.5.2.3 Heated Series (H)

- .1 Rectangular windows of the heated series shall contain a heated glass pane in accordance with ISO 3434.

- .2 For heated rectangular windows, deviations in the design of glassholder or main frame based on the thickness of the heated glass pane and the electrical connection, shall be taken into consideration.

3.5.2.4 Types

- .1 Ordinary rectangular ship's windows may be of two types:
 - Type E: Heavy type rectangular window
 - Type F: Light type rectangular window

3.5.2.5 Models

- .1 Models shall be designated according to the following characteristics:
 - opening or non-opening model,
 - opening direction of glassholder,
 - type of fastening.
- .2 The various combinations of these, which are in accordance with the definitions in ISO 6345, are laid down in Table 3.5.

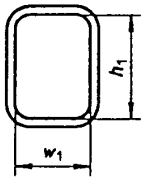
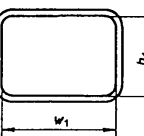
Table 3.5
Principal Characteristics of Models

Opening or non-opening	Opening direction		Fastening		Model designated code	
			bolted (B)	welded (W)		
opening	inwards (I)	side hinged	left hand (L)	B	-	ILB
			right hand (R)	-	W	ILW
		top hinged (T)	B	-	IRB	
			-	W	IRW	
		B	-	ITB		
		-	W	ITW		
	outwards (O)	side hinged	left hand (L)	B	-	OLB
			right hand (R)	-	W	OLW
		top hinged (T)	B	-	ORB	
			-	W	ORW	
B	-	OTB				
-	W	OTW				
non-opening (NO)	-		B	-	NOB	
			-	W	NOW	

3.5.2.6 Nominal Sizes

- .1 The nominal sizes are defined by the clear light dimension for width (w_1) and height (h_1) of side rectangular window and are given in Table 3.6.

Table 3.6
Nominal Sizes

Code No.	Nominal size $w_1 \times h_1$	Illustration
1	300 x 425	
2	355 x 500	
3	400 x 560	
4	450 x 630	
5	500 x 710	
6	560 x 800	
7	900 x 630	
8	1000 x 710	
9	1100 x 800	

3.5.3 Requirements, materials and Manufacture

3.5.3.1 Rectangular windows of all series, types, models and nominal sizes shall be manufactured to the requirements (dimensions, materials, etc.) given in this ISO 3903 and shall be capable of meeting the test requirements specified in 3.5.4. In addition, for rectangular windows for fire-resistant constructions, the glass holder and the main frame shall be made of a material that keeps its mechanical characteristics at the temperatures given in ISO 5797-1.

3.5.3.2 They shall be designed so that temperature gradients do not cause stresses in the glass which could result in rupture.

3.5.3.3 The materials for the manufacture of individual main components shall be of adequate type and characteristics, in accordance with applicable standard or approved documentation.

3.5.3.4 Particular materials for the manufacture of main components of rectangular windows shall meet the requirements of the *Rules, Part 25 - Metallic Materials*, as regards the type of material and nature of product.

3.5.3.5 The product shall be manufactured in accordance with approved documentation or specification and shall be without defects in the material or those arisen due to manufacturing failure.

3.5.3.6 The manufacturer shall be fully responsible for compliance of the final product with specified requirements, regardless the testing and checks performed by the *Register*.

3.5.4 Testing**3.5.4.1 Watertightness Test**

- .1 A prototype of rectangular windows shall be subjected to hydraulic test, using maximum allowable pressures as to the type, nominal size, deviations and glass thickness.

3.5.4.2 Mechanical Strength Test

- .1 A prototype of rectangular windows shall be subjected to a mechanical strength test method, applying a load equivalent to the following pressures:
- type E windows: 75 kPa
 - type F windows: 35 kPa.

3.5.4.3 Shop Test

- .1 After completed visual tests, tests of applied materials, dimensions, structural details, glass installation etc., performed in accordance with ISO 3903, the rectangular windows shall be subjected to the hydraulic test.
- .2 An equivalent hydraulic test shall be carried out by the manufacturer before dispatch by means of batch tests, approximately 10% of the delivery batch, with a minimum of one window, at a test pressure of 25 kPa.

3.5.4.4 Board Test

- .1 To ensure that rectangular window and packing are watertight when fitted, a hose test shall be carried out, consisting of hosing the rectangular window by means of at least 12,5 mm nominal size hose held not more than 1,5 m from the window and with a water pressure of at least 25 kPa.

3.5.4.5 Fire-resistance Test

- .1 Rectangular windows for fire-resistant construction of series P shall be subjected to prototype testing for fire-resistance, in accordance with ISO 5797-1 or FTP Code, Part 3, respectively.

3.5.4.6 Test for Heated Windows

- .1 Heated windows shall be subjected to the electrical testing described in ISO 3434, clause 5.

3.5.5 Marking**3.5.5.1 Regular Rectangular Windows (Series N)**

- .1 Marking of Body
- a) The main frame or some other metallic main component part of the rectangular window shall be marked with the letter for the type (E or F).

- b) Further marking indications are optional, for example:
 - nominal size,
 - material class,
 - manufacturer's name or trade mark,
 - number of standard.
- .2 Marking of Glass Pane
The glass pane shall be marked in accordance with ISO 614.

3.5.5.2 Fire-Resistant (Series P)

- .1 Marking of Body
In addition to the indication given in 3.5.5.1.1 body of fire-resistant rectangular window, shall be marked with the following indication:
 - fire-resistant class (B-0 or B-15 or similar)
- .2 Marking of Glass Pane
Fire-resistant Glass Pane shall be marked in accordance with ISO 5797-1.

3.5.5.3 Heated Rectangular Windows (Series H)

- .1 Marking of body of heated rectangular window shall be marked in accordance with body of heated 3.5.5.1.1.
- .2 Marking of Glass Pane
The heated glass pane shall be marked in accordance with ISO 3434, clause 7.

3.6 CLEAR-VIEW SCREEN

3.6.1 General Requirements

3.6.1.1 This side scuttle is intended to ensure clear vision in any weather conditions or in heavy seas.

3.6.1.2 The side scuttle shall contain main metallic frame with rapidly rotating glass disc, electric-motor driven.

3.6.2 Classification

3.6.2.1 Clear view screen shall be classified by type as regards position of electric motor, as follows:

- Type A: Electric motor is fitted directly above main frame.
- Type B: Electric motor is fitted directly at the side of main frame.
- Type C: Electric motor is fitted in glass disc metal wall.

3.6.3 Requirements, Materials and Manufacture

3.6.3.1 The clear view screens shall meet the requirements of ISO 3904 as regards construction, dimensions, applicable materials, rotating speed, testing and installation.

3.6.3.2 The electrical equipment shall meet the requirements of IEC 92 and IEC 94.

3.7 GLASSES FOR SHIP'S WINDOWS

3.7.1 General Requirements

3.7.1.1 The manufacturers of glass intended for ship/s windows shall be approved by the *Register* and glasses shall be type approved.

Register may accept manufacturer approved by other Recognized organisation (such as IACS member classification society), subject to special consideration by the *Register* in each particular case.

3.7.1.2 Technology of manufacture and control of glass manufacture shall be subjected to approval.

3.7.1.3 For the approval of the types of products, the information containing composition and characteristics shall be submitted to the *Register* by the manufacturer.

3.7.1.4 Physical and chemical properties of glass shall be tested for the purpose of type approval.

3.7.1.5 Physical and chemical properties shall be controlled in accordance with national and international standards, accepted by the *Register* under the scope established during approval of the testing program for the approval of particular type.

3.7.2 Definitions

3.7.2.1 Glass pane: is a flat piece of glass cut or edge-worked to size and shape ready for glazing.

3.7.2.2 Heated glass Pane: two or more glass panes, laminated and bonded together with an electrical heating element between them to ensure unrestricted vision in frost and snow conditions.

3.7.2.3 Fire-resistant glass pane: is a glass pane consisting of one or more glass panes and one or more intermediate layers which consists of a gas, a transparent plastic or any other transparent material.

3.7.2.4 Safety glass: is a glass which, if fractured, gives fragments which are less liable to cause severe cuts than fragments of ordinary glass. Laminated and wired glass are considered to be types of safety glass.

3.7.2.5 Toughened safety glass: is a glass which has been converted to safety glass by subjection to a process of heating and rapid cooling, so that, if fractured, it disintegrates into small pieces and, in addition, its liability to fracture under action of external forces or changes of temperatures is greatly reduced.

3.7.2.6 Plate glass: is a transparent soda-lime-silica glass produced by floating molten glass on a bath of molten metal thus creating flat parallel and polished surface.

3.7.2.7 Sheet glass: is a transparent soda-lime-silica glass obtained by continuous vertical drawing thus creating fire-polished surfaces.

3.7.2.8 Clear glass: is a non-tinted transparent soda-lime-silica glass.

3.7.2.9 Tinted glass: is a soda-lime silica glass, coloured in the body of the glass, surface modified or coated.

3.7.2.10 Obscured glass: is a transparent soda-lime silica glass which, after manufacture, is surface-worked by sand-blasting or acid etching on one or both surfaces. Such treatment prevents clear vision through the glass.

3.7.3 Requirements, Materials and Manufacture

3.7.3.1 Glasses for side scuttles and rectangular ship's windows as regards the materials and processing, dimensions, tolerances, optical qualities, parallelism, flatness, testing and marking, shall meet the requirements of **ISO 21005** of ISO 3254.

3.7.3.2 Glass panes for ship's windows shall be manufactured of plate glass and toughening shall be performed in vertical furnaces.

3.7.3.3 Heated Glass Panes

- .1 Heated glass panes as regards the construction characteristics, optical qualities and heating circuit, dimensions (outer dimensions and glass thickness), tests and marking shall meet the requirements of ISO 3434.
- .2 The composition of laminated pane (type A - two glass panes and type B - three glass panes) shall be as shown in Fig. 3.8 and in Table 3.7.
- .3 Heated glass panes shall ensure perfect visibility in all weather conditions to the temperature -40°, and shall not also cause any significant reduction in the resolving power of the eye or binoculars.
- .4 The carrier glass pane shall be manufactured from clear safety glass toughened in vertical furnaces and shall meet the requirements of ISO 3254.
- .5 The cover glass pane protects the heating element and it is thinner than the carrier pane.
- .6 The heating element consists of a thin wire, a transparent conductive film or a transparent coating.
- .7 Inter-layer is a thin plastics material (foil) of 0,76 mm minimum thickness.
- .8 In order to avoid any penetration of humidity or any other form of chemical attack between the layers of the laminate and to protect the edges against impact as well as to ensure durable electrical insulation, the periphery of the glass pane shall be protected by materials such as silicone, rubbers, polysulfides or similar compatible with the plastics inter-layers of the laminate. This edge protection shall be bonded to the edge and not thicker than 3 mm.

3.7.3.4 Fire-Resistant Glass Pane

- .1 Construction of fire-resistant glass panes shall meet the requirement of ISO 5797.
- .2 As regards the composition there are three types of glass pane:
Type T - single: one single glass pane of toughened safety glass,
Type L - laminated: two glass panes with an interlayer. The external glass pane is of toughened safety glass (main glass pane), the internal glass pane of a safety glass material type that is left optional,
Type MT and ML - separated: two or more glass panes separated by a gap. The external glass pane shall be in accordance with glass pane type T or L. The internal glass pane is of a safety glass material type that is left optional.
- .3 Outer dimensions, edges parallelism, flatness and tolerances for glass panes of rectangular windows and side scuttles shall be in accordance with the requirements of ISO 3254 or **ISO 21005** respectively.

3.7.3.5 The manufacturer is fully responsible for compliance of the finished product with established requirements, regardless the testing and checks performed by the *Register*.

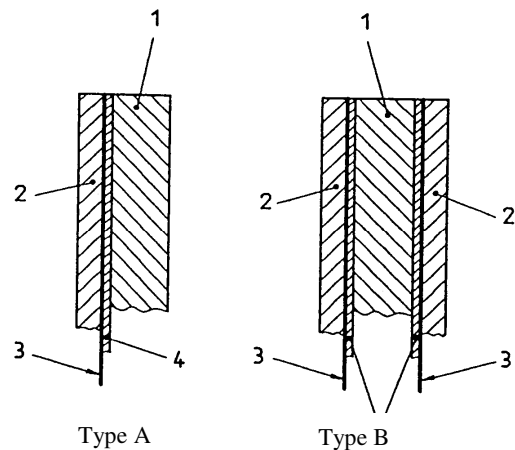


Fig. 3.8
Cross-section of heated glass panes

Table 3.7
Components of heated glass panes

Component No. (see Fig.3.8)	Term
1	Carrier pane
2	Cover pane
3	Heating element
4	Inter-layer

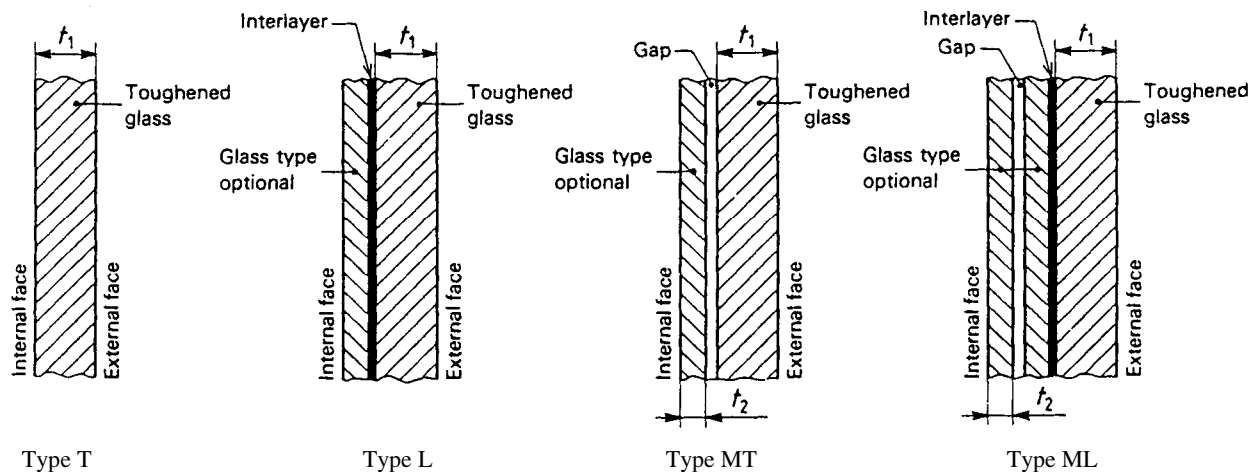


Fig.3.9
Composition of whole glass panes

3.7.4 Testing

3.7.4.1 Tests of the raw material shall be carried out in order to meet specified requirements as regards the application of final product.

3.7.4.2 Records shall be taken about performed tests, which shall be submitted to the Register for consideration, during survey.

3.7.4.3 The manufacturer shall submit a record on temperature conditions in furnace for every manufactured quantity of glass panes.

3.7.4.4 The manufacturer shall take into account that the edges of glass panes shall not exceed 15 mm from the glass edge, for the glasses of larger size.

3.7.4.5 The manufacturer shall ensure proof for the clear plate glass that the light transmission through the glass exceeds the value given in Table 3.8.

Table 3.8

Nominal thickness of glass pane mm	Light transmission %
6	85
8	83
10	81
12	79
15	76
19	72

3.7.4.6 The manufactured toughened safety glass panes shall be subjected to the tests of:

- .1 dimensions and markings,

- .2 edges processing, taking account of final size within permissible tolerances,
 - .3 optical characteristics (visibility),
 - .4 toughening quality,
 - .5 construction (heated and fire-resistant glass),
 - .6 parallelism,
 - .7 flatness,
 - .8 glass strength.
- tests specified in .1, .2, .6 and .7 shall be carried out in accordance with **ISO 21005** or ISO 3254, as applicable.

3.7.4.7

Examination of Toughening Quality

- .1 A suitable type of polariscope shall be used for examination of toughening quality, shown in Fig. 3.10. White light from two fluorescent tubes passes through a sheet of diffusing glass and a sheet of transparent polarising material, both of which extend the full width of the glass to be examined. The glass is supported on rollers and passes in front of the polarising sheet so that the whole of the glass is viewed in succession through a second polarising device, e.g. spectacles with polarising material correctly orientated to obtain a polarisation pattern. A sheet of plate glass is placed between the polarisation sheet and the glass being examined to protect the former from damage.

3.7.4.8

Examination of Toughened Safety Glass Strength

- .1 Examination of toughened safety glass strength shall be performed in accordance with ISO 614.

- .2 Form of the apparatus is given in Fig. 3.11.
- .3 This method is applied for examination of toughened safety glass of round and rectangular form. The relevant load is transferred to the glass fitted on a steel pad with a circular orifice through rounded steel mandrel, acting vertically to the orifice centre.
- .4 This procedure shall be applied for all samples of the individual batch.
- .5 Appropriate proof load according to the glass thickness and diameter of orifice is specified in Table 3.9.
- .6 Appropriate proof load shall be reached by an increase of load rate of 1000 N per second, and then shall be maintained for a period of 5 seconds. After gradual relive of load, no signs of damage shall be seen on the glass pane.

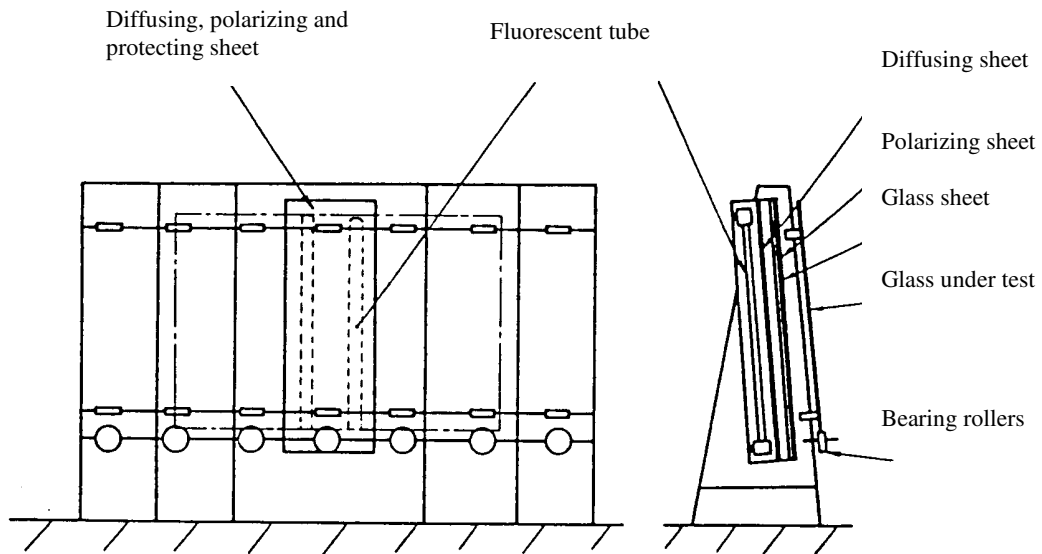


Fig. 3.10

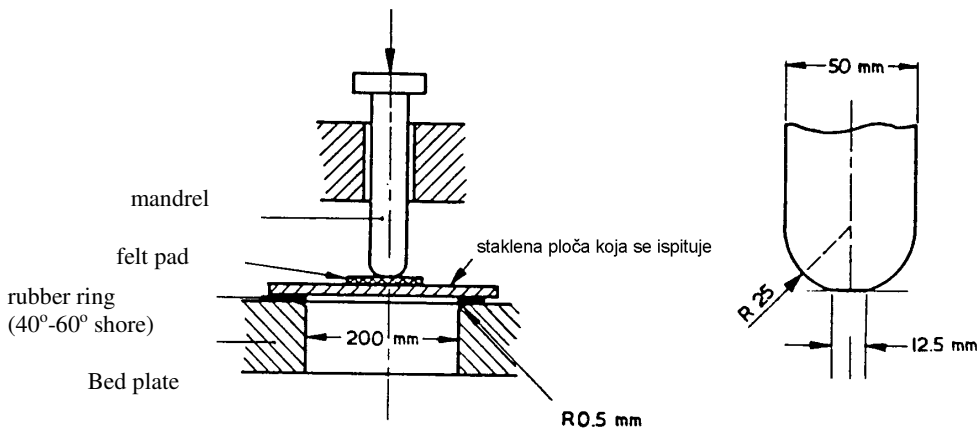


Fig. 3.11

Apparatus for examination of the toughened safety glass strength

Table 3.9

Thickness of glass pane		Proof load with test apparatus	
Nominal thickness	Tolerance	200 mm	150 mm
	Clear glass pane		
mm	mm	N	N
6	± 0,2	3400	3500
8	± 0,3	6500	6700
10		10200	11000
12		15500	-
15	± 0,5	24000	-
19	± 1	33400	-

3.7.4.9 Marking

- .1 Glass panes tested in accordance with the requirements of ISO 614 shall be marked as specified in clause 5. of ISO 614.

3.7.4.10 Hydrostatic Tests

- .1 Instead of the tests prescribed under ISO, the *Register* may allow for the hydrostatic tests of strength.
- .2 From a batch consisting of 100 samples, or parts thereof, having the same nominal size and nominal thickness, produced in the same process, under consistent controlled conditions, one sample shall be tested.
- .3 Hydrostatic test pressure shall be determined according to diameter, thickness and type of glass, under table 3.10. Where glasses are tested which have not round form from the selected glass of a batch, a round sample shall be cut.
- .4 For toughened safety glasses a sample shall be taken prior to heat treatment and shall be heat treated with the whole batch which it represents.
- .5 A sample shall be maintained under pressure for at least 60 seconds and during that period the glass shall not break.
- .6 Where during the test a glass pane (sample) breaks, at request of the manufacturer the test shall be repeated on further two samples from the same batch, whereby both samples shall withstand the pressure unbroken.
- .7 Where during final inspection of the heat treated glass pane, which is not of round form, first sample breaks, and previously two further samples were not taken, individual test shall be followed, under the procedure specified in 3.7.4.8.

Table 3.10

Glass thickness (mm)	Glass diameter (mm)					
	200	250	300	350	400	450
	Hydrostatic test pressure (MPa)					
6	0,33	0,21	-	-	-	-
8	0,58	0,37	0,26	0,19	-	-
10	0,92	0,58	0,41	0,30	0,23	0,18
12	1,32	0,84	0,59	0,43	0,33	-
15	2,12	-	-	0,67	0,52	0,41
19	-	2,00	-	1,07	0,82	-

3.7.4.11 Visual examination

- .1 This examination shall ensure that the glass pane is free from:
 - inclusions, blisters,
 - corrugation,
 - then that the visibility is clear and undisturbed when the glass pane is fitted vertically and under angle of 15° to 25°,
 - that there is no change in appearance of colour.

Note:

Visual examination shall be carried out on the cleaned and non-greased glass panes.

3.7.4.12 Packing, Storage and Transport

- .1 Package and transport shall be such as to protect the glass panes from possible physical damages and humidity.
- .2 Storage shall be provided in closed and low heated space, as to avoid vapour condensation.

4 CORROSION PROTECTION

4.1 GENERAL REQUIREMENTS

4.1.1 This Section recommends the requirements for the corrosion protection of the steel sea-going ships.

4.1.2 Corrosion protection of other types of ships coated with other materials, e.g. aluminium, shall be specially considered by the *Register*.

4.1.3 Coating manufacturers shall be approved by the *Register* and special products shall be type approved for the intended application.

4.1.4 The plans, selection, application, procedures and inspections of the corrosion protection system should follow the requirements of IMO Resolution A.798(19) (SOLAS 74, Chapter II-1, Part A-1, Regulation 3-2, Regulation 3-11).

4.1.5 The plans, procedures and corrosion protection materials shall be submitted for approval.

4.1.6 Special attention shall be paid to the protection of assemblies, which are after installation very hard to be inspected or repaired, as well as to the areas effected by aggressive media.

4.1.7 All necessary actions shall be taken to prevent the contact corrosion occurred due to application of different metals with various potentials liable to come in contact with electrolyte solution such as sea water, (selection of appropriate materials, sealing, effective protective coating, cathodic protection).

4.1.8 Direct contact of materials whose potential difference exceeds 300 mV shall be avoided.

4.2 SHOP PRIMER

4.2.1 During storage, transport and work processes the steel parts shall be coated with shop primer.

4.2.2 In order to reach adequate protection in duration of c/a 6 months, under normal working conditions in the yard, the coatings with thickness of dry film of 15 µm to 20 µm shall be applied.

4.2.3 The shop primer shall be highly resistant to mechanical stresses, to which shall be exposed during ship/s construction.

4.2.4 Shop primer shall be resistant to alkalis and shall not hydrolyse.

4.2.5 The shop primer shall be type approved, where-by the following shall be checked:

- that the compatibility of shop primer meets the standards - for the corrosion protection system,
- the shop primer does not affect the welding.

4.3 DEDICATED SEAWATER BALLAST TANKS / CORROSION PROTECTION

4.3.1 General

4.3.1.1 All dedicated seawater ballast tanks (which include double bottom, shell plating, deck) shall be protected by effective corrosion protection system.

4.3.1.2 One of the following corrosion protection systems shall be applied:

- protection by coatings (as specified in 4.3.2)

- combined protection by coatings and cathodic protection (as specified in 4.3.3)

- protection by cathodic protection without coatings (as specified in 4.3.4)

4.3.1.3 Impressed current system shall not be applied for protection of ballast tanks.

4.3.2 Protection by Coatings

4.3.2.1 Corrosion protection coatings shall be resistant to sea water, coastal sea water and harbour sea water as well as to the substances they may include.

4.3.2.2 The surfaces that are shielded or are not evenly distributed for the application of the spraying system shall be specially and formerly coated as to achieve adequate coating thickness.

4.3.2.3 The surface to be protected shall be prepared in accordance with the manufacturers' recommendations and approved documentation.

4.3.2.4 Surface preparation shall be assessed according to **ISO 8501** or any other equivalent agreed standard.

4.3.2.5 Coating dry film thickness shall be in accordance with the approved documentation and shall be at least 250 µm.

4.3.2.6 Prescribed coating thickness shall be of minimum coating thickness and shall be achieved under all conditions.

4.3.3 Combined Coating and Cathodic Protection

4.3.3.1 Coating protection shall be applied as specified in 4.3.2.

4.3.3.2 Besides, the coatings shall be resistant to cathodic protection, i.e. the coatings shall not result in any loosening of their protection performance to potential **more negative than -1200 mV related to Ag/AgCl electrode**. Resistance control as regards the cathodic protection shall be performed according to an approved standard, e.g. DIN 50928 or similar.

4.3.3.3 For the combined cathodic and coating protection of ballast tanks, zinc and aluminium anodes shall be applied.

4.3.3.4 Zinc anodes shall be applied when working temperatures may be expected to exceed 60°C.

4.3.3.5 For the protected surface coating of ballast tanks, the required protective current density shall be 0,02 A/m².

4.3.3.6 In case the ballast tanks are exposed to the temperatures exceeding 25°C, e.g. due to adjacent heated fuel oil tanks, protective current density shall be increased by 1 mA/m² for every °C above 25°C.

4.3.3.7 Protection of ballast tanks shall be planned for a period of at least 5 years.

4.3.3.8 Position and arrangement of anodes in the tank shall be such as to achieve necessary protection of current density in all surfaces.

4.3.3.9 Number and size of anodes depends on design and calculated anode inlet current.

4.3.3.10 Increase of number of required anodes may be requested under the following conditions:

- Where frequent low filling level lead to limitation area, efficiently protected by anodes,
- structure reduces actual current in some tank surfaces,
- increased protection current density is required for the protection of more noble material, e.g. internals made of stainless steel inner surfaces.

4.3.4 Cathodic Protection Without Coating

4.3.4.1 In special cases, e.g. in relatively small ships having low double bottom heights, corrosion protection with sacrificial anodes of ballast tanks, without additional coatings, may be permitted.

4.3.4.2 In such cases, the corrosion protection calculation shall specifically prove that the protection is appropriate for the assumed working conditions.

4.3.4.3 In such cases the cathodic protection by sacrificial anodes shall meet the following requirements:

- steel surfaces shall be coated with shop primer,
- ballast tanks shall be filled with sea water for a period over 50% of the (efficient) service time,
- ballast tanks shall be either complete filled or completely empty.

4.3.4.4 Protection current density of 0,12 A/m² shall be ensured in order to protect the non-coated surfaces inside the ballast tanks.

4.3.4.5 In case that in ballast tanks the temperatures exceed for 25°C, e.g. caused due to adjacent heating of fuel oil tanks, the required protection current density shall be increased by 2 mA/m², for every Oct above 25°C.

4.3.4.6 The protection of ballast tanks shall be planned for a period of 5 years.

4.3.4.7 Number, size, position and arrangement of anodes shall be in accordance with 4.3.3.8, 4.3.3.9 and 4.3.3.10.

4.3.5 Documentation

4.3.5.1 The plan of protection of ballast tanks by coatings shall be submitted for the approval to the *Register*.

4.3.5.2 The plan shall include the work process, materials and inspection.

4.3.5.3 The report (data sheet) on performed protection, including work phases, signed by the coating manufacturer, subcontractor, shipyard representative and owner shall be submitted to the *Register* for approval.

4.3.5.4 The report comprising the coating manufacturer and/or subcontractor or shipyard, shall include the following information:

- Place and date,
- Ship and tanks to be protected,
- Specification of the coating manufacturer (number of layers, thickness of coating layer, total thickness of dry film, protection conditions),
- Coating technical data,
- Number of type approval,
- Preparation of the surface (procedures, materials, environmental conditions),
- Condition of surface before coating (purity, roughness, existing workshop protection coating, achieved surface quality level),
- Application (procedure, number of layers),
- Application conditions (time, surface, environmental temperature, humidity, dew point, ventilation),
- Report on measurement of thickness and visual examination,
- Signatures (of shipyard representative, coating manufacturer, subcontractor).

4.3.5.5 In case of combined cathodic and coating protection of ballast tanks, the report specified in 4.3.5.1 shall also comprise the plan and calculation of the cathodic protection.

4.3.5.6 In case of cathodic protection of ballast tanks, the following documentation shall be submitted for approval:

- drawings,
- calculation,
- details of anodes.

4.3.5.7 Description of the cathodic protection system with guidelines shall be included in the ship's documentation.

4.3.5.8 Details of the level of filling ballast tanks shall be recorded and filed.

4.4 CARGO HOLDS PROTECTION

4.4.1 General Requirements

4.4.1.1 In bulk carriers, the total shell plating and structural transverse superstructures area, including elements thereof which are in contact with cargo shall be provided with an efficient coating protection (epoxy or equivalent coating), applied in accordance with the manufacturer's recommendations. When selecting the coating, care shall be taken of intended

cargoes and expected conditions, that can appear during exploitation.

4.4.1.2 Cargo hold protecting coatings shall be approved for their purpose.

4.4.2 Documentation

4.4.2.1 The cargo hold protection plan shall be submitted for approval.

4.4.2.2 The protection plan shall include the protection system, work process and inspection.

4.4.2.3 The report on performed coating protection, which shall be made by the coating manufacturer and/or works/ executor and/or shipyard representative, shall be submitted for approval.

4.5 PROTECTION OF THE UNDERWATER HULL

4.5.1 General Requirements

4.5.1.1 The underwater hull shall be protected with an adequate corrosion protection system comprising coating and cathodic protection.

4.5.1.2 For this purpose the coatings based on epoxy resin, polyurethane and polyvinyl chloride shall be suitable.

4.5.1.3 When providing corrosion protection, account shall be taken of the recommendations of the coating manufacturer, related to the surface preparation, application conditions and protection performance.

4.5.1.4 Coating system, without anti-fouling, shall have the thickness of dry film at least 250 µm and shall be compatible with cathodic protection, in accordance with recognised standards. Additionally, protection system shall be suitable for mechanical underwater cleaning.

4.5.1.5 The cathodic protection by sacrificial anodes or impressed current may be applied.

4.5.1.6 Under normal conditions of the protection of steel corrosion, the current density of at least 10 mA/m² shall be provided.

4.5.1.7 Cathodic protection by sacrificial anodes shall be provided for a period of one docking.

4.5.1.8 In case of protection by impressed current, over protection due to inadequate low potential, shall be avoided.

4.5.1.9 A protection screen shall be fitted as close as possible to the impressed current anode.

4.5.2 Documentation

4.5.2.1 The coating protection plan and the cathodic protection plan shall be submitted for approval.

4.5.2.2 Where protection by impressed current is applied, the following information shall be submitted:

- place and method of anode installation,

- description of the method providing rudder, propeller and - shaft in the cathodic protection plan,
- system of resources and current distribution.

4.5.2.3 The report on performed corrosion protection shall include information on all accomplished controls during performance and then shall be submitted for approval.

4.5.2.4 In case of protection by impressed current application, the functioning at sea shall be inspected. The obtained value for the protection current and voltage shall be recorded and filed.

4.6 PROTECTION OF ALUMINIUM ALLOYS

4.6.1 The aluminium alloys in the present item are considered to be the alloys referred to in the Chapter 5 of the *Rules, Part 25, Metallic Materials*.

4.6.2 Coating protection

4.6.2.1 When parts made of aluminium alloys are to be protected from corrosion **with coating**, they shall be thoroughly cleaned and degreased, prior to application of anticorrosion coatings.

4.6.2.2 To ensure efficient adhesion between anticorrosion coating and material to be protected, the respective part shall be pre-coated with a layer of adhesion increasing compound or an active pigmentation primer.

4.6.2.3 Special compositions shall be selected for the priming of aluminium alloys which shall not contain copper, lead and mercury pigments or bitumen-based paints containing phenol, shall be strictly avoided.

4.6.3 Cathodic protection

4.6.3.1 The potential of the aluminium alloys as defined in 4.6.1 is generally in the range -0,7 to -0,9 V with reference to a Ag/AgCl sea water reference electrode. A negative potential swing of at least 0,1 V from the corrosion potential is necessary to provide cathodic protection in sea water (i.e. -0,8 to -1,0 V). The limit of negative potential is, however, not to exceed -1,1 V with reference to a Ag/AgCl sea water reference electrode. Zinc or aluminium anodes may be used for cathodic protection but aluminium anodes containing mercury are not acceptable.

4.6.3.2 Where cathodic protection is used for corrosion protection, protection plan shall be submitted to the *Register*, as specified in 4.10.1.8.

4.7 PROTECTION OF COMPOSITE STRUCTURES

4.7.1 In structures of different materials, their structural elements shall be isolated from each other with an appropriate insulating medium.

4.7.2 Steel parts with belonging screws and washers, the contact of which with the aluminium alloys cannot be avoided, shall be zinc or cadmium coated. The parts used inside plant units which are constantly filled with oil mist or

permanently closed, may be exempted. The thickness of coating shall be in accordance with Table 4.1, for permanent exposure to seawater.

4.7.3 In special cases, on agreement with the *Register*, less thickness of coating than that specified in Table 4.1, may be permitted.

4.7.4 Zinc or cadmium by galvanisation shall be carried out only using the baths and anodes without admixture of mercury.

4.7.5 The use of fastening bolts, rivets and similar made of copper alloys shall not be permitted for riveting or fixing elements made of aluminium alloys.

4.7.6 Where practicable, screwed connections shall be used for joining the parts inside aluminium alloy structures.

4.7.7 External screwed connections shall be insulated by packing or sealing material against moisture affect.

4.7.8 For screwed connections exposed to high stresses or those frequently unscrewed, provisions shall be made for the threaded steel bushings for screws to be twisted. The bushings shall be zinc or cadmium coated before they are fixed into place.

4.7.9 Contact areas between aluminium alloys and acid containing wood or other materials deleterious for the aluminium alloys shall be adequately insulated by means of coatings or gaskets.

4.7.10 Sealing materials shall be subject to the *Register* for approval.

4.8 PROTECTION BY NON-METALLING COATING

4.8.1 Protection by Coatings (Paints)

4.8.1.1 Steel structures may be protected by coatings of the approved types as well as systems of coating, made by the manufacturers approved for such purpose.

4.8.1.2 Type Approval

- .1 For approval of particular coating systems, the following shall be tested:
 - adhesion,
 - resistance to sea water,
 - temperature range (maximum and minimum limits),
 - resistance to ageing,
 - resistance to mechanical damage, i.e. impact resistance, elongation and tensile strength,
 - resistance to biological attack for coating exposed to seawater,
 - resistance to boundlessness in combination with cathodic protection,
 - compatibility of different coatings, if the system is so combined,
 - reparation during construction, installation and service.

4.8.1.3 Coating Application

- .1 A specification of the coating application procedure shall be submitted to the *Register* for approval, which shall comprise:
 - description of general conditions in the coating yard,
 - method and equipment for the surface preparation,
 - temperature, conditions and relative humidity,
 - application method,
 - interval between surface preparation and primer,
 - minimum and maximum dry film thickness of a single coat,
 - number of coats and minimum total dry film thickness,
 - data on dryness i.e. possibility of repeated coating application as to the temperature and relative humidity,
 - procedure for repair of damaged coating,
 - method of supervision.
- .2 Surface may be prepared and cleaned provided the surface temperature is at least 3°C above dew point or provided the relative humidity is below 90%, unless otherwise recommended by the coating manufacturer.
- .3 The application process shall be supervised and relevant reports shall be available at request of the *Register*. The report shall cover:
 - acceptance in accordance with approved specifications,
 - data on the surface preparation,
 - measurement of temperature and humidity,
 - data on adhesion,
 - dry film thickness of particular coating system,
 - total dry film thickness of the applied coating.

4.8.2 Protection by Other Non-metallic Coatings

4.8.2.1 The *Register* shall approve plastics used for protection of propeller shafts, pipelines and machinery components, subject to the supervision of the *Register*.

4.8.2.2 Plastics used for corrosion protection may be applied by spraying, melting, or like solutions and by gluing.

4.9 PROTECTION BY METALLIC COATING

4.9.1 The thickness of protection layer of the items and products for galvanisation and cadmium plating may be defined in accordance with the approved standards, and in no case it shall not be less than the value specified in Table 4.1.

Table 4.1

Load group	Corrosion medium	Minimum thickness Zn or Cd (μm)
1	Permanent exposure to sea water	48
2	Temporary exposure to sea water	24
3	Effect of seawater splashing	12
4	Effect of marine atmosphere	6

4.9.2 As to the structure, pipeline and parts thereof as well as environmental corrosion properties, the *Register* may require the layer thickness to be increased.

4.10 ELECTROCHEMICAL PROTECTION (CATHODIC PROTECTION)

4.10.1 Protection by Sacrificial Anodes

4.10.1.1 For the electrochemical protection of structures and structural elements, the anodes may be made of metals

Table 4.2

Anode material	Potential against reference electrode Ag/AgCl (V)	Anode efficiency (%)	Output capacity (Ah/kg)	Anode consumption (Kg/A.year)
Mg-alloys	-1,50 to -1,70	55-65	1200-1400	6,5-8
Al alloys	-1,00 to -1,35	50-95	1500-2900	2,9-4,7
Zn	-1,05 to -1,10	80-95	760-810	≈ 11

4.10.1.5 Recommended alloy components for manufacture of sacrificial anodes are given in Table 4.3.

Table 4.3

	Al-Anode [%]	Zn-Anode [%]	Mg-Anode
Si	total	-	$\leq 0,02$
Fe	$\leq 0,1$	$\leq 0,0014$	$\leq 0,003$
Sn	$\leq 0,02$	$\leq 0,005$	-
Cd	-	0,025 – 0,07	-
Mn	0,10	-	$\geq 0,2$
Zn	2,0 – 5,0	rest	2,3 – 3,5
Ti	0,01 – 0,05	$\leq 0,006$	-
Pb	-	0,006	-
In	0,01 – 0,015	-	-
Cu	$\leq 0,005$	$\leq 0,005$	$\leq 0,01$
Al	rest	0,1 – 0,5	5,3 – 6,7
Mg	-	-	91

4.10.1.6 Sacrificial anodes may be made in different shapes and sizes, by casting, as well as in the form of strips and wires.

less noble than steel, i.e. metals having lower potential in sea water.

4.10.1.2 The anodes shall be of a long lifetime and shall have a high capacity (in ampere-hours per weight unit). The current generated by sacrificial anodes shall be constant and shall not be reduced by deposit of corrosion products on the anode surface. Consumption of anodes shall be uniform.

4.10.1.3 Sacrificial anodes may be made of zinc, aluminium and magnesium. Oppositely, zinc which has to be of very high grade of purity (especially regarding iron), aluminium and magnesium shall be alloyed with other metals.

4.10.1.4 Some properties of the anode materials are specified in Table 4.2.

4.10.1.7 The manufacturers of anodes intended for the electrochemical protection shall be approved for the manufacture and the anodes shall be of approved type. The certificate on testing and inspection of anodes shall include:

- Type approval certificate,
- Actual chemical analysis before casting,
- Actual chemical analysis of finished anodes,
- Number of batch.

4.10.1.8 Protection plan shall be submitted to the *Register* for approval. The specification plan shall include the following data:

- Area to be protected,
- Method of electric connection,
- Required current density,
- Design, weight, arrangement and anodes total number,
- Anode material and manufacturer,
- System efficiency calculation,
- Method of anode installation.

4.10.1.9 Cathodic protection system shall ensure sufficient current supply as to obtain potentials specified in Table 4.4 within structural area.

Table 4.4

Metal	Protection potential (V) Reference electrodes		
	Cu/CuSO ₄	Ag/AgCl	Zn
Steel in aerobic environment: a) positive limit b) negative limit	-0,85 -1,10	-0,80 -1,05	+0,25 +0,00
Steel in anaerobic environment: a) positive limit b) negative limit	-0,95 -1,10	-0,90 -1,05	+0,15 +0,00
High strength steel (ultimate tensile strength >800 N/mm ²): a) positive limit b) negative limit	-0,85 -1,00	-0,80 -0,95	+0,25 +0,10

4.10.1.10 Bare steel area to be protected shall be defined. For unprotected area to be protected, a percentage of the total area, gained on the basis of experience of coating damage and resistance, shall be specified.

4.10.1.11 Required current density shall be determined under environmental conditions, either by experience in similar conditions or by measurement.

4.10.1.12 Cathodic protection system using sacrificial anodes shall be so designed as to ensure required potential throughout the assumed service.

4.10.1.13 A shorter service period may be taken into account if a change of anode is planned.

4.10.1.14 The anodes shall be located as to provide uniform distribution of current over the steel structure.

4.10.1.15 Output current from anodes shall be defined by working potential and circuit resistance or by test measurements.

4.10.1.16 Effective anode lifetime (L) shall be determined by Owner, taking into account the likelihood of the design life of the protection object being extended.

4.10.1.17 Minimum required amount of anode material may be obtained, from the formula:

$$W = \frac{L \cdot I \cdot t \cdot 100}{C \cdot u}$$

where:

- W = minimum amount of anode material, in kg;
- L = effective anode lifetime, in years;
- t = total submersion time in hours/years = 8760 hours/years
- I = required current, in A;
- u = anode utility factor, in %;
- C = anode material capacity, in Ah/kg.

Required current shall be obtained from the formula:

$$I = \frac{F \cdot I_a}{1000}$$

where:

- I = required current, in A;
- I_a = required current density, in mA/m²;
- F = area to be protected, in m².

4.10.1.18 Anodes shall be so designed as to ensure sufficiently large area to produce required current, taking account of the maximum possible current density.

4.10.1.19 Anode core shall be so designed as to support anode throughout all structural and operational phases, i.e. transportation, attachment, etc.

4.10.1.20 Anodes shall be attached as to ensure proper current conductivity. Resistance shall not exceed 0,02 ohm, unless anodes attachment is made by adjustable resistance and unless reduction of protection potential is required by switching adjustable resistance.

4.10.1.21 Anodes which are fitted for protection of cargo tanks shall be properly designed and attached as to fix anode and fittings with supports, in case of anode consumption.

4.10.1.22 Steel fitting shall be fastened to the structure by a continuous weld of adequate section,. Alternatively, when it is fastened by bolts on particular supports, minimum of two bolts shall be provided and they shall be secured by lock nuts.

4.10.1.23 Anode ends shall not be attached to separate structural parts, which are likely to shift.

4.10.1.24 Where magnesium anodes are used for protection of bare light alloy, structural parts shall be shielded with non-conductive blinds to prevent corrosion of light alloys due to excessive protection.

4.10.1.25 Where magnesium anodes are used for protection of slashed parts of structures made of steel or aluminium, a reinforced protection coating shall be prescribed.

4.10.1.26 In the cargo tanks of oil tankers the application of magnesium anodes shall not be permitted.

4.10.1.27 The application of aluminium anodes shall not be allowed in cargo tanks of oil tankers, in places where potential energy exceeds 275 J; whereas the height of attached anodes shall be measured from tank bottom to the anode centre and its mass shall be taken as anode mass, in the form as fitted, including fastening device.

4.10.1.28 However, where aluminium anodes are fitted in horizontal areas, such as bulkhead/ stiffeners, deck girders, etc., at least 1 m in width and if fitted with perpendicular flange or strake protruding at least 75 mm, the height of anode fitting shall be measured from such areas.

4.10.1.29 Aluminium anodes shall not be fitted below openings and hatches unless protected against metallic items of adjacent structures, liable to fall.

4.10.2 Protection by Impressed Current

4.10.2.1 For protection by impressed current the conditions valid for protection by sacrificial anodes, as specified in 4.10.1, shall be met.

4.10.2.2 In oil tankers the application of protection by impressed current shall not be allowed.

4.10.2.3 Plan of protection by impressed current shall be submitted to the *Register* for approval. The following data shall be included in the plan:

- area to be protected;
- electrically connected systems;
- required current density;
- general protection plan;
- anodes, anode shields, rectifiers, cables, cable connections and electric circuits,
- monitoring system;

4.10.2.4 Impressed current anodes shall be located and shielded as to ensure uniform distribution of current throughout the steel surface.

4.10.2.5 Special consideration shall be paid to detrimental effect of chlorine, especially if combined with hydrogen developed due to excessive protection.

4.10.2.6 Installed monitoring system for measuring of required potential shall be provided.

4.10.2.7 Power source shall be tested as to ensure the correctness of electric connections and to identify any damage.

4.10.2.8 Cables and connections shall be carefully inspected as to identify any possible damage of insulation. Damages shall be properly removed.

4.10.2.9 Compatibility of anode material and anode size related to specification, shall be checked.

4.10.2.10 Equipment, cables etc., shall be approved for the application in individual hazardous zones.

4.10.3 Testing of System Efficiency

4.10.3.1 Tests shall be carried out after a particular cathodic protection system has been set to operate, as to ensure that the steel potential is within prescribed limits.

4.10.3.2 Test equipment, procedure and scope of potential measurement shall be submitted to approval.

4.10.3.3 Reference electrode shall be fitted as close as possible to the selected position of the area where measurement will be performed.

5 SOLID WOOD - PLYWOOD

5.1 QUALITY AND GRADES OF SOLID WOOD

5.1.1 This Section applies to the quality of wood applied for the construction of ship's hull parts or shipboard equipment, which are subject to the supervision of the *Register*.

5.1.2 The timber used in shipbuilding shall at least satisfy the quality requirements as specified in Table 5.1.

5.1.3 The timber species to be used for various structural elements, with regard to their determined properties such as (strength, density, working and bonding capabilities), in relation to different construction methods and purposes, shall be specially agreed with the *Register*.

5.1.4 The timber shall be protected with proper preservatives, as necessary. Preservatives shall be deposited either by immersion, spraying or free brushing namely after all

works have been completed. In selection of preservatives, care shall be taken to the possible effect on paint or synthetic resin are to be applied.

5.1.5 As to the deck planks and shell plating planks, timber is to be cut in accordance with Figures 5.1, 5.2 and 5.3.

5.1.6 The timber is to be stored under dry condition and is to have on air dried moisture content of not more than 20% before use.

5.1.7 Adhesives to be used for manufacture of structural elements shall be of approved type and shall ensure a bond highly resistant to atmosphere, micro-organisms, cold and boiling water, vapour and heat.

5.1.8 Technological process of manufacture of laminated structures and finished products (boats) shall be approved, i.e. the manufacturer shall be approved for such manufacture.

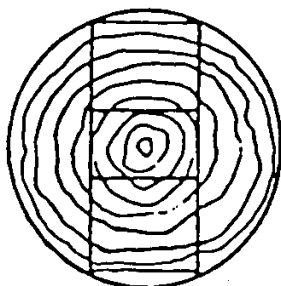


Fig. 5.1

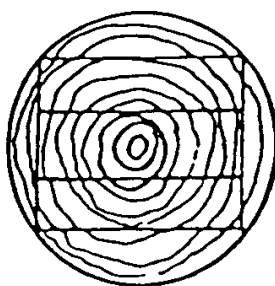


Fig. 5.2

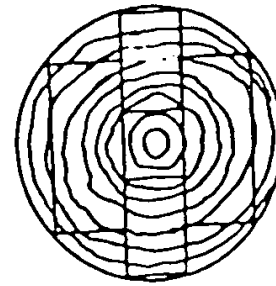
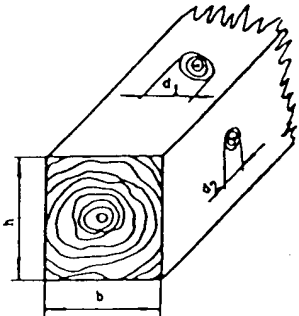
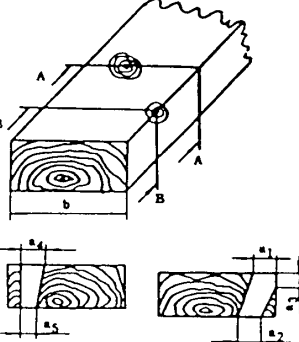
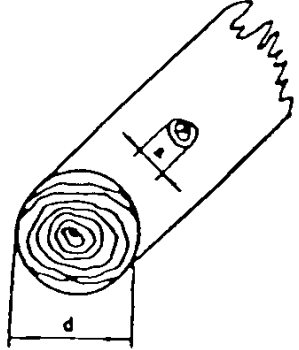
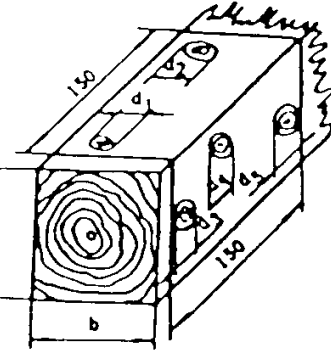
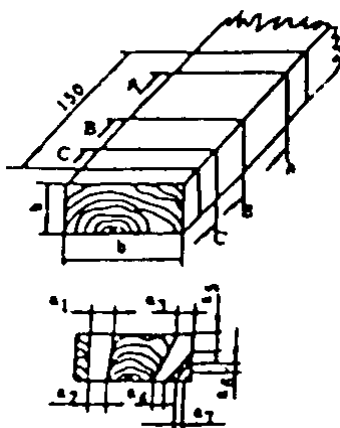
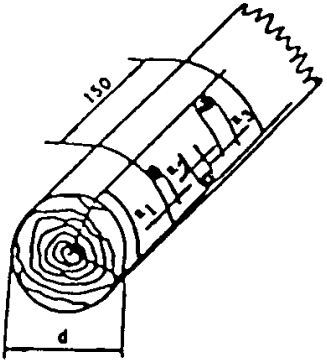
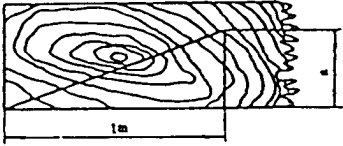
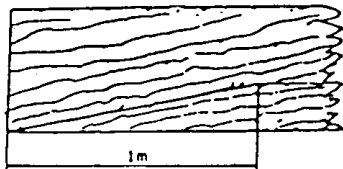


Fig. a 5.3

Table 5.1
Permissible defects in massive timber

Evaluation criteria requirements	Grade I	Grade II	Examples
1. General properties	Permissible for artificially seasoned timber: blue stains and hard brown stripe. Not permissible: frost shakes frost heart shakes insects injuries, damages by mistletoe ring shake, red rot, white rot, red stripe.	Permissible: blue stains, damage of surface due to insects, hard brown and red stripe. Not permissible: frost shakes damage by mistletoe ring shake, red rot, white rot	
2. Quality of cutting	Depending on the application, reduced criteria for estimation shall be agreed with the <i>Register</i> .		
3. Annual ring width	For external annual rings measured at a distance of 50% of cross-section of the area-mostly 4 mm. Where there is a difference in a width of annual rings at the end cross sections the largest width of annual rings shall be considered during measurement.		

1	2	3	4
4. Knots	Tight and sound knots shall be taken into account only if their diameter in planks exceeds 10 mm and in beams 20 mm.		
4.1 Single knots	The values specified in 4.1.1 through 4.1.3 shall not be exceeded.		
4.1.1 Beams	$\frac{d_1}{b} = \frac{d_2}{h} \leq \frac{1}{5}$ $d_1 \text{ or } d_2 \leq 50 \text{ mm}$	$\frac{d_1}{b} = \frac{d_2}{h} \leq \frac{1}{3}$ $d_1 \text{ or } d_2 \leq 70 \text{ mm}$	
4.1.2 Planks	$\frac{a_1 + a_2 + a_3}{2b} \leq \frac{1}{5}$ $\frac{a_4 + a_5}{2b} \leq \frac{1}{5}$	$\frac{a_1 + a_2 + a_3}{2b} \leq \frac{1}{5}$ $\frac{a_4 + a_5}{2b} \leq \frac{1}{5}$	
4.1.3 Round timber	$\frac{a}{d} \leq \frac{1}{6}$	$\frac{a}{d} \leq \frac{1}{4}$	
4.2 Group of knots at a length of 150 mm	Size and number of knots shall not exceed values specified in 4.2.1 through 4.2.3.		
4.2.1 Planks	$\frac{d_1 + d_2}{b} \leq \frac{2}{5}$ $\frac{d_3 + d_4 + d_5}{h} \leq \frac{2}{5}$	$\frac{d_1 + d_2}{b} \leq \frac{2}{3}$ $\frac{d_3 + d_4 + d_5}{h} \leq \frac{2}{5}$	

4.2.2 Planks	$\frac{a_1 + a_2 \dots a_7}{2b} \leq \frac{1}{3}$	$\frac{a_1 + a_2 \dots a_7}{2b} \leq \frac{1}{2}$	
4.2.3 Round timber	$\frac{a_1 + a_2 + a_3}{d} \leq \frac{1}{3}$	$\frac{a_1 + a_2 + a_3}{d} \leq \frac{1}{3}$	
5. Diagonal grain measured in direction of grain in a length of 1 m.	$a \leq 100 \text{ mm}$	$a \leq 200 \text{ mm}$	
6. Slope of grain measured in direction of grain in length of 1 m.	$A_F \leq 70 \text{ mm}$	$A_F \leq 120 \text{ mm}$	
7. Timber moisture content	10% ÷ 14% no gluing to 16%.		

5.1.9 The application of adhesives guaranteeing a lower degree of resistance shall be approved for each particular case separately.

5.1.10 Timber for gluing shall be clean and dry, the joining surface shall be properly prepared, free from dust and grease. Gluing should be performed in accordance with the manufacturers' recommendations.

5.1.11 The layers forming the lamination shall be made of the same timber species and same moisture content. The grain of the layers shall be approximately parallel to the elements' length. The thickness of individual layers shall be such as to prevent appearance of excessive stress in the element.

5.1.12 The glues to be applied for lamination shall be of approved type and shall ensure WBP resistance degree.

5.2 PLYWOOD

5.2.1 General Requirements

5.2.1.1 The plywood panels manufacturers shall be recognised by the Register and the products type approved.

5.2.1.2 The present requirements apply to veneer properties, construction and method of gluing of plywood panels, used in the shipbuilding.

5.2.1.3 Plywood is considered a wood based panel consisting of an assembly of plies boned together, some or all of which are of wood. The plies are cross-grained in relation to the direction of grain, and outer and inner plies are positioned symmetrically on each side of the central ply or core.

5.2.2 Classification of plywood panels

The plywood panels are classified as follows:

- 5.2.2.1** Construction:
 - a) veneer plywood
 - b) core plywood
 - c) combined plywood
- 5.2.2.2** Bond performance
 - a) for interior use
 - b) for exterior use
- 5.2.2.3** Surface treatment
 - a) non-sanded plywood
 - b) sanded plywood
 - c) scraped plywood
 - d) further processed plywood
- 5.2.2.4** Durability (protection)
 - a) untreated plywood
 - b) treated plywood
- 5.2.2.5** Form
 - a) flat
 - b) shaped
- 5.2.2.6** Plies species:
 - a) homogenous plywood
 - b) mixed plywood.
- 5.2.2.7** Quality of face plies
- 5.2.2.8** Application
 - a) raw plywood
 - b) special plywood
 - c) structural plywood

5.2.3 Veneer plywood

5.2.3.1 Wood species and construction of panels

- .1 Wood species and construction of panels (number of veneer plies) shall be selected according to the purpose. For highly loaded supporting elements, the relevant panel class of durable hardwood shall be applied, the structure of which is to be composed of several thin veneer plies.
- .2 For less loaded elements as well as for plating panels, the less resistant wood species may be used, a veneer may be thicker and number of plies reduced. Such panels shall be well surface protected.
- .3 In general the thickness of outer veneer ply amounts 1,5 mm. Where , an additional surface treatment of panel by sanding is provided that ply may be thicker but in any case the thickness shall not exceed 2,6, mm.

- .4 In the case of panels with thickness to 15 mm. the veneer shall not have thickness exceeding 2,6 mm, and in the case of panels over 15 mm - mostly 3,8 mm in thickness.
- .5 The specified veneer thickness may be exceeded only if specially approved by the Register. Standard constructions of plywood panels are shown in Table 1.2.3.1.
- .6 The arrangement of individual veneer plies, relative to the specie and thickness of wood, shall be symmetrical.
- .7 The layers may be made of rotary cut or sliced veneer in a form of strips with perpendicularly cut edges, arranged closely to each other so that joints are parallel to grain direction. The outer slices are to be made of the strips of the same specie and colour of wood. Pressed veneer side shall be placed at the panel face. Symmetrical inner plies of veneer in plywood having more than three plies shall be made of the same wood specie and thickness.
- .8 Directions of wooden grains of two adjacent veneer plies in a panel shall make a right angle. In the case of panels with inner plies made of other specie of wood in relation to the outer plies, the relevant particulars should be specified in the description of construction and marking of panels.

Table 5.2
Standard constructions

Panel thickness (mm)	Minimum number of plies	Minimum thickness of outer plies (mm)	Maximum thickness of inner plies (mm)
$t \leq 6$	3	1,5-1,9	2,6
$6 < t \leq 10$	5	1,5	
$10 < t \leq 15$	7	1,5	
$15 < t \leq 20$	7		
$20 < t \leq 26$	9		
$26 < t \leq 34$	11		
$34 < t \leq 40$	13		
$40 < t \leq 48$	15		
$48 < t \leq 55$	17		
$55 < t \leq 60$	19		
$60 < t \leq 70$	21		

5.2.3.2 Quality of panels

- .1 According to the properties of the veneer face and back the panels are classified into one of five quality grades, namely E, I, II, III, IV.
- .2 These present five grades correspond approximately to the following intended final uses:
E grade: natural surface intend to remain visible;

- I grade: surface which may remain visible;
 II grade: surface which may be directly painted or coated;
 III grade: surface generally intended to be unseen, painted or coated;
 IV grade: no requirements for surface quality.
- .3 The limit of permissible defects for each of specified grades shall be determined individually for panels with outer plies of temperate hardwood species, of tropical hardwood species and coniferous species. Both surfaces may be of same or different grade.
 - .4 Panel quality grade according to outer properties of plywood shall be expressed in quality grades of both surfaces. Both surfaces may be of equal or different quality grade.
 - .5 Where the surfaces have different quality, the surface of better quality will be the face namely the first element of quality grade and the opposite surface is back namely the second element of quality grade.
 - .6 Defects that are limited in number, cumulative size or extent relative to square meter of panel surface or to the meter of sheet breadth, shall be calculated as the average of their appearance throughout the total area or with of the face or back, under evaluation. Resulting value shall be rounded to the nearest whole number, i.e. 0,5 = 1.
 - .7 The number of categories of defects on one surface shall not exceed the values stated in Table 5.3.
 - .3 The application of synthetic adhesives of other chemical composition and their compliance with specified requirements for a type of plywood bond, shall be considered and agreed by the *Register* for each particular case. The veneer plies shall have a proper adhesion.
 - .4 During gluing procedure all conditions providing proper adhesion shall be taken into account, such as: moisture of wood, pressure, pressing time, pressing temperature, quantity of adhesive.
 - .5 Bonds of veneer plywood shall be of the following types;
 - WBP - highly resistant to weather, micro-organisms, cold and boiling water and wet and dry heat during excessive exposure;
 - CBR - resistant to weather during limited exposure, good resistant to boiling water, and excessive exposure to cold water and highly resistant to micro-organisms;
 - MR - resistant to weather only for a period of several years, resistant to hot water for a limited time resistant to micro-organisms and resistant for long period exposure to cold water;
 - INT - resistant to cold water, long term resistant under dry climatic conditions.
 - .6 Bond of veneer plywood shall be acceptable if one of combination of shear strength and percentage of wood failure is obtained, in accordance with Table 5.4 for each of the procedures which require the test pieces to be subjected in order to determine the type of bond.

Table 5.3

Permitted limits of categories of defects

Grade by appearance of the surface of the panel	Maximum number of categories of permitted defects unlimited
E	1
I	3
II	6
III	9
IV	unlimited

- .8 If the number of categories of defects permissible exceeds maximum number stated in Table 5.3 for defined grade, the estimated surface be classified in the next relevant lower grade.

5.2.3.3 Bond performance

- .1 For the manufacture of veneer plywood phenol or amino-plastic base resins adhesives or their combination, may be used.
- .2 The applied adhesives shall be approved by the *Register*.

Table 5.4

Requirements for shear strength and wood failure

Average shear strength	Average wood failure [%]	Minimum average wood failure in any test piece [%]
0,35 t 0,7	75	25
0,7 t 1,7	50	15
1,7 t 2,5	25	5
2,5 t	15	0

5.2.3.4 Durability (resistance)

- .1 Veneer plywood shall be classified into four durability (resistance) classes with respect to the resistance to fungal decay and to destroying effect of insects, namely:
 - G - Plywood for general purpose not specified with respect to durability (resistance);
 - E - Plywood having a high resistance to wood borer attack

- (not termites) but not-resistant to decay;
- M - Plywood moderately resistant to decay but not resistant to certain types of wood borer attack, e.g. termites, unless treated.
- H - Plywood having a high resistance to decay but not resistant to certain types of wood borer attack, e.g. termites, unless protected.
- 2 No plywood shall allow the inclusion of live wood boring insects.

Table 5.5
Natural properties of wood for manufacture of special plywood

Timber species	Origin	Botanical name, gender/family	Density at 15% moisture kg/m ³	Natural durability	Colour
AFROMOSIA	Africa	Afromosia elata/leguminosae	700	very durable	white
AFZELIA	Africa	Afzelija africana/leguminosae	800	very durable	light yellow
AGBA (PINK MAHOGANI)	Africa	Gossweilerodendron balsamiferum/leguminosae	500	durable	yellow pink
LARCH	Europe	Larix decidua/Pinaceae	550	moderately durable	brownish white
DOUGLAS FIR	America	Pseudotsuga menziesis/Pinaceae	500	moderately durable	yellowish white
DUCA	Africa	Dumoria africana/Saporaceae	700	very durable	reddish brown
IDIGBO	Africa	Terminalia ivorensis/Combretaceae	530	durable	yellowish
GUAREA	Africa	Guarea spp/Meliaceae	580	durable	brown to dark red
OAK, AMERICAN WHITE	America	Quercus spp/Fagaceae	730	durable	yellowish white
OAK, ENGLISH	Europe	Quercus robur/Fagaceae	710	durable	yellowish brown
IROKO (AFRICAN TEAK)	Africa	Chlorophera excelsa/Maraceae	650	very durable	yellowish white
CHESTNUT	Europe	Castanea spp/Fagaceae	600	durable	light brown
AMERICAN MAHOGANI	America	Swietenia macrophylla/Meliaceae	550	durable	light to dark red brown
KAJA MAHOGANI (MAHOGANI AFRICAN)	Africa	Khaya ivorensis/ Meliaceae	520	moderately durable	reddish brown
MAHOGANI OMU	Africa	Etandrophragma Candollei/Meliaceae	680	moderately durable	red brown with violet shades
MAHOGANI SAPELE	Africa	Etandrophragma cylindricum/Meliaceae	650	moderately durable	pink reddish brown
MAHOGANI-TIJAMA	Africa	Etandrophragma angolense/Meliaceae	550	moderately durable	pink reddish brown
MAHOGANI UTILE	Africa	Etandrophragma utile/Meliaceae	640	durable	pink
MAKORE	Africa	Dumoria hecaelli/SapoRaceae	620	very durable	red
LIGHT RED MERANTI	Asia	Shorea spp/Dipterocarpaceae	520	moderately durable	pink
GABDON (OKOUME)	Africa	Acoumea Klaineana/ Burseraceae	440	non durable	pink

5.2.3.5 Special plywood

- .1 For the construction of different structures in shipbuilding, veneer plywood sheets shall be manufactured of wood having sufficient hardness, which is not subject to the effect of decay and which is resistant to all atmospheric influences, including tropic climate too, and also resistant to extended exposure in fresh or sea water.
- .2 The resistance to the effect of decay and insects (including termites) may be obtained by additional treatment with appropriate preservative, either veneer or finished panels.
- .3 Bonding between the veneers and every other bonding shall be W.B.P. bonding type.
- .4 Table 5.5 shows all types of wood which are considered appropriate for the manufacture of veneer plywood intended for shipbuilding.

5.2.3.6 Moisture content

- .1 In the time of leaving the factory, finished boards shall have a moisture content of 6 % to 14 % with respect to the mass of wood dried in an oven.
- .2 Where the moisture content has changed due to time of transport or storage, prior to subsequent treatment the moisture content should be checked relating to compliance with usage conditions.

5.2.3.7 Joining of boards

- .1 During manufacture of boards exceeding the pressing machine dimensions, a scarf joint through the thickness of the board shall be permitted. All scarf joints shall be made with an inclination not steeper than 1 to 8 and shall be bonded with an adhesive having properties similar to that applied in a board.

5.2.3.8 Repair of boards

- .1 Inferior defects of limited extent not affecting the quality of finished boards may be repaired.
- .2 The repair is to be done by bonding with an adhesive having properties similar to that applied in a board. Colour and grain of insertions and also colour of fillers for the quality grades I and II shall correspond to the surrounding wood.

5.2.3.9 Surface treatment

- .1 The surface treatment of boards for the purpose of determined purpose, decoration, increasing of durability or fire spread retarding, shall be specially agreed with the *Register*.

5.2.3.10 Tolerances on dimensions of plywood

- .1 The panel dimensions shall comply with the applied standards and conditions of order.
- .2 Difference between determined thickness and nominal thickness may be $\pm 0,5$ and the maximum permissible difference of individual measurements may be 0,8 mm. Average panel thickness shall be expressed to an accuracy of 0,1 mm.
- .3 The deviation in edge straightness shall not exceed ± 1 mm per metre length of the edge of panel being assessed.
- .4 The out of squareness of the panel shall not exceed $\pm 1,5$ mm by metre of the edge of the panel being assessed.
- .5 The deviation from the maximum length and breadth of a panel shall be within limits of ± 4 mm.

5.2.3.11 Testing

- .1 The testing results shall comply with the manufacturer's specification of products and it shall comply with before mentioned requirements or standards specified in documentation accepted during type approval of products.
- .2 For the purpose of type approval of veneer plywood, the following testing shall be performed:
 - a) density test - according to manufacturer's specification;
 - b) moisture content of final product;
 - c) tensile strength test - average test value shall not be less than the value stated by the manufacturer, nor the value of individual test shall be less than 86% of the specified one;
 - d) bend strength test - average value shall not be less than the value specified by the manufacturer, nor the value of individual testing shall be less than 75% of the stated value;
 - e) test of the bond performance - according to BS 1203, or any other equivalent standard;
 - f) test of fire behaviour properties if required, shall be determined according to BS476 Part 7 (Chapter 2) or any other equivalent standard;
 - g) test of resistance to micro-organisms and insects (if required) shall be determined according to BS 1203.

5.2.3.12 Sampling

- .1 The material from which samples are taken for type approval purposes shall be selected under supervision of the Register, namely in the manufacturer's warehouse or directly from the manufacture.
- .2 For each type of panel for which type approval is required, two samples shall be taken from one size of thickness, i.e. one

pair for the least, one for medium and one for largest thickness (6 panel).

Note:

Type of a panel is a batch of the products of the same composition, i.e. applying the same adhesive and eventual additional chemical treatment.

- .3 Each of the panels selected as sample shall be marked into areas from which test pieces shall be cut. Marking shall be carried out according Fig.5.4.

01	02	03	04	05	06
07	08	09	10	11	12
13	14	15	16	17	18
19	20	21	22	23	24

Figure 5.4

- .4 At least four test pieces shall be selected at random from which the required number of test specimens shall be cut.
- .5 The number, dimensions and any special requirement in respect of the test specimens shall be chosen according to the requirement of the respective test procedure.

5.2.3.13 Repeated tests

- .1 Where during testing on one or more panels from the same batch the satisfactory results are not obtained, two subsequent panels of the same batch shall be tested. If in repeated tests satisfactory results are not obtained, the batch is to be rejected.

5.2.3.14 Marking

- .1 Each panel shall be indelibly marked, near an edge on the back or on an edge, with the mark containing:
- number of standard,
 - panel thickness,
 - appearance grade,
 - bond performance,
 - durability class and (if specially treated) treatment particulars,
 - name of manufacturer or identification mark,
 - final *Register* stamp.

5.2.4 Core plywood

5.2.4.1 The application of this type of plywood shall be specially agreed and considered by the *Register*.

5.2.5 Combined plywood panels

5.2.5.1 The application of this type of plywood shall be specially considered and agreed by the *Register*.

5.3 VENEER

5.3.1 Veneer applied in ship's interiors, crew accommodation and offices shall comply with the FTP Code Part 2 and Part 5, related to development of smoke, toxicity and surface combustibility.

6 FIBRE ROPES

6.1 GENERAL REQUIREMENTS

6.1.1 This Section apply to the manufacture and supervision of ropes made of natural and synthetic fibres intended for shipbuilding and specially for towing and mooring.

6.1.2 The fibre ropes shall be of adequate type and of strength necessary for specified purpose and shall comply with the standards accepted by the *Register*.

6.1.3 The manufacturer (method of manufacture and quality control) shall be recognised in accordance with the *Rules* for the recognition of manufacturers testing institutions and service suppliers..

6.1.4 During inspection of the factory the manufacturer shall prove the suitability of equipment for proper manufacture and testing.

6.2 ROPE STRUCTURE

6.2.1 In general, the fibre ropes shall be composed of strands, which may make cabled or plaited ropes.

6.2.2 Cabled ropes shall be constructed from 3 or 4 strands. Four-strand ropes are fitted with a core made of the same material as the strands.

6.2.3 Plaited rope is eight-strand square rope.

6.2.4 The application of fibre ropes of other structure shall be considered and agreed by the *Register* for each particular case.

6.3 MANUFACTURE OF ROPES

6.3.1 Fibre ropes are manufactured either from natural fibres (manila, sisal, hemp or choir) or synthetic fibres (polyamide, polyester, polypropylene). Other material may be also used with agreement of the *Register*.

6.3.2 Every rope length shall be manufactured from the same type and quality of natural or synthetic fibres. Number of yarn shall be equal for all strands in a rope. Fibres shall be as long as practicable, free from impurities and defects.

6.3.3 Too much lubricants shall not be allowed and means for increasing rope weight shall not be provided at all.

6.3.4 Any root-proofing or water repellence treatments shall not be deleterious to fibres nor rope weight shall be considerably increased or strength reduced. Only new fibres may be used for manufacture of ropes.

6.3.5 Manila, hemp, sisal, polyamide, polyester and polypropylene ropes may contain adequately marker yarns throughout the rope length, in accordance with relevant standards.

6.3.6 Rope strands and cores shall be made of material of the same type and quality. Yarns and strands shall be uniformly and adequately twisted, coiled and stretched.

6.3.7 In order to increase abrasion resistance the rope may be provided, in addition with its basic composition, also with polyester yarn, in the outer layer. The rope shall be completely flexible.

Table 6.2 Load to be applied to ropes for the measurement of net mass per meter (linear density) and diameter

Nominal diameter	Nominal circumference	Reference tension for		Nominal diameter	Nominal circumference	Reference tension for	
		Natural fibre rope	Synthetic fibre rope			Natural fibre rope	Synthetic fibre rope
mm	in	daN Tolerance ±5%)	daN Tolerance ±5%)	mm	in	daN Tolerance ±5%)	daN Tolerance ±5%)
4	1/2	2,9	2	28	3 ^{1/2}	118	93
5	5/8	3,9	2,9	30	3 ^{3/4}	137	108
6	1	5,9	3,9	32	4	157	118
7	7/8	7,8	5,9	36	4 ^{1/2}	196	147
8	1	11	7,8	40	5	235	176
9	1 ^{1/8}	-	9,8	44	5 ^{1/2}	285	210
10	1 ^{1/4}	14	13	48	6	330	240
11	1 ^{3/8}	-	15	52	6 ^{1/2}	390	290
12	1 ^{1/2}	20	18	56	7	440	330
13	1 ^{5/8}	-	21	60	7 ^{1/2}	500	380
14	1 ^{3/4}	29	24	64	8	570	420
16	2	39	29	68	8 ^{1/2}	630	-
18	2 ^{1/4}	49	39	72	9	700	530
20	2 ^{1/2}	69	49	76	9 ^{1/2}	750	-
22	2 ^{3/4}	78	59	80	10	820	650
24	3	88	69	88	11	980	770
26	3 ^{1/4}	108	83	96	12	1080	910

Table 6.3 Realisation factor *r*

Nominal diameter	Realisation factor, <i>r</i>							
	Natural fibre ropes				Synthetic fibre ropes			
	Hemp 3-strands	Manila or sisal			3-strands polyamide	3-strands polyester	3 or 8-strands polypropylene monofilament	3 or 8-strands polypropylene film
3-strands		4-strands	8-strands					
mm								
24	-	-	-	-	0,7500	0,6222		
28	-	-	-	-	0,7377	0,6042		
32	-	-	-	-	0,7270	0,5925		
36	-	-	-	-	0,7177	0,5840		
40	-	-	-	-	0,7095	-		
44	-	-	-	-	0,7022	0,5705		
48	-	-	-	-	0,6958	0,5655	0,8719	0,890
52	-	-	-	-	0,6900	0,5610	0,8646	0,880
56	-	-	-	-	0,6850	0,5572	0,8583	0,875
60	0,664	0,592	0,533	-	0,6808	0,5536	0,8531	0,870
64	0,659	0,589	0,530	0,610	0,6770	0,5502	0,8483	0,865
68	0,653	0,585	0,527	0,606	-	-	-	-
72	0,647	0,582	0,524	0,603	0,6700	0,5446	0,8395	0,855
76	0,643	0,579	0,521	0,600	-	-	-	-
80	0,640	0,577	0,519	0,598	0,6650	0,5400	0,8332	0,845
88	0,638	0,574	0,517	0,595	0,6613	0,5367	0,8286	0,840
96	0,636	0,572	0,515	0,593	0,6578	0,5333	0,8242	0,835

6.4 TESTING OF ROPES

6.4.1

6.4.1.1 For each particular type of rope for which approval is required, the samples of manufactured rope having maximum diameter shall be tested and also the one mostly produced (manufactured).

- 6.4.1.2** Testing shall determine:
- net mass per meter (linear density);
 - lay;
 - diameter or circumference of rope;
 - breaking load and elongation.

6.4.2 Sampling

6.4.2.1 The sample shall represent the homogenous batch of ropes to be tested as close as possible. The batch is to be homogenous i.e. composed of ropes of the same type and dimensions, manufactured in the same manufacturing cycle. An amount of test samples shall be taken from the ropes batch, of cca 2500 mm in length according to the following Table 6.1.

Table 6.1

Size of batch m	Number of samples
to 2000	1
Each batch over 2000	1

6.4.2.2 Number of samples for testing of natural fibre ropes shall not be less than one sample per every ten rope coils.

6.4.3 Determination of net mass per meter (linear density)

6.4.3.1 Net mass per meter, *m*, shall be calculated according to the formula:

$$m = \frac{m_o}{L}$$

where:

- m_o* = mass of test piece within limits;
- L* = test piece length in meters, under determined load (Table 6.2) calculated according to formula:

$$L = \frac{D_p \cdot L_o}{D_o}$$

where:

- D_o* = initial spacing between reference marks located symmetrically around mean test piece position if freely placed on flat plate;
- D_p* = spacing between reference marks measured under determined load (Table 6.2);
- L_o* = initial total length of test piece freely placed on flat plate.

6.4.4 Determination of rope diameter and circumference

6.4.4.1 The sample shall be subjected to adequate load (Table 6.2) and then diameter to be measured. Obtained values shall be within limits $\pm 4\%$ from the nominal value.

6.4.5 Determination of lay (uniformity of twisting)

6.4.5.1 The sample shall be subjected to the respective load (Table 6.2) and then a length of 10 lays shall be measured. The maximum determined length shall comply with the values specified in relevant standards.

6.4.6 Determination of breaking strength

6.4.6.1 Breaking strength of rope shall be determined by tensile test of specimen in full section.

6.4.6.2 The test specimen shall be loaded to the initial loading as stated in Table 6.2 and diameter and uniformity of twisting shall be checked. After that loading shall be increased uniformly and continuously until the rope breaks.

6.4.6.3 It is important to determine the position of rope breakage in order to ascertain if obtained result shows the actual rope strength.

6.4.6.4 If the breakage occurs beyond defined marks, the rope is considered to satisfy provided that obtained value is not less than 90% of the value required by the relevant standard .

6.4.6.5 The report shall specify only the actually obtained value, with position of the breakage.

6.4.6.6 If there is no technical possibility to examine the test specimen of manufactured rope in total for the ropes having breaking strength above 25.000 daN can be calculated from the breaking strengths of the particular yarn, provided the rope has fulfilled the specified requirements in all other respects.

6.4.6.7 Number of individual yarns shall comply with at least half rope diameter. The yarn shall be uniformly taken from the outer layer, inner layer and middle of rope strands. For plaited rope, half the yarns shall be selected from right twist strands and the other half from left twist strands.

6.4.6.8 Breaking strength of rope F_{MC} from which yarns are taken shall be determined according to formula:

$$F_{MC} = F_Y \cdot n \cdot r,$$

where:

- F_{MC} = rope breaking strength, daN;
- F_Y = average yarn strength, daN;
- n = number of yarns in the rope;
- r = realisation factor (Table 6.3).

6.4.6.9 The test report shall include testing results of particular yarns. Obtained breaking strength shall comply with the values stated in the relevant standards.

6.5 MARKING

6.5.1 Every tested rope coil shall be fitted with an attached identification table, comprising the following:

- manufacturer's mark;
- type of material;
- structure;
- diameter;
- length;
- date of manufacture ;
- stamp and number of the *Register*.

7 GLASS FIBRE REINFORCED PLASTICS

7.1 GENERAL REQUIREMENTS

7.1.1 This Section applies to the manufacturer and products of glass fibre-reinforced plastic manufactured from unsaturated polyester resins reinforced with low alkaline glass fibres, as well as to the manufacturers of raw materials and to the raw materials.

7.1.2 The manufacturer, method of manufacture and products of glass-reinforced plastics shall be approved by the *Register*.

7.1.3 Resins and reinforcements used shall be of approved type.

7.1.4 Type and content of catalyst and accelerator shall be selected in accordance with the recommendations of the resin manufacturer for each individual application separately, as to ensure the process of resin hardening within a specified period of time, without additional heating.

7.1.5 Added pigments shall not affect the resin hardening process.

7.1.6 Pigments added to the resin by the manufacturer shall be dispersed in the same or any other compatible resin.

7.1.7 The content of added pigment shall not exceed 5% of the resin weight.

7.1.8 The amount of fillers that may be added to resins shall not substantially affect the resin viscosity, i.e. the content shall not exceed 10% in relation to resin weight.

7.1.9 It shall be allowed to add 3% of thixotropic filler to the resin. Up to 5% of flame retardant filler shall be permitted to be added.

7.1.10 Filler shall not be added to the resins, intended for the manufacture of oil fuel or water tanks.

7.1.11 The fillers shall be of approved type.

7.1.12 Details of resin system, additives and application of reinforcement layers shall be submitted to the *Register* for approval, in each particular case.

7.2 MANUFACTURE OF LAMINATES

7.2.1 The present requirements apply to the manufacture of laminates either by hand lay up or by spraying, or alternatively by applying both methods.

7.2.2 Other technologies of manufacture may be applied only when specially approved.

7.2.3 When laminates are manufactured by spraying, the proper functioning of the equipment for application of resin and glass fibre shall be identified as well as the operator's capability.

7.2.4 The moulds used during manufacture shall be of appropriate material, properly stiffened as to maintain the prescribed shape and line. Used materials shall not affect the resin system.

7.2.5 The mould surface shall enable the manufacture of a product, the surface of which meets the assumed purpose.

7.2.6 Mould shape and mould handling shall enable free access and undisturbed operation throughout the area.

7.2.7 Prior to commencement of the manufacture of glass reinforced plastics product, the moulds shall be cleaned, dried and conditioned to the room temperature. The release agent shall not affect the resin hardening process.

7.2.8 Gelcoat may be applied by brush, roller or by spraying, as to obtain uniform film of 0,4 to 0,8 mm in thickness.

7.2.9 After curing period, the gelcoat shall not be left free longer than necessary but in no case overnight.

7.2.10 Light glass mat (not exceeding 300 gr/m²), shall be applied as the first laminate layer close to gelcoat, with ratio resin-glass of at least 2,5:1.

7.2.11 The laminate shall be manufactured as to apply particular reinforcement layers according to the approved scheme and in proper direction. Each individual layer shall be properly impregnated as to obtain required glass content.

7.2.12 In composite laminates, attention shall be paid to alternate application of mat and woven roving as to reach required interlaminar shear strength.

7.2.13 Material quantity to be applied at once (number of laminate layers) shall be such as to prevent excessive production of heat.

7.2.14 Lamination process may be continued in a way that a glass mat layer shall be applied to the cured resin area.

7.2.15 Reinforcement joints shall be performed by overlapping, whereas the overlaps shall be arranged throughout the laminate area.

7.2.16 Changes of laminate thickness shall be gradual and not less than 25 mm per 600 gr/m².

7.2.17 After completed manufacture, the laminate shall be left in mould for a sufficient period of time as to achieve curing of resin, but not less than 12 hours or in accordance with the recommendation of resin manufacturer.

7.2.18 After being taken off the mould, the manufactured items shall not be exposed to open space before required hardness is reached (Barcol).

7.2.19 Artificial curing may be applied at the earliest 24 hours after the manufacture.

7.3 CONDITIONS OF MANUFACTURE

7.3.1 Workshop for the manufacture of glass fibre reinforced plastic laminates shall be equipped as to maintain the temperature of at least 16°C and not exceeding 28°C, throughout the curing time.

7.3.2 The workshop relative humidity shall be less than 70%.

7.3.3 The workshop conditions shall be followed and recorded by applying adequate equipment.

7.3.4 Working spaces shall be clean, without dust and free of direct sunlight effect.

7.3.5 Forced ventilation shall not cause increased evaporation of monomer from the resin.

7.3.6 The resins shall be stored in dry, good ventilated rooms with temperatures not exceeding 25°C, and not below 0°C.

7.3.7 When the resin temperature in the store falls below 16°C prior to commencement of the manufacture, the resin shall be conditioned at the room temperature.

7.3.8 Catalyst and accelerator shall be stored separately in accordance with the manufacturer/s recommendation.

7.3.9 Glass fibre reinforcements shall be stored in dry place, free of dust. Where the storage temperature is below 16°C, the glass fibre reinforcement shall be conditioned at the room temperature, prior to operation.

7.3.10 The application procedure as well as handling with materials shall not cause their damage or contamination.

7.3.11 Materials whose validity has expired shall not be used without special approval.

7.4 PROPERTIES

7.4.1 Glass fibre reinforced laminates with glass content of 30% by weight shall reach at least the following values of mechanical properties:

- tensile strength 85,0 N/mm² in accordance with HR EN ISO 527-4,
- tensile modulus of elasticity 6500 N/mm² in accordance with HR EN ISO 527-4,
- flexural strength 150,0 N/mm in accordance with HR EN ISO 14125,
- flexural modulus of elasticity 5500 N/mm² in accordance with HR EN ISO 527-4,
- pressure strength 115,0 N/mm² in accordance with HR EN ISO 14126,
- pressure modulus of elasticity 6000 N/mm² in accordance with HR EN ISO 14126,
- interlaminar shear strength 17,0 N/mm² in accordance with EN ISO 14130.

7.4.2 Nominal thickness of laminate for reinforcement weighing 300 gr/m² is 0,7 mm for glass mat and 0,5 mm for woven roving.

7.4.3 Maximum permissible glass content in laminate by weight for particular type of reinforcement shall not exceed the following values (ISO 1172):

- glass mat or chopped roving 35%,
- woven roving (fabrics) 50%,
- one-direction fibre 54%.

7.4.4 Average total glass content in the cured laminate shall neither be less than 27% nor shall exceed 45% (by weigh).

7.4.5 The glass reinforced plastics products, as regards their purpose, shall;

- .1 have prescribed fireproof degree (as required),
- .2 be resistant to fresh and sea water, oil and oil products and other aggressive agents (as required),
- .3 meet the hygienic and sanitary requirements (as required),
- .4 meet the requirements of the environmental protection (as required),
- .5 be resistant to rot and fungi effect and shall not adversely affect the adjoining materials.

7.5 SAMPLING AND TESTING

7.5.1 Tests for the type approval of products shall be carried out on test pieces cut from a product or laminate manufactured from the same material and under the same conditions like the product.

7.5.2 The test plate shall kept at the room temperature for at least 24 hours and then subjected to the artificial post-curing at the temperature of 40°C for next 16 hours.

7.5.3 All tests shall be carried out in accordance with the national or international standards, agreed with the Register when approving the type test program.

7.5.4 In serial production the mechanical properties shall be tested at least once a year. Alternatively, the properties shall be tested at every new production.

7.5.5 The Register may require determination of humidity effect to the glass reinforced plastics by 3-hours cooking of test piece in fresh water, in order to examine the quality of finished laminates.

7.5.6 When making this test, the test piece edges, if protected on finished products, may be coated with resin.

7.5.7 In case satisfactory results are not achieved, the following requirements shall be met:

7.5.7.1 Where tests of one or two specimens fail to give satisfactory results, retest shall be carried out with double number of specimens.

7.5.7.2 Where tests of three or more specimens fail to give satisfactory results, the register may require the tests to be performed with specimens cut directly from product.

7.5.8 Where retest fail to give satisfactory results with at least one specimen, the product shall be rejected.

7.6 INSPECTION

7.6.1 Glass fibre reinforced plastic products shall be free from delamination, voids, inclusions or other defects, that may adversely affect their purpose.

7.6.2 Where a doubt arises that appearance of internal defects occurred, the *Register* may require the products to be subjected to one of destructive or non-destructive test method.

Table 7.1
Resin properties under delivery condition (liquid)

Property	Standard	Requirements		
		Grade 1	Grade 2	Grade 3
* Density	ISO 1675	The manufacture nominal value		
* Viscosity	ISO 2555	The manufacture nominal value ±20%		
* Acid number	ISO 2114	The manufacture nominal value ±10%		
* Solvent content (monomer)	ISO/DIS 7028-2 Br. 1.4.10	The manufacture nominal value ±5%		
Mineral content	DIN 16945 No.: 1.4.10	Maximum 5%	Maximum 5%	The manufacture nominal value +5%
* Gel time	ISO 2535	Production nominal value ±20%		
Reactivity		The manufacture nominal value		
Linear shrinkage	ASTM D 2566	The manufacture nominal value		
Colour		The manufacture nominal value		
Stability non-catalysed in dark	-	At least 3 months		

Table 7.2
Requirements for cured resins

Property	Standard	Requirements		
		Grade 1	Grade 2	Grade 3
Density		The manufacture nominal value		
Hardness (Barcol)	EN 59	Minimum 35	Minimum 35	Minimum 35
Thermal stability	ISO 75-2	Minimum 75°C	Minimum 62°C	Minimum 62°C
Water absorption	ISO 62	Maximum 80 mg/ sample	Maximum 100 mg/ sample	Maximum 100 mg/ sample
Tensile strength	ISO 527	Minimum 50 N/mm ²	Minimum 45 N/mm ²	Minimum 45 N/mm ²
Modulus of elasticity	ISO 527	Minimum 3500 N/mm ²	Minimum 3000 N/mm ²	Minimum 3000 N/mm ²
Breaking elongation	ISO 527	Minimum 2,0%	Minimum 1,5%	Minimum 1,5%
Oxygen index	ASTM D 2863			Minimum 23
Flame spread speed	FTP Code Part 5			Self- extinguishing
Ageing (artificial, 24 weeks)		Mechanical properties shall not be reduced for more than 20%		

7.7 MARKING

7.7.1 After satisfactorily performed tests, the products shall be marked with an indication, comprising:

- name of manufacturer,

- mark or kind of product,
- date of manufacture,
- the *Register* mark.

7.8 POLYESTER RESINS

7.8.1 General

7.8.1.1 Resin manufacturers intended for the manufacture of glass fibre reinforced plastic products shall be approved for that production and resins shall be type approved.

7.8.1.2 Resins shall have appropriate soaking reinforcement properties and shall be adequately cured at normal temperatures conditions.

7.8.2 Classification of Unsaturated Polyester Resins

7.8.2.1 Polyester resins shall be classified in one of three quality grades:

Grade 1 Resins with high water resistance,

Grade 2 Resins with normal water resistance,

Grade 3 Resins with special fire resistance properties.

7.8.2.2 Resins for special purposes and other technologies shall be specially considered by the *Register* in each particular case.

7.8.3 Properties of Polyester Resins

7.8.3.1 Properties of polyester resins which are to be type tested, shall meet the requirements specified in Table 7.1 and Table 7.2.

7.8.3.2 Properties marked with asterisk shall be tested at every delivery. Mechanical properties of laminates shall be tested with properly manufactured laminates under normal operating conditions as well as under extreme temperature conditions, i.e. from -35°C to + 65°C.

7.8.3.3 All tests may be carried out in accordance with agreed international and national standards.

7.8.4 Gelcoat and Topcoat

7.8.4.1 Gelcoat and topcoat shall be manufactured from the polyester resins, meeting the requirements referred to in Table 7.2.

7.8.4.2 Gelcoat and topcoat shall meet the requirements referred to in Table 7.3 and Table 7.4.

Table 7.3
Gelcoat and topcoat properties under delivery condition

Property	Standard	Requirements		
		Grade 1	Grade 2	Grade 3
* Density	ISO 1675	The manufacture nominal value		
* Viscosity	ISO 2555	The manufacture nominal value		
* Acid number	ISO 2114	The manufacture nominal value		
* Solvent content (monomer)	ISO/DIS 17028-2	The manufacture nominal value 5%		
Pigment and filler content	DIN 16995 Br. 1.4.1	Maximum 10%	Maximum 10%	Maximum 10%
Thixotropic index	-	The manufacture nominal value		
* Gel time	ISO 2535	The manufacture nominal value ±20%		
Stability non-catalysed in dark	-	At least 3 months		
Covering capacity	-	Maximum 500 ppm		

Properties marked with asterisk shall be tested at each delivery.

Table 7.4
Gelcoat and topcoat properties in cured condition

Property	Standard	Requirements		
		Grade 1	Grade 2	Grade 3
Density	ISO 1675	The manufacture nominal value		
Hardness (Barcol)	EN 59	Minimum 40		
Tensile strength	ISO 527	Minimum 50 N/mm ²		
Modulus of elasticity	ISO 527	Minimum 2,5		
Fracture elongation	ISO 527	Minimum 2,5%		
Water absorption	ISO 62	Minimum 80 mg/sample		
Ageing (artificial, 24 weeks)		There shall be neither visible cracks nor washings of material and major colour changes.		

7.8.4.3 Gelcoat and topcoat intended for products with special fire resistant properties shall be tested to flame spread.

7.8.4.4 All properties shall be determined in accordance with agreed international or national standards.

7.8.5 Inspection, Delivery and Marking

7.8.5.1 For every batch of products, the manufacturer shall control the properties marked with * in table 7.1 and Table 7.3 and shall file obtained data, available at periodical examination, conducted at least twice a year.

7.8.5.2 Every delivered batch amount shall be marked as follows:

- mark of the manufacturer,
- mark of product,
- number of batch,
- date of manufacture,
- the *Register* mark.

7.9 GLASS REINFORCEMENT

7.9.1 Glass reinforcement manufacturers shall be approved for such manufacture and particular types of products shall be type approved.

7.9.2 Glass reinforcements which may be applied for manufacture of glass reinforced plastic products shall be appropriate for hand lay-up and spray-up application, without additional pressure or temperature, exceeding room temperature.

7.9.3 Glass products (roving, mat, woven roving and composites) shall be made of E-glass, where sum of Na₂O and K₂O contents is less than 1%. Alternatively, chemical composition of glass shall be within limits: SiO₂ 56%, CaO 16-25%, Al₂O₃ 12-16%, B₂O₃ 6-12%, Na₂O+K₂O 0-1% and MgO 0-6%.

7.9.4 Glass fibres shall be processed with agents based on silan or complex chromium compounds.

7.9.5 Glass fibres shall be manufactured as continuous fibres and their properties shall be determined by testing products made of them.

7.9.6 The type approval shall determine the following basic properties, where applicable:

- type of reinforcement,
- type of fibre for each particular direction,
- number of tex,
- treatment of fibres,
- number of strands,
- width of manufactured reinforcement,
- weight per unit area,
- weight per linear meter,
- compatibility (appropriate for polyesters, epoxid, etc.),
- structural scheme,
- type of weave,
- type and composition of binder.

7.9.7 Control of mechanical properties shall be performed on the laminate samples, which are manufactured from:

- approved type of resin,
- at least three layers of reinforcement to get thickness of at least 4 mm.

7.9.8 Weights of resins and reinforcements shall be recorded, as well as obtained laminate thickness.

7.9.9 The following weight ratios glass/resin shall be applied for individual glass reinforcements:

Type of reinforcement	Glass ratio in laminate
directed fibre	0,6
mat	0,3
woven roving	0,5
woven cloth	0,5
composite roving	0,45
chopped roving	0,33
multi-axis weave roving	0,5

7.9.10 The roving provided for processing by winding shall be tested as directed fibre.

7.9.11 The following tests shall be carried out on finished products:

- Tensile strength at break,
- Tensile modulus,
- Breaking elongation,
- Compression strength at break,
- Breaking bend strength,
- Inter-layer shear strength,
- Glass content (weight percentage and volume ratio),
- Water absorption.

7.9.12 Mechanical properties shall be examined under normal dry conditions and in directions according to Table 7.5.

Table 7.5

Type of reinforcement	Direction of samples testing
directed fibres	0°
mat and chopped roving	any direction
woven roving, woven cloth composite roving	0° and 90°
multi-axis weave roving	0°, 45°, 90° and -45°

7.9.13 In addition the properties in one direction shall be tested after exposure of laminates in fresh water for a period of 28 days, at the temperature of 35°C.

7.9.14 All tests shall be carried out in accordance with agreed international or national standards.

8 RUBBERIZED OR PLASTICIZED TEXTILES (TEXTILES WITH POLYMERIC COATINGS)

8.1 GENERAL REQUIREMENTS

8.1.1 This Section prescribes general requirements for rubberised or elasticised textiles (textiles with polymeric coatings).

8.1.2 Manufacturers of rubberised or elasticised textiles used for the manufacture of life-saving appliances, inflatable boats and other products, manufactured under supervision of the *Register*, shall be approved for the production in question and particular types of products shall be type approved.

8.1.3 Produced rubberised or elasticised textiles shall meet the approved specification comprising:

- details of basic textile (fibre material, type and structure, physical properties,
- details of plastification (rubberisation) process, type of covering material, structure, covering material weight, finished textile weight, physical properties and quality.

8.1.4 Basic textile shall be resistant to rotting.

8.1.5 Covering material shall be of natural or synthetic rubber or other polymeric material, which meets the prescribed requirements.

8.1.6 Adhesives used in the manufacturing process of rubberised or plasticised textiles shall be approved by the *Register* accordingly.

Table 8.1

Property	Requirements	
	Main buoyancy tubes, floor, tubes, supports for canopies, seats	Outer canopy
Tensile strength	Minimum 2kN/5cm by width	Minimum 2kN/5cm by width
Elongation	Maximum 35%	-
Tear strength	Minimum 40 N, or for main buoyancy tubes supports for canopy at least 800 N in warp and weft direction For floor: minimum 700 N in warp and weft direction.	Minimum 10 N, or Minimum 450 N in warp and weft direction
Ageing resistance	No signs of tackiness, cracks or other damages shall be visible. Tensile strength shall be at least 90% of the strength before ageing.	
	Difference in dimensions before and after ageing shall not exceed 2%.	-
Joint strength	No cracks shall be visible where joints are exposed to tension.	
Oil resistance	No permanent tackiness or any other damage shall be visible.	
Coldness resistance	No permanent cracks or any other damage shall be visible.	
Coating adhesion	Minimum 10 N/1 cm by width	Minimum 5 N/1 cm by width
Folding resistance	Separation of basic textile and covering material shall not appear.	-
	Tensile strength after folding shall not be less than 90% of strength before folding, or	-
	No cracking or other damage shall appear after 200.000 cycles.	-
Watertightness (hydraulic test)	-	No cracks, leakage or any other damage shall appear.
Test for porosity	Less than 3l/m ² /24 using hydrogen or, No air bubbles shall appear after 5 min.	-
		-
Ozone resistance	No cracks shall appear	
Wear resistance	Basic textile shall not be visible after 1000 cycles.	
Sea water resistance	No separation of piles (peeling) or colour changes shall appear, and during tensile test no cracks shall appear at joints.	
Weight of unit area	Manufacturer's specification	
Thickness	Manufacturer's specification	
Dimensions	Manufacturer's specification	

8.2 FABRICS FOR THE MANUFACTURE OF LIFERAFTS AND INFLATABLE BOATS

8.2.1 General Requirements

8.2.1.1 Fabrics used for the manufacture of main buoyancy tubes, tubes, floor, supports for canopies, seats and outer canopies, shall, in addition to general requirements, meet the requirements referred to in table 8.1.

8.2.2 Sampling, Conditions, Scope and Frequency of Tests

8.2.2.1 The required number of test specimens shall be taken from a roll of fabric at appropriate distance from the edges in warp and weft direction.

8.2.2.2 The roll from which the specimens are taken shall be made (vulcanised) at least 24 hours and mostly three months before taking specimens.

8.2.2.3 Prior to tests, the specimens shall be maintained under standard conditions at least for 16 hours.

8.2.2.4 Unless otherwise specified, the test conditions shall be: $20^{\circ}\text{C} \pm 2^{\circ}\text{C}$, and relative humidity ($65 \pm 5\%$). Test conditions shall be stated in the Test report.

8.2.2.5 All tests specified in table 8.1 shall be performed during type approval. The *Register* may require other tests to be carried out other than those referred to in Table 8.1.

8.2.2.6 Tensile strength, elongation, tear strength, weight of unit area and dimensions shall be performed during delivery of particular batches.

8.2.2.7 All tests shall be carried out in accordance with national or international standards agreed with the *Register* at the approval of type test program.

8.2.3 Tests

8.2.3.1 Tensile Strength and Elongation

- .1 Tensile strength shall be determined with five test specimens in warp and weft direction.
- .2 The specimens shall be 50 mm in width and shall have length as to ensure spacing between grips of 200 mm. The test shall be carried out at the speed of $100 \text{ mm/min} \pm 10 \text{ mm/min}$.
- .3 Prior to commencement of tensile test the specimens in the testing machine shall be subjected to load of:
 - a) 2N for fabrics weighing $< 200 \text{ g/m}^2$,
 - b) 5N for fabrics weighing over 200 g/m^2 to 500 g/m^2 ,
 - c) 10 N for fabrics weighing over 500 g/m^2 .

- .4 The test shall be carried out in accordance with ISO 1421:1977.

8.2.3.2 Tear Strength

- .1 Tear strength shall be determined according to one of two alternative methods: ISO 4674:1977 or ISO 1421:1977 at the speed up to $70 \text{ mm/min} \pm 10 \text{ mm/min}$.
- .2 Test shall be carried out with specimens taken from both warp and weft direction.

8.2.3.3 Ageing Resistance

- .1 Ageing test includes dimension test, folding test and tensile strength test.
- .2 Dimension test and folding test shall be carried out with four square specimens, with dimensions of at least $100 \text{ mm} \times 100 \text{ mm}$.
- .3 For tensile strength test six specimens shall be taken in warp and weft direction, three of which shall be placed in the oven at temperature of $70^{\circ}\text{C} \pm 1^{\circ}\text{C}$ and three shall be placed above water in a closed vessel at temperature of $70^{\circ}\text{C} \pm 1^{\circ}\text{C}$. Test specimens shall be kept under specified conditions for 336 hours.
- .4 After the period of exposure any change of dimensions shall be tested and after performed folding the specimens shall be tested for possible cracks, separation of piles, tackiness or brittleness.
- .5 Tensile strength shall be tested in accordance with 8.2.3.1.

8.2.3.4 Joining Strength

- .1 Joining strength shall be tested with five specimens in warp and weft direction. Test specimens with 50 mm in width and 300 mm in length shall be mutually joined with an overlap of 25 mm.
- .2 Joining strength shall be determined in the pull direction. The test shall be carried out under normal conditions and after the specimen is exposed in the oven at temperature of $70^{\circ}\text{C} \pm 1^{\circ}\text{C}$ for 336 hours.

8.2.3.5 Oil Resistance Test

- .1 The oil resistance test shall reveal any signs of tackiness or surface softening. The test shall be carried out by depositing a surface of round specimen of at least 70 mm in diameter at the temperature of $20^{\circ}\text{C} \pm 2^{\circ}\text{C}$ to the test mixture (oil No. 1 ISO 1817:1985). The test shall be carried out by means of the apparatus shown in Figure 8.1.

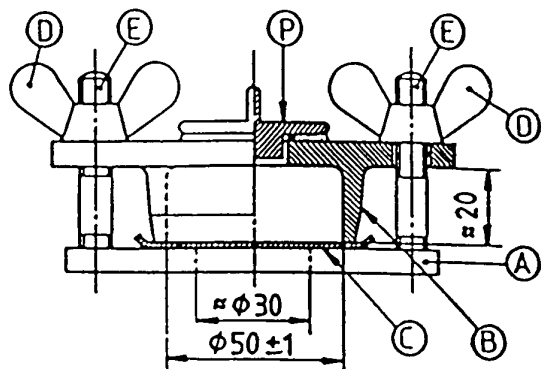


Figure 8.1

Dimensions are given in mm

- A basic plate
- B open cylindrical chamber
- C specimen
- D wing screw
- E tightening screw
- P cover

8.2.3.6 Low Temperature Resistance

- .1 Low temperature resistance shall be determined by exposing test specimens to the temperature of $-30^{\circ}\text{C} \pm 5^{\circ}\text{C}$ for 1 hour. Fabrics for manufacture of main buoyancy chambers shall be tested additionally after exposure to temperature of $-60^{\circ}\text{C} \pm 5^{\circ}\text{C}$ for 20 min. The test shall be carried out in accordance with ISO 4675:1990.

8.2.3.7 Coating Adhesion

- .1 This test shall be carried out in accordance with ISO 2411:1991 at a speed of 100 mm/min.

8.2.3.8 Folding Resistance

- .1 Fabrics resistance to frequent folding shall be tested either by Scott method (after 500 cycles) or by De Mattia method (after 200.000 cycles). The test shall be carried out with test specimens in warp and weft direction.

8.2.3.9 Waterproofness Test

- .1 Fabrics for the manufacture of outer canopy shall be tested for waterproofness. A test specimen with dimensions of 200 mm x 200 mm shall be subjected to hydraulic test at 0,02 MPa for 3 min. After the test no leakage or any other damage shall occur.

8.2.3.10 Air Tightness Test

- .1 Air tightness shall be tested either by low pressure method, i.e. measuring hydrogen content passing through fabric surface of 1 m^2 for 24 hours or by high pressure

method, assessing folding effect to the fabrics permeability, expressed by number of produced air bubbles for 5 min.

8.2.3.11 Ozone Resistance

- .1 Ozone resistance shall be tested in accordance with ISO 3011:1991 with three specimens for 1 hour, at the temperature of $30^{\circ}\text{C} \pm 2^{\circ}\text{C}$ and ozone concentration $50 \text{ ppm} \pm 5 \text{ ppm}$.

8.2.3.12 Sea Water Resistance

- .1 A specimen with dimensions of 300 mm x 300 mm joined in the middle shall be immersed 500 mm under water level (artificial sea water) and shall be kept for four hours at the temperature of $40^{\circ}\text{C} \pm 1^{\circ}\text{C}$.

8.2.3.13 Weight of Unit Area

- .1 Weight of unit area shall be determined in accordance with ISO 2286 : 1986.

8.2.4 Marking

8.2.4.1 Tested rubberised or elasticised fabrics shall be marked as follows:

- Manufacturer's mark,
- Type of fabrics,
- Date of manufacture,
- Weight of unit area,
- Register mark.

8.3 RUBBERIZED OR PLASTICIZED FABRICS FOR OTHER PURPOSES

8.3.1 The rubberised or plasticised fabrics for the manufacture of products other than referred to in 8.2 shall meet the requirements related to type and conditions of such products.

8.3.2 The Register may require the tests of other properties fabrics as to its purpose,

8.3.3 Program and scope of test shall be determined during type test approval.

9 INSULATING MATERIAL

9.1 GENERAL REQUIREMENTS

9.1.1 This Section specifies the requirements for material for sound and thermal insulation for fire divisions and for other applications, referred to in the *Rules, Part 17 – Fire Protection*.

9.2 REQUIREMENTS, MATERIALS AND MANUFACTURE

9.2.1 The manufacturer and manufacturing process shall be approved by the *Register* and special types of product shall be type approved.

9.2.2 For the approval of manufacturers and type approval of particular products, the manufacturer shall submit the following data to the *Register*:

- description of manufacture,
- specification of product (including type of material, additives, density, ageing resistance, moisture and vapours resistance, fire resistance),
- description of the quality control system,
- test results regarding methods, standards, etc.,
- application,
- limit conditions of application,
- procedure of joining and installation,
- marking of products,
- possible past practice.

9.2.3 Insulating materials, other than those applied in cargo holds and refrigerated spaces shall be incombustible, i.e. shall meet the requirements of FTP Code, Part 1.

9.2.4 Possible covering layer together with applied adhesives shall be moisture vapour resistant and shall meet the requirements of FTP Code, Part 2 and Part 5.

9.2.5 Test of incombustible properties (FTO Code, Part 1) shall be performed once in two years.

9.2.6 Manufacture and quality control system shall be surveyed for the purpose of approval of manufacturers.

9.3 TESTS

9.3.1 On the basis of submitted data, the agreed type test program shall be carried for control of specified properties and for compliance with special requirements, as regards type of material and anticipated application.

9.3.2 Scope and procedures of tests shall be defined in accordance with type and purpose of material.

9.3.3 Tests may be performed either in a testing institution approved by the *Register* or in a laboratory of the manufacturer, witnessed by the *Register* surveyor.

9.3.4 During manufacturing process of insulating materials, all tests and checks, identified in approved technical

documentation, shall be carried out and relevant records shall be filed.

9.4 THE REGISTER CERTIFICATES

9.4.1 Upon approval of submitted report (three copies) and successfully performed supervision over production and quality control system, the *Register* shall issue to the manufacturer the Certificate on Approval of Manufacturer and shall enlist the same in the *Register* of Type Approved Products and Approved Manufacturers, Testing Institutions and Service Stations.

9.4.2 After successfully performed type approval program, the *Register* shall issue to the manufacturer the Certificate on Type Approval and shall enlist the approved type of product in the *Register* of Type Approved Products, and Approved Manufacturers, Testing Institutions and Service Stations.

9.4.3 For each produced quantity of insulating material, upon completion of tests and checks the *Register* shall issue a special Certificate for Insulation.

9.5 MARKING

9.5.1 The manufacturer shall mark insulating materials in the manner specified in the Certificate on Type Approval.

10 PIPES AND PIPE CONNECTIONS (FITTINGS) OF POLYMERIC MATERIALS

10.1 GENERAL REQUIREMENTS

10.1.1 This Section applies to the pipes and pipe connections (fittings) made of polymeric materials with or without reinforcement (glass reinforced plastic-GRP, polyvinyl chloride-PVC, polyethylene-PE, polyethylene-PP and acrylonitril butadiene - ABS), intended for shipbuilding, as specified in the *Rules, Part 8 – Piping, 1.7*.

10.2 REQUIREMENTS, MATERIALS AND MANUFACTURE

10.2.1 The manufacturer, manufacturing process, assembling and installation shall be approved by the *Register* and special product types shall be type approved.

10.2.2 Personnel engaged in installation and assembling of pipes and pipe connections (fittings) shall be adequately trained.

10.2.3 The manufacturer of pipes shall provide the personnel engaged for assembling and installing of pipes and pipe connections on board, with adequate individual certificate, including:

- name of holder,
- qualification certificate,
- description of production process,
- date of issue and validity term,
- seal and signature of the authorised person.

10.2.4 Pipes and pipe connections of polymeric materials shall meet the requirements of IMO Resolution A.753(18) and FTP Code part 2 and Part 5.

10.2.5 All basic materials shall be of approved type and their individual application shall be approved.

10.2.6 Charge test of basic material specifications shall be conducted by incoming control of pipe manufacturers and relevant files shall be recorded.

10.2.7 Specifications of fittings shall be verified by a pressure test, in a way that connected pipes shall be subjected to a hydrostatic test pressure equal to the pressure 5 times the nominal pressure, for 5 min.

10.2.8 For approval of manufacturers and type approval of special products, the manufacturers shall submit to the *Register* the following data:

- description of production process,
- specification of product,
- nominal working pressures (outer and inner),
- temperature limit of application,
- dimension and permissible deviations,
- specification of basic materials (with identified properties),
- description of quality control system,

- test results regarding methods, standards etc.,
- application,
- limit conditions of application,
- assembling and installing procedure,
- personnel training procedure for assembling and installing,
- marking of products, and
- methods of former application.

10.2.9 Manufacture and quality control system shall be surveyed for the purpose of the approval of manufacturer.

10.2.10 On the basis of submitted data the agreed type test program shall be carried for checking specified properties and meeting special requirements as regards type of material and prescribed application.

10.3 TESTING

10.3.1 Type Test

10.3.1.1 The following properties shall be tested during type test:

- appearance and dimensions,
- hydraulic test (maximum working pressure and bursting pressure),
- temperature area of application, (high and low temperature),
- mechanical properties,
- ageing resistance,
- erosion resistance,
- medium resistance (absorption of medium and effect of medium),
- behaviour in fire and
- electric conductivity.

10.3.1.2 Tests may be performed either in a testing institution approved by the *Register* or in a laboratory of the manufacturer witnessed by the *Register* surveyor.

10.3.2 Inspections and Tests during Manufacture

10.3.2.1 During manufacture of pipes, all inspections and tests prescribed by approved technical documentation shall be performed and relevant records shall be filed.

10.3.2.2 The following shall be tested separately, on finished products (every pipe), namely:

- appearance,
- dimensions,
- hydrostatic test and
- electric resistance.

10.4 THE REGISTER CERTIFICATES

10.4.1 Upon approval of submitted report (three copies) and successfully performed supervision over production and quality control system, the *Register* shall issue to the manufacturer the Certificate on Approval of Manufacturers and shall enlist the same in the *Register* of Type Approved

Products and Approved Manufacturers, Testing Institutions and Service Stations.

10.4.2 After successfully performed type test program, the Register shall issue to the manufacturer the certificate on Type Approval and approved type of product shall be recorded in the *Register* of Type Approved Products and Approved Manufacturers, Test Institutions and Service Stations.

10.4.3 For every produced quantity of pipes and pipe connections, after completion of tests and checks the *Register* shall issue a special Certificate for pipes of polymeric materials.

10.5 MARKING

10.5.1 The manufacturer shall mark the pipes and pipe connections of polymeric materials in the manner specified in the Certificate on Type Approval.

11 FLEXIBLE HOSES AND PIPES

11.1 GENERAL REQUIREMENTS

11.1.1 This Section prescribes the general requirements for flexible hoses and pipes, made of rubber with or without reinforcement (metallic braid), intended for the application in shipbuilding, as specified in the IACS UR P 2.12 (Rules, Part 8 – Piping, 1.3.8; 1.11).

11.1.2 Working age of the rubber hose shall be mostly 5 years.

11.1.3 Scope of application, design, construction and installation are specified in the Rules, Part 8 – Piping, 1.3.8.

11.1.4 Testing and marking are prescribed in the Rules, Part 8 – Piping, 1.11.

11.2 APPROVAL OF HOSE MANUFACTURER

11.2.1 The manufacturer and production process of the flexible hose shall be approved by the Register and special hose types shall be type approved as well.

11.2.2 The manufacturer of flexible hoses fitted with connections, intended for the application in the services specified in the special Parts of the Rules, shall be approved for such production (manufacture) and special pipe types shall be type approved as well.

11.2.3 For the approval of manufacturer and type approval of hoses, the manufacturer shall submit to the Register the following data:

- description of production process,
- description of quality control system,
- specification of product (description, construction, chemical composition and specification of properties),
- test results related to testing methods, standards, etc.,
- application,
- limit conditions of application,
- marking of products.

11.2.4 Manufacture and quality control system shall be surveyed for the purpose of the approval of manufacturer.

11.2.5 Flexible hose assemblies are to be selected for the intended location and application taking into consideration ambient conditions, compatibility with fluids under working pressure and temperature conditions consistent with the manufacturer's instructions and requirements of Rules, Part 8, Piping

11.3 THE REGISTER CERTIFICATES

11.3.1 After approval of the submitted documentation (in triplicates) and satisfactorily performed supervision during production and quality control system, the Register shall issue to the manufacturer the Certificate on approval of the manufacturers and shall enlist the same in the Register of the type approved products and approved manufacturers, testing institutions and service stations.

11.3.2 After satisfactorily executed type testing program, the Register shall issue to the manufacturer the Certificate on type approval and shall enlist the approved product type in the Register of the Type Approved Products and Manufacturers, Testing Institutions and Service Stations.

11.3.3 Upon completion of the performed testing and examinations, for every produced quantity, the Register shall issue a particular Certificate for flexible rubber pipes.

12 PLASTIC FOAMS

12.1 GENERAL REQUIREMENTS

12.1.1 This Section applies to rigid, semi-rigid and flexible plastic foams used in shipbuilding as materials for core of sandwich structure, buoyancy materials or thermal and sound insulating materials as well as for other special purposes.

12.1.2 Manufacturers of plastic foams shall be approved by the *Register* for such manufacture and special types shall be type approved accordingly.

12.1.3 For approval of manufacturers and type approval of special products, the manufacturers shall submit to the *Register* the following data:

- description of production process,
- description of quality control system,
- description, generic type and material property specification,
- list of procedures and property test results,
- scope and method of application.

12.2 PLASTIC FOAMS FOR MANUFACTURE OF CORES

12.2.1 Plastic foams used for the manufacture of sandwich structure cores, in addition to general requirements, shall meet the requirements specified in Table 12.1.

12.2.2 Plastic foams for manufacture of cores shall be classified in one of two quality grades.

12.2.3 Quality grade 1 shall be required for hull structures and quality grade 2 shall be required for less loaded structures.

Table 12.1

Property	Requirements	
	Grade 1	Grade 2
Tensile strength (N/mm ²)	Minimum 0,8 N/mm ²	Minimum 0,6 N/mm ²
Tensile modulus	Minimum 30 N/mm ²	Minimum 20 N/mm ²
Compression strength 23°C	Minimum 0,7 N/mm ²	Minimum 0,4 N/mm ²
Compression modulus at 28°C	Minimum 30 N/mm ²	
Compression strength at 48°C	Minimum 50% of value obtained at 23°C	
Shear strength	Minimum 0,3 N/mm ²	Minimum 0,2 N/mm ²
Shear modulus	Minimum 12 N/mm ²	Minimum 9 N/mm ²
Water absorption (7 days at 40°C in artificial sea water)	Maximum 1,5 kg/m ²	

Table 12.1 - continued

1	2	3
Water resistance (28 days at 40°C in artificial sea water)	Reduction of tensile strength and compression strength maximum	
	25%	30%
Density	Nominal value +15% - 0%	
Oxygen index	Identified value	
Resistance to styrene	No signs of damage (resistant)	

12.2.4 All necessary tests shall be carried out in accordance with national or international standards, in agreement with the *Register*, at the approval of type test program.

12.2.5 Properties referred to in Table 12.1 shall be tested during type approval of product and density and compression strength shall be tested at every delivery.

12.3.1 Buoyancy Plastic Foams

12.3.1.1 Buoyancy plastic foams shall be subjected to the tests referred to in 12.2 and specified in Table 12.1.

12.3.1.2 In addition to tests referred to in 12.2 for Grade 2 buoyancy plastic foams shall be subjected to tests required to determine:

- thermal material stability subjected to alternative effect of low and high temperatures (-30 °C and +65 °C: 10 cycles),
- resistance to high-octane gasoline (24 hours),
- water absorption – loss of buoyancy (7 days),
- buoyancy loss after exposure to oil (14 days).

12.3.1.3 After these tests, the samples shall be free from any signs of outside structural changes, damages or any changes of sample mechanical properties.

12.3.1.4 Buoyancy loss shall not exceed 5% of the initial buoyancy.

12.3.1.5 The tests shall be performed in accordance with IMO Resolution A689 (18).

12.4 INSULATING PLASTIC FOAMS

12.4.1 Plastic foams used for thermal insulation shall be subjected to the tests referred to in 12.1. Additional tests shall identify the following:

- heat conductivity,
- combustibility,
- flame spread characteristics (for pipe insulation).

12.4.2 The tests shall be performed in accordance with FTP Code and agreed standards.

12.5 MARKING

12.5.1 The products shall be marked as to ensure identification of materials and references with the Certificate of type approval.

13 ADHESIVES

13.1 This section prescribes the general requirements for adhesives used for connecting (joining) parts of construction or for manufacture of products intended for the application in shipbuilding.

13.2 Manufacturers of adhesives shall be approved by the *Register* and special types of adhesives shall be type approved.

13.3 For approval of manufacturers and type approval of particular products, the manufacturers shall submit to the register the following data:

- description of production process,
- description of quality control system,
- description, generic type and specification of product properties,
- list of procedures and test results of product properties,
- application, limit conditions and method of application.

13.4 On the basis of submitted data the type test program of a particular product shall be agreed and conducted. Type test program shall include examination of specified properties and compliance with special requirements of the *Register Rules*.

13.5 Scope and method of testing of particular adhesive shall be determined in accordance with type and application of relevant adhesive.

14 DECORATIVE FABRICS AND OTHER TEXTILE MATERIALS

14.1 GENERAL REQUIREMENTS

14.1.1 This Section prescribes general requirements for fabrics and other textile materials used for manufacture of products intended in shipbuilding.

14.1.2 Manufacturers of fabrics and other textile materials shall be approved by the *Register* and each individual product shall be type approved.

14.2 REQUIREMENTS, MATERIALS AND PRODUCTION

14.2.1 The requirements shall be applied to upholstery, bedding components, decorative fabrics, curtains and drapery.

14.2.2 When burning decorative fabrics shall not be produce larger quantities of toxic substances.

14.2.3 Curtains and similar vertically supported materials shall have low flame spread properties (FTP Code Part 7).

14.2.4 Drapery shall have low flame spread properties (FTP Code Part 5).

14.2.5 Upholstery lining shall meet the requirements of FTP Code Part 8.

14.2.6 Bedding components shall meet the requirements of FTP Code part 9.

14.2.7 For approval of manufacturers and type approval of special products, the manufacturers shall submit to the *Register* the following data:

- description of production process,
- description of quality control system,
- description, generic type and specification of product properties,
- list of procedures and test results of product properties,
- application, limit conditions and method of application.

14.2.8 On the basis of submitted data the test program of a particular product shall be agreed and carried out. Type test program shall include examination of specified properties and compliance with special requirements as to the assumed application.

14.2.9 Scope and procedures of testing of particular products shall be carried out in accordance with type and application of material.

15 FURNITURE

15.1 GENERAL REQUIREMENTS

15.1.1 This Section of the *Rules* prescribes the general requirements applied to furniture, either upholstered or non-upholstered, intended for the application inside ship's spaces.

15.2 REQUIREMENTS, MATERIALS AND PRODUCTION

15.2.1 The furniture manufacturers shall be approved for such manufacture and special types of products shall be type approved.

15.2.2 Structural part of the furniture shall be made of incombustible material (FTP Code Part 1).

15.2.3 Veneer applied during manufacture of the furniture shall meet the requirements of FTP Code Part 2 and Part 5.

15.2.4 Upholstering fabrics shall meet the requirements of Chapter 14.

15.2.5 Bedding components (sheets, covers, blankets, pillows and mattresses) shall meet the requirements of FTP Code Part 9.

15.2.6 For the approval of manufacturers and type approval of particular products, the manufacturers shall submit to the Register the following data:

- description of production process,
- description of quality control system,
- description, generic type and specification of product -properties,
- description of procedures and test results of product specification,
- application, limit conditions and method of application.

15.2.7 On the basis of submitted data, the type testing program for a particular product shall be agreed and carried out. The type testing program shall cover review of specified properties and their compliance with special requirements of the prescribed application.

15.2.8 Scope and method of testing of a particular material shall be determined in accordance with the type and application of the material.

16 PRODUCTS OF RUBBER AND ELASTOMERS

16.1 This Section of the *Rules* prescribes the general requirements for products made of rubber and elastomers, intended for ship's systems, subject to the supervision by the *Register*.

16.2 The manufacturers of the rubber and elastomers products shall be approved by the *Register* and special products shall be also type approved.

16.3 For the manufacture of the rubber and elastomers products, the rubber mixtures may be applied, which have been type approved and manufactured by the approved manufacturer.

16.4 For the approval of the manufacturer and type approval of particular product, the manufacturers shall submit to the *Register* the following data:

- description of the production process,
- description of the quality control system,
- description, generic type and specification of the product properties,
- list of the procedures and test results of the product properties,
- application, limit conditions and method of application.

16.5 On the basis of the submitted data, the type testing program of a particular product shall be agreed and carried out. The type testing program shall cover the review of the specified properties and their compliance with special requirements of the prescribed application.

16.6 Scope and method of testing (procedures) of a particular product type shall be determined in accordance with the type and application of the product.

17 DECK COVERINGS

17.1 GENERAL REQUIREMENTS

17.1.1 This Section prescribes general requirements for deck coverings on board ships.

17.2 REQUIREMENTS, MATERIALS AND PRODUCTION

17.2.1 Manufacturers of materials intended for deck coverings shall be approved by the *Register* and each particular material shall be type approved.

17.2.2 For approval of manufacturers and type approval of special products, the manufacturers shall submit to the *Register* the following data:

- description of production process,
- description of quality control system,
- description, generic type and specification of product properties,
- list of procedure and test results of product properties,
- application, limit conditions and method of application.

17.2.3 On the basis of submitted data the type test program of a particular product shall be agreed and carried out. Program of type testing shall include examination of specified properties and compliance with special requirements of the *Register Rules* (FTP Code Part 5 and Part 6).

17.2.4 Tests for type approval shall be carried out in accordance with agreed international or national standards.

17.3 MARKING

17.3.1 Products shall be marked as specified in the Certificate on type approval.

18 PRIMARY DECK COVERINGS

18.1 GENERAL REQUIREMENTS

18.1.1 This Section defines the general requirements for primary deck coverings which are fitted on steel decks during construction.

18.2 REQUIREMENTS, MATERIALS AND MANUFACTURE (PRODUCTION)

18.2.1 Manufacturers of primary deck covering materials shall be approved by the *Register* and special products shall be type approved as well.

18.2.2 Primary deck coverings shall neither be readily ignitable nor shall, at elevated temperatures, develop larger quantities of toxic and flammable gases.

18.2.3 For the approval of manufacturers and type approval of particular products, the manufacturers shall submit to the Register the following data:

- description of production process,
- description of quality control system,
- description, generic type and specification of product specification,
- list of procedures and test results of product specification,
- application, limit conditions and method of application,
- mode of application.

18.2.4 On the basis of submitted data, the type testing program shall be agreed and carried out. The type testing program shall cover the review of specified properties of the products and their compliance with special requirements of the prescribed application (FTP Code part 2 and Part 6).

18.2.5 Scope and method of testing of a particular product type shall be determined in accordance with the type and application of the product.

18.3 MARKING

18.3.1 The products shall be marked as prescribed by the Certificate on type approval.

19 DECORATIVE LININGS

19.1 GENERAL REQUIREMENTS

19.1.1 This Section applies to the decorative lining (decorative carpets, veneer, decorative laminates) intended for the ship's interiors, crew accommodation and other spaces.

19.2 REQUIREMENTS, MATERIALS AND PRODUCTION

19.2.1 The manufacturers of the materials for decorative linings shall be approved by the *Register* and special products shall be type approved.

19.2.2 As regards the fire, the decorative linings shall have the low flame spread properties and when burning shall not generate larger quantities of toxic substances.

19.2.3 For the approval of manufacturers and type approval of special products, the manufacturers shall submit to the Register the following data:

- description of production process,
- description of quality control system,
- description, generic type and specification of product properties,
- list of procedures and test results of product specification,
- application, limit conditions and method of application.

19.2.4 On the basis of submitted data, the type testing program of a particular product shall be agreed and carried out. The type testing program shall cover the review of specified properties of the products and their compliance with the special requirements of the SOLAS Convention and the *Register Rules* (FTP Code Part 2 and Part 5).

19.2.5 Testing for the type approval shall be carried out in accordance with the international and national standards.

19.3 MARKING

19.3.1 The products shall be marked as prescribed by the Certificate on type approval.

20 FLOOR COVERINGS

20.1 GENERAL REQUIREMENTS

20.1.1 This Section prescribes the general requirements for the floor coverings intended for the ship's interiors.

20.2 REQUIREMENTS, MATERIALS AND MANUFACTURE (PRODUCTION)

20.2.1 The manufacturers of floor coverings shall be approved by the *Register* and special products shall be type approved.

20.2.2 Every floor covering shall be of low flame spread type and when burning shall neither produce larger quantities of toxic substances nor smoke.

20.2.3 For the approval of manufacturers and type approval of special products, the manufacturers shall submit to the Register the following data:

- description of production process,
- description of quality control system,
- description, generic type and specification of product properties,
- list of procedures and test results of product properties,
- application, limit conditions and method of application.

20.2.4 On the basis of submitted data, the type testing program of a particular product shall be agreed and carried out. The type testing program shall cover the review of specified properties of the products and their compliance with the special requirements of the SOLAS Convention and the *Register Rules* (FTP Code Part 2 and Part 5).

20.2.5 Testing for the type approval shall be carried out in accordance with agreed international and national standards.

20.3 MARKING

20.3.1 The products shall be marked as prescribed by the Certificate on type approval.

21 LUMINESCENT MATERIALS AND GRAPHICAL SYMBOLS

21.1 GENERAL REQUIREMENTS

21.1.1 This Section prescribes the general requirements for the luminescent materials and graphical symbols, made of retro-reflecting or photoluminescent material intended for equipping of ships and for the equipment to be installed on board ships.

21.2 REQUIREMENTS, MATERIALS AND PRODUCTION

21.2.1 The manufacturers of materials (retro-reflecting and photoluminescent) shall be approved for such production and special materials shall be type approved.

21.2.2 The manufacturers of graphical symbols (fabricators) shall be approved for such production and special products shall be type approved.

21.2.3 Type approval of graphical symbols shall be applied only on the type approved materials for manufacture of symbols.

21.2.4 Retro-reflecting graphical symbols shall meet the requirements of IMO resolution MSC47(66) and IMO Resolution A.658(16).

21.2.5 Photoluminescent materials shall meet the requirements of IMO Resolution A.752(18).

21.2.6 Graphical symbols made of luminescent materials shall meet the requirements of IMO Resolution A.654(16), IMO Resolution A.658(16) and IMO Resolution A.752(18) and ISO 3864, as regards their purpose.

21.2.7 For the approval of manufacturers and type approval of products, the manufacturer shall submit to the *Register* the following data:

- description of production process,
- description of quality control system,
- product specification,
- test results as regards the standards and specification,
- scope of application,
- limit conditions,
- marking of products.

21.2.8 For the approval of manufacturers, the production and quality control system are subject to the survey.

21.2.9 On the basis of submitted data, the type testing program of a particular product shall be agreed and carried out. The type testing program shall cover the review of specified properties and their compliance with the special requirements of the SOLAS Convention and the *Register Rules*.

21.2.10 The testing for the type approval shall be carried out in a testing institution approved by the *Register* or in a manufacturer's laboratory witnessed by the surveyor to the *Register*.

21.3 MARKING

21.3.1 The products shall be marked as prescribed by the Certificate on type approval.

22 FIRE-FIGHTING FOAM CONCENTRATES

22.1 GENERAL REQUIREMENTS

22.1.1 This Section prescribes the general requirements for the fire-fighting foam concentrates intended for the ships.

22.1.2 Foam concentrates which are fitted on fire-fighting equipment and systems shall be subject to the first examination within a period of mostly 3 years from the date of their manufacture and subsequently every year.

22.2 REQUIREMENTS, MATERIALS AND PRODUCTION

22.2.1 The manufacturer of fire-fighting foam concentrates shall be approved by the *Register* and special product (foam concentrates) shall be type approved.

22.2.2 Fire-fighting foam concentrates shall fully meet the requirements of ISO 7203 as regards the expansion ratio.

22.2.3 For the approval of manufacturers and type approval of products, the manufacturer shall submit to the *Register* the following data:

- description of production process,
- description of quality control system,
- product specification,
- test results as regards the standards and specification,
- scope of application,
- limit conditions,
- marking of products.

22.2.4 For the approval of manufacturers, the production (manufacture) and quality control system shall be subject to the survey.

22.2.5 On the basis of submitted data the type testing program of particular product shall be agreed and carried out. The type testing program shall cover the review of specified properties of the products and their compliance with the special requirements of the SOLAS Convention and the *Register Rules*.

22.2.6 The testing for the type approval shall be carried out in a testing institution approved by the *Register* or in a manufacturer's laboratory witnessed by the surveyor to the *Register*.

22.3 MARKING

22.3.1 The products shall be marked as prescribed by the Certificate on type approval.