RUSSIAN MARITIME REGISTER OF SHIPPING

Internal refrences are marked in blue

Notice

RULES

FOR TECHNICAL SUPERVISION DURING CONSTRUCTION OF SHIPS AND MANUFACTURE OF MATERIALS AND PRODUCTS FOR SHIPS

Volume 2

Part III
TECHNICAL SUPERVISION DURING MANUFACTURE OF MATERIALS

Part IV
TECHNICAL SUPERVISION DURING MANUFACTURE OF PRODUCTS

ND No 2-020101-040-E

Saint-Petersburg

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LIST OF CIRCULAR LETTERS AMENDING/SUPPLEMENTING NORMATIVE DOCUMENT

Rules for Technical Supervision During Construction of Ships and Manufacture of Materials and Products for Ships (2007), Volume 2, Parts III and IV
ND 2-0201011-040-E
(Normative document No. and title)

Item No.	Circular letter No., date of approval	List of amended and supplemented paras
	Part III "Technical Supervision During Manufacture of Materials":	
1.	010-13.4-325ц dated 12.05.08	Chapter 3.2
2.	010-13.4-344ц dated 22.07.08	Chapter 3.2.
3.	010-13.4-345ц dated 24.07.08	Chapter 3.2.
4.	010-13.4-355ц dated 01.09.08	Items 3.1.3.2, 3.1.3.3, 3.1.3.3.3, 3.1.3.3.4.
5.	010-13.1-386ц dated 25.02.09	Item 2.2.1.
6.	010-13.4-402ц dated 25.05.09	Items 3.2.3.1.5 - 3.2.3.1.7, 3.2.10.
	Part IV "Technical Supervision During Manufacture of Products":	
1.	011-6.15.1-277ц dated 26.11.07	Section 12.
2.	009-1.9-282ц dated 30.11.07	Section 2: appendix 2.
3.	009-1.9-370ц dated 30.10.08	Section 5: 5.1.16, 5.12.20, appendix 1.
4.	009-1.9-405ц dated 25.06.09	Section 5: 5.2.3.

Rules for Technical Supervision During Construction of Ships and Manufacture of Materials and Products for Ships have been approved in compliance with the established approval procedure and come into force since 1 October 2007.

The present edition has been prepared on the basis of the latest edition of the Rules for Technical Supervision During Construction of Ships and Manufacture of Materials and Products (2005) taking into account the additions and amendments contained in Notice No. 1 (2006) as well as those prepared directly before publication of the Rules.

The Rules are published in three volumes containing the following parts:

Volume 1 – Part I "General Regulations for Technical Supervision", Part II "Technical Documentation";

Volume 2 – Part III "Technical Supervision During Manufacture of Materials", Part IV "Technical Supervision During Manufacture of Products";

Volume 3 – Part V "Technical Supervision During Construction of Ships".

On the entry into force of these Rules the Rules for Technical Supervision During Construction of Ships and Manufacture of Materials and Products for Ships (2005) become void.

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The present edition of the Rules, as compared with the last one (2005), includes the following amendments and additions.

The words “Register Location” and “RS Regional Location” over the whole text of the Rules have been replaced by the words “RS Branch Office”.

PART III. TECHNICAL SUPERVISION DURING MANUFACTURE OF MATERIALS

1. Chapter 1.1: to simplify using the Rules, new paragraph 1.1.2 has been supplemented, it specifies that this Part is inapplicable to materials for fire protection of ships.

2. Chapter 1.2: in an effort to use a common terminology, some definitions available in Part I “General Regulations for Technical Supervision” have been deleted in paragraph 1.2.2.

3. Section 2, Chapters 2.1 and 2.2: amendments and additions have been introduced relating to approval of metallurgical works production manufacturers. The additions are based on IACS Unified Requirements UR W11 (Rev.5 and Rev.6) while the amendments are caused by a need to separate key matters of technical supervision from Part XIII “Materials” of the Rules for the Classification and Construction of Sea-Going Ships and transfer them to the Rules for Technical Supervision during Construction of Ships and Manufacture of Materials and Products for Ships.

4. Section 3: Chapter 3.1 “Procedure for approval of protective coatings for hull structures” has been completely revised and replaced.

PART IV. TECHNICAL SUPERVISION DURING MANUFACTURE OF PRODUCTS

1. Section 1: requirements for the supervision of survey items have been specified having regard that the RS confirms the compliance of the supervision item with the RS requirements, but not with the technical documentation approved;

Chapter 1.1: references have been introduced to specify the procedure for single approval and actions when the documents of another Classification organization, issued without the RS authorization are provided;

Paragraph 1.3.5: has been amended regarding the products manufactured without RS technical supervision, but with the documents of another Classification organization.

2. Section 3, APPENDIX 3: amendments with due regard for IACS Unified Requirement UR A1 (Rev.5, June 2005) being in force since 1 January 2007 have been introduced.

3. Section 4: has been revised considering Circular letter No. 009-1.6-133ц dated 19 December 2005 “On technical supervision during manufacture of fire protection materials and products”.

4. Section 5, Chapter 5.2: IACS Unified Requirement M9 (Rev.3, Jan 2005),(Corr.1, Nov 2005) has been taken into account regarding crankcase explosion relief valves of internal combustion engines and reduction gears. New products have been added to Table with items of technical supervision;

Chapter 5.10: the requirements for some items of technical supervision have been transferred from Chapter 5.10 to Chapters 5.8 and 5.9;

Chapter 5.11, paragraph 5.11.6: the requirements for duration of check tests have been specified;

has been supplemented with new APENDICES 2 and 3 considering IACS Unified Requirements M66 (Jan 2005), (Corr.1, Nov 2005), (Rev.1, Oct 2006) and M67 (Jan 2005), (Corr.1, Nov 2005), (Rev.1, Oct 2006)

with regard to the procedures for type tests of crankcase explosion relief valves and crankcase oil mist detectors.

5. Section 8: the misprints in Table 8.1.3.1, Chapter 8.2 heading and paragraph 8.2.1.4 have been eliminated;

Chapter 8.7: new paragraph 8.7.3 has been introduced wherein the amendments of IACS Unified Requirements UR P4 (Rev. 3, Feb 2005) and Recommendation No. 86 (Feb 2005) have been taken into account.

6. Section 10: editorial corrections have been made to correct the misprints noted and to specify the text, and the provisions of IACS Unified Interpretation SC180 concerning the tests of a cargo hold water level alarm system of bulk carriers have been introduced.

7. Sections 15 and 16: have been supplemented with standards and procedures for testing radio and navigational equipment in compliance with the 4th edition of IEC60945.

8. Section 17: amendments have been introduced on the basis of the following IMO documents that have entered into force:

Annex VI “Regulations for the prevention of air pollution from ships” to convention MARPOL 73/78 (effective since 19 May 2005).

Resolution MEPC.107(49) “Revised guidelines and specifications for pollution prevention equipment for machinery space bilges of ships” (effective since 1 January 2005).

Resolution MEPC.108(49) “Revised guidelines and specifications for oil discharge monitoring and control systems for oil tankers” (effective since 1 January 2005).

Resolution MEPC.159(55) “Revised guidelines on implementation of effluent standards and performance tests for sewage treatment plants” (will be effective for new ships of which the keel will be laid on or after 1 January 2010, and also for new plants with a delivery date by contract on or after 1 January 2010).

CONTENTS

PART III. TECHNICAL SUPERVISION DURING MANUFACTURE OF MATERIALS

1 GENERAL

1.1 APPLICATION

1.1.1 The provisions of this Part of Rules for Technical Supervision during Construction of Ships and Manufacture of Materials and Products for Ships[1] are applied by Russian Maritime Register of Shipping[2] during technical supervision in manufacture and use of materials for ships.

1.1.2 Technical supervision during manufacture and application of materials intended for fire protection of ships is carried out in accordance with the provisions of Section 4 "Fire Protection Equipment", Part IV "Technical Supervision during Manufacture of Products".

1.2 TERMS, DEFINITIONS AND EXPLANATIONS

1.2.1 The terms and their definitions and explanations relating to the general terminology are given in Part XIII "Materials" of Rules for the Classification and Construction of Sea-Going Ships and in Part I "General Regulations for Technical Supervision" of the Rules.

1.2.2 The following definitions have been adopted for the purposes of this Part.

Manufacturer Certificate (Certificate of Quality) is a manufacturer document verifying the conformity of the certain amount of the particular product with the order requirements, and confirming the manufacture of the product in full compliance with the existing manufacturer's practice.

The Certificate is issued by the manufacturer and shall be verified by the signature of an authorized person of the manufacturer's production quality control body.

Production model is the specimen of a material or products batch, made in accordance with the manufacturer's adopted production process for series production, which is subject to testing to verify its conformity with the prototype according to the Register approved technical documentation.

Register's brand is a brand, stamp or seal of the certain Register specified type to be marked on finalized products or on products in the course of their manufacturing to confirm the fact of the Register technical supervision and the products identity to the documents issued.

Sample is a part of a semi-finished product or a specially fabricated blank intended for manufacturing test specimens.

Specimen is a specially shaped and dimensioned product made from a sample and used in tests to determine mechanical, technological and other properties of the material.

Semi-finished product is a sheet, forging, casting, tube, etc. subjected to machining or technological treatment when used for its intended purpose.

Batch is a limited number of semi-finished products covered by the results of the tests duly performed.

Initial tests are a certain scope of check tests specified by the specific Register approved program and carried out during the Register survey of the manufacturer to issue Recognition Certificate for Manufacturer to the latter.

Acceptance tests are a scope of tests, specified by the Register rules or Register agreed documentation, for products supplied under the Register technical supervision whose results may allow to issue Certificates of Conformity.

Second party is an external party involved and interested in the manufacturer's activities, e.g. a customer or an organization/a person acting on its behalf.

Third party is an external party recognized as independent of the parties involved while determining the conformity of material or product to any existing requirements, e.g. national or international standards, the RS rules, ISO 9001, etc.

1.3 TECHNICAL SUPERVISION

1.3.1 Technical supervision is carried out on the basis of the RS issued rules and is aimed at determining whether materials and products intended for construction and repair of ships and their equipment meet the rules and additional requirements if specially stated.

The additional requirements include:

the potential requirements of the Register in the course of technical supervision to obtain some additional data on product quality (change of tests scope and procedures, sampling locations, specimen dimensions, etc.);

[1] Hereinafter referred to as "the Rules".
[2] Hereinafter referred to as "the Register".
[3] Hereinafter referred to as "the Register documents".

the requirements that a customer may include in the order for material supply over and above those specified by the rules.

Recognition Certificate for Manufacturer is the document certifying the manufacturer as the one recognized by the Register to produce materials meeting the RS rules requirements.

The above document confirms the conformity of the manufacturer supplied product and the conditions of its manufacturing with the RS Rules requirements, and verifies the fact of listing the manufacturer in the Register issued List of Approved (Recognized) Materials and Manufacturers[1].

The documents confirming the conformity of the material supplied with the rules requirements, and containing the data to identify the supplied product include:

Certificate of Conformity (refer to 1.1, Part I, "General Regulations for Technical Supervision");

Manufacturer Certificate (refer to 1.2.2) in the form agreed with the Register and witnessed by the Register representative.

Technical supervision of the Register at material manufacturers does not replace the activity of technical control bodies functioning therein branch office.

Manufacturers can directly address to the Register higher regarding any controversial matters emerging during technical supervision. The decision of the Register Head Office is considered final.

Interpretation of the provisions in this Part of the Rules is within the Register competence only.

1.3.2 Considering design technical and working documentation, the Register branch office shall be guided by the following:

.1 requirements of the relevant parts of the Rules;

.2 RS Nomenclature (refer to Appendix 1 to Part I "General Regulations for Technical Supervision");

.3 special instructions from the RHO.

2 METALS

2.1 RECOGNITION CERTIFICATE FOR MANUFACTURER

2.1.1 General.

2.1.1.1 Application.

Recognition Certificate for Manufacturer is issued to manufacturers producing products and materials specified in 1.1.4, Part XIII "Materials" of Rules for the Classification and Construction of Sea-Going Ships, namely:

rolled products of hull structural steel;

rolled steel for boilers and pressure vessels;

steel pipes for boilers, heat exchangers, pressure vessels, ship systems and piping;

steel forgings and castings;

iron castings;

castings of light-weight and non-ferrous alloys;

semi-finished products of non-ferrous and light-weight alloys;

chain cables and ropes;

chain steel;

slabs, blooms and billets for rolled products of hull structural and boiler steels if made at a manufacturer lacking the rolling.

The above listed products and materials being subject to technical supervision during manufacture according to the RS Rules cannot be supplied by the manufacturers lacking Recognition Certificate for Manufacturer.

To get Recognition Certificate for Manufacturer, the latter shall be recognized by the Register in accordance with the requirements of Section 10, Part I "General Regulations for Technical Supervision" and 2.1 of this Part.

2.1.1.2 Validity period.

Recognition Certificate for Manufacturer is issued for the period of up to 5 years and subject to endorsement at least 1 time per 2,5 years.

The Certificate shall be denounced and renewed if the terms of its issue have changed (refer to 2.1.1.3).

If due to some technological reasons the works needed for reissuing Recognition Certificate for Manufacturer cannot be performed at set dates, the new dates for those works shall be agreed during the validity period of the Certificate, to keep the Certificate and the manufacturer in the List of Materials. (Generally, the main reason to postpone an audit is lack of adequate orders, i.e. materials essential for performance of clue tests).

With the positive results of the works, the validity period of Recognition Certificate for Manufacturer and the date of its next reissuing remain unchanged. The Certificate validity is not suspended.

The relevant decision is taken by the Register location carrying out technical supervision at the manufacturer's on the basis of the manufacturer's application justifying postponement.

[1] Hereinafter referred to as "the List of Materials".

The procedure for proper keeping up the List of Materials is set forth in 2.2.4.

2.1.1.3 Conditions for issuing Recognition Certificate for Manufacturer:

As agreed with RHO, all the works associated with the Certificate issue, endorsement or renewal shall be carried out by the RS branch offices having the relevant area of activities.

Recognition Certificate for Manufacturer is issued to a manufacturer in case certain Register requirements and formalities (refer to 2.1.2) are fulfilled and on the basis of positive results of the Register initial or renewal surveys (refer to 2.1.3).

The survey of a manufacturer is carried out on the basis of a request/ application (refer to 2.1.2.1) and generally includes fulfillment of the following conditions:

review of the request and necessary documentation (refer to 2.1.2);

analysis of the request, identification of financial, labour and time resources, negotiation of plan of works necessary to accomplish the task with the manufacturer who has applied for the survey.

familiarization with the production process and current quality control system (refer to 2.2);

performance of tests (refer to 2.2);

review of the results of production process, current quality control system and tests performed and comparing this with the documentation submitted by the manufacturer earlier.

All the information received by the Register for issue, renewal or endorsement of the Recognition Certificate for Manufacturer is considered strictly confidential and cannot be disclosed to any third party without a preliminary agreement with the manufacturer covered with the information and providing the information.

2.1.1.4.1 Survey of the manufacturer.

In survey, the information submitted by a manufacturer in the application and its enclosure regarding manufacturer potentials, product stated and its actual conformity with requirements of the RS Rules is confirmed.

If necessary, due to execution of certain orders, product conformity with the additional contract requirements (with standards, specifications and other specified documentation) may concurrently be confirmed.

The survey includes familiarization with actual production (from a stockyard to a stock room and rejected product bay) and practical comparison of the data with the documentation on shops, sections, laboratories and offices of the manufacturer submitted according to 2.1.1.2.

2.1.1.4.2 Initial survey is carried out at a manufacturer's applying to the Register for the first time or at the manufacturer's recognized by the Register and submitting material(s) not specified in Recognition Certificate for Manufacturer issued.

The survey in the scope equivalent to initial survey may be carried out in the following cases:

changes of technology associated with any of the material production processes (heat, casting, rolling and/ or heat treatment, forging, pressing etc.) mentioned in the RS Rules;

changes of the maximum thickness (dimensions) of materials supplied;

changes of chemical composition (composition correction, micro alloying, etc.);

application of different equipment and means of production used in technological process earlier approved by the Register (mills, thermal and other equipment);

use of billets (slabs, blooms, etc.) supplied by unknown manufacturers or those not recognized by the Register.

The amount of documentation submitted to the Register for initial approval of the manufacturer shall comply with that specified in 2.1.2.

The scope of surveys and tests in initial approval is considered to be basic and shall take into account to maximum extent particular features of manufacturing products at the specific manufacturers.

2.1.1.4.3 Survey for endorsement or renewal of Recognition Certificate for Manufacturer is carried out in accordance with 2.1.4 to 2.1.5.

2.1.1.4.4 If manufacturer's requisites are changed, an appropriate set of documents changed is submitted to the Register, and reissue of Recognition Certificate for Manufacturer is therewith carried out in accordance with the established procedure but the dates specified in the initial document remain the same. Survey of the manufacturer is not required.

2.1.1.4.5 In surveying laboratories forming part of metallurgical or other manufacturers, their activity is considered as the integral part of a material production process, and drawing up a Register separate document, i.e. Recognition Certificate for Laboratory, is not required for them.

Recognition Certificate for Manufacturer may be issued to the laboratory by its individual application, as a rule, when orders of external organizations are executed.

If the manufacturer cannot conduct testing of the stated product, the tests needed shall be carried out in the laboratory recognized by the Register.

The basic provisions on a laboratory survey are set forth in 1.5, Part XIII "Materials" of Rules for the Classification and Construction of Sea-Going Ships.

2.1.1.4.6 In survey of the laboratory and in familiarization with the documentation special attention shall be paid to the following:

procedure of receipt and drawing up of applications for work performance by the laboratory;

personnel qualification;

sampling procedure, identification in specimens manufacture and tests;

availability of data on laboratory accreditation by competent national or international organizations.

2.1.1.4.7 A testing laboratory passport shall contain all the pertinent information relating to the laboratory including requisites, the nomenclature of products and test types and procedures, as well as data on laboratory equipment (technical characteristics, data on condition, date of equipment calibration), the list of regulatory documents, and data on spaces condition and attending personnel.

The form and drawing up of test reports is noteworthy. The report content for separate types of tests may be different, but the general form shall be standardized. Amendments and additions to the report after its issuance may be made only in the form of a separate document. Each report shall be provided with an identification number, and the laboratory name, membership (if the laboratory belongs to a manufacturer, its name shall be specified), branch office and dates of tests performance shall be specified herein.

The reports shall generally be signed by a person in charge of performance of the given test type according to the effective regulations at the manufacturer's/in a laboratory, and by the head of the laboratory.

2.1.1.4.8 Check tests of materials submitted according to the application and carried out at the manufacturer's shall be certified by the Register representative in the course of surveying. The test reports shall be witnessed by the Register representative.

2.1.1.4.9 In familiarizing with documentation and surveying the quality control system applied at the manufacturer's, the following procedures and formalization thereof shall be in the focus of attention:

receiving inspection;

inspection scope and nature;

identification system for materials or incoming semi-finished products during their storage and the manufacturing process as a whole. It is necessary to ascertain that all the incoming raw or other materials are used and processed later on only provided that the proper inspection is carried out and documented at the manufacturer's. The scope of supplier inspection shall be determined;

technological process effecting quality of the finished product. The stages of the process shall be under control (Instruction specifying inspection and control methods; documented criteria for works performed; corrective actions; marking; a system for gathering, use and storage of manufacturing parameters);

inspection of rejected materials; repair;

processing, re-inspection;

2.1.1.4.10 Tests shall be carried out in accordance with the agreed program.

Selection of semi-finished products, samples cutting out and specimens manufacturing shall be directly supervised by the Register representative.

Dimensions of semi-finished products submitted for testing shall be consistent with those of semi-finished products in supplies expected (at least one of semi-finished products shall have maximum width, thickness and diameter).

Test specimens shall be stamped for their identification with semi-finished product submitted for testing. The cutting and manufacturing procedure, intermediate stamping, as well as diagrams of specimen branch office and samples cutting out shall be preagreed.

All test results shall be noted in the reports signed by the representative of the quality control system applied at the manufacturer's and witnessed by the Register representative carrying out technical supervision of testing.

The above results form part of the set of documents (report) submitted to the Register by the manufacturer as the basis for issuing Recognition Certificate for Manufacturer.

2.1.1.4.11 The set of documents in the form of a report containing all the information on manufacture and tests of semi-finished products submitted for testing is submitted to the Register for approval. The report is drawn up in an arbitrary form, but the sections consistent with 2.1.2 shall be included.

The report shall include copies of the program and the Register witnessed test reports. The data on conditions of melting, casting, rolling, heat treatment, etc., on microphotography and the results of non-destructive testing shall also be submitted, if needed.

The report content shall meet the requirements of the RS Rules and documentation attached to the application. With the satisfactory results of tests, survey of the manufacturer and consideration of the report, the Register branch office carrying out the survey draws up the Report on Inspection of Manufacturer (Form 6.3.19) which is the basis for issuing Recognition Certificate for Manufacturer.

The reports and data on test results, surveys and technical documentation review, as well as the documentation as such, shall be kept at the branch office supervising the manufacturer during the time period set by this branch office. The copies of those reports and data shall be submitted to the RHO, unless otherwise specified.

All the information on the key decisions made in the course of approval, the results of the technical documentation review shall be submitted to the RHO including the following:

Notice (Form 25.П.01/01), in electronic format;

original information document of a firm (Form 71.П.01), in electronic format in case the manufacturer's name is changed;

draft Recognition Certificate for Manufacturer (an initial survey) and copies of reissued Recognition Certificate for Manufacturer (in renewal);

copies of agreed documentation for product supply (if any).

Recognition Certificates for Manufacturer issued earlier to the manufacturer are cancelled and the RHO is informed thereof.

All the decisions made on the results of the Register branch office presentations review shall be brought to the notice of the branch offices concerned and manufacturers by the RHO.

2.1.2 Issue of Application for Manufacturer Recognition by the Register (obtaining of Recognition Certificate for Manufacturer).

2.1.2.1 The manufacturer's application generally makes up the formal application on a letter form which is drawn up by a manufacturer in an arbitrary form, unless otherwise specified.

Additionally to the objectives of work, the application shall contain information on financial guarantees and the list of documentation necessary for the application review (refer to 2.1.2.2). The application is forwarded to the Register branch office covering the manufacturer in its activity area, or it may be forwarded to the RHO directly.

In so doing, the following documents shall be submitted to the RHO:

data on results of works performed by the Register branch office and on the changes that took place (or lack of such) during renewal of Recognition Certificate for Manufacturer;

application copy in case of the manufacturer first application to the Register or renewal of the RS technical supervision.

2.1.2.2 Enclosures to the application.

Concurrent with the application, the brief information on manufacturer and products is submitted to the Register (refer to 2.2.1.2).

As a rule, the information set out in 2.2.1.2 is applicable for all the works intended to manufacture or already manufacturing the materials under the RS technical supervision and applying to the Register with relevant applications.

2.1.3 Issue of Recognition Certificate for Manufacturer.

2.1.3.1 Recognition Certificate for Manufacturer (Form 7.1.4.1), unless otherwise stated (refer to 2.1.3.3), is issued by the branch office that surveyed the manufacturer.

2.1.3.2 The issued Recognition Certificate shall contain in its annex information on the process and special features of material manufacture, dimensions of semi-finished products supplied, procurement documentation and , if needed, special features of product marking (refer to 1.4.1.2, Part XIII "Materials" of Rules for the Classification and Construction of Sea-Going Ships).

Recognition Certificate shall be necessarily provided with an annex. The code of an item shall be given for each material in the Recognition Certificate for Manufacturer form according to the RS Nomenclature (Appendix 1 to Part I "General Regulations for Technical Supervision").

2.1.4 Endorsement of Recognition Certificate for Manufacturer.

2.1.4.1 Endorsement of Recognition Certificate for Manufacturer is carried out within the period stated in the Recognition Certificate for Manufacturer form according to 2.1.1.2.

2.1.4.2 A manufacturer shall confirm validity of its Recognition Certificate for Manufacturer during the validity period in the following cases:

inspection for defects in product use or operation, identification of causes effecting the product quality;

rejection to submit product in its manufacture and use;

unsatisfactory operation of the quality control system;

making changes in conditions of approval unless preagreed with the Register;

numerous failures in test performance;

recurring deviations from production or control procedure, and identified degradation of product quality stability (even with the results submitted regarding the review of the deviations detected, and the restoration of the Register confidence in a quality level).

Recognition Certificate for Manufacturer endorsement may apply to the individual kinds of product or to all the materials listed in the Recognition Certificate.

In the above cases the decision on Recognition Certificate for Manufacturer endorsement is made by the RHO and/or the Register branch office carrying out technical supervision at the manufacturer's.

2.1.4.3 Everything listed in 2.1.4.2 may be considered by the Register as calling into question the intact validity of the Recognition Certificate at a specific works and therefore may be interpreted by the parties as "occasional renewal" of the Certificate with the relevant drawing up of a manufacturer's application, etc.

2.1.4.4 Additionally to the listed in 2.1.4.2, confirmation may be demanded when the materials supervised by the Register were not supplied during the period exceeding two years after issuance, renewal or previous endorsement of the Certificate.

2.1.4.5 In confirming Recognition Certificate for Manufacturer the scope of tests and surveys is determined in each particular case and may be equal to that of an initial survey (refer to 2.1.1.4.2).

2.1.4.6 If the terms of the Certificate issue and the pertinent statistical data testifying to stability of the product quality level remain unchanged, being formally confirmed by the manufacturer, the Certificate may be confirmed in a brief or even formal way (no additional tests or surveys are needed).

At the discretion of the Register branch office carrying out technical supervision at the works the tests may be omitted in the following cases:

with regular supplies of the product specified in Recognition Certificate for Manufacturer under technical

supervision of the Register or other classification society, and with provision of the pertinent information by the manufacturer (a statistically processed form is preferable);

with irregular supplies of the product specified in Recognition Certificate for Manufacturer under technical supervision of the Register or other classification society, but with provision by the manufacturer of the pertinent information on supply of materials close by their parameters to those supplied and manufactured according to similar procedures. The data on chemical composition shall include all the elements specified for materials being presented by the manufacturer, micro alloying elements inclusive.

Additionally to the above conditions, the RS branch office may demand data on product rejecting, internal flaws, surface condition and dimensions.

If data on materials stated in Recognition Certificate for Manufacturer are lacking, statistics may contain data on similar materials manufactured under the same technology.

2.1.4.7 Where the product mentioned in the Certificate or like is not produced by the manufacturer, the Certificate can be confirmed when the relevant orders are received. In this case the scope of surveys and tests may also be equal to that of an initial survey, but it shall be consistent with the order extent and the validity period of the Recognition Certificate.

If the RS branch office decides to endorse the Recognition Certificate, the relevant statement is forwarded to the RHO.

2.1.5 Renewal (reissue) of Recognition Certificate for Manufacturer.

2.1.5.1 Renewal of Recognition Certificate for Manufacturer is carried out within the period stated in the Recognition Certificate for Manufacturer form according to 2.1.1.2.

2.1.5.2 Renewal (reissue) of Recognition Certificate for Manufacturer at a specific known works is carried out on the basis of the works special survey. Decisions on the procedure, scope and execution of works, unless otherwise stated, are made by the Register branch office carrying out technical supervision at the works considering the results of previous surveys (refer to 2.1.4).

Everything listed in 2.1.4.2 and 2.1.4.3 is applicable for the conditions of Recognition Certificate for Manufacturer renewal.

2.1.5.3 In confirming Recognition Certificate for Manufacturer the scope of tests and surveys is determined in each particular case and may be equal to that of an initial survey. As a rule, the scope of tests and surveys is determined in accordance with 2.1.4.5, 2.1.4.6 and 2.1.4.7.

Survey within the scope of initial tests, in addition to the above mentioned, may be required in case the previous audit was carried out in a formal way (refer to 2.1.4.6).

Necessity of work performance and the scope of approval equivalent to the initial one may be agreed with the RHO.

2.1.6 Cancellation of Recognition Certificate for Manufacturer.

Generally, Recognition Certificate for Manufacturer can be cancelled in the following cases:

upon the manufacturer's request;

when the product supplied by the manufacturer shows non-conformity with the provisions of Recognition Certificate for Manufacturer issued (with the requirements of Rules and documentation entered in the Certificate);

when the terms of the agreement for technical supervision at the works are violated;

when the Certificate validity period has expired and the manufacturer has failed to submit the relevant application at due time;

As a rule, the specific conditions wherein the Certificate shall be cancelled are regulated by an agreement on technical supervision concluded between the Register and the manufacturer.

2.2 PROCEDURES FOR RECOGNITION OF MANUFACTURERS

2.2.1 Procedure for recognition of hull structural steel manufacturers.

2.2.1.1 General.

The present specifies the procedure for the Register recognition of the manufacturing process of rolled steels of normal and higher strength, as required by 1.3, Part XIII "Materials" of the Rules for the Classification and Construction of Sea-Going Ships. These regulations also apply to the Register recognition of processes used in manufacture of such products as slabs, blooms and billets for rolled hull structural steel.

The recognition procedure is the basis for the Register verification of the manufacturer's capability to provide the stable satisfactory quality of products ensured, in turn, by the production technology, including programmed rolling schedules, and the quality system adopted at the manufacturer's in accordance with the requirements of 3.2.1.3 and 3.2.1.4, XIII "Materials" of the Rules for the Classification and Construction of Sea-Going Ships.

As a rule, recognition of a certain steel grade produced in accordance with the proposed production process flow chart, means recognition of a certain type of products supplied by the manufacturer and made of this steel grade meeting the requirements of the Register Rules.

2.2.1.2 Recognition application. Documentation.

2.2.1.2.1 Initial documentation.

To obtain the recognition, the manufacturer shall submit to the Register the control test program and general information describing the manufacturer and its products:

.1 manufacturer's name and address, location of the workshops, general indication relevant to the background, dimensions of the works, estimated total annual production and types of products for shipbuilding and for other applications (as deemed useful);

.2 organization and quality:

organizational chart:

staff employed;

staff employed and organization of the Quality Control Department;

qualification of the personnel involved in activities related to the required quality of products;

certification of quality of compliance with ISO standards of 9001 or 9002 series, if any;

approval certificates already granted by other classification societies, if any;

.3 manufacturing facilities:

flow chart of manufacturing process;

origin and stowage of original materials (charge);

stowage and storage of finished goods;

regular control equipment and devices used in product manufacturing;

.4 quality control system and equipment:

description of material identification system, used at different stages of production;

equipment for chemical analysis, mechanical tests, metallography and devices for relevant calibration of the above equipment;

equipment for performance of non-destructive testing;

list of quality system control procedures;

.5 types of semi-finished products (sheets/plates, sections, coiled rolled products), steel grade, thickness range and main mechanical characteristics of material:

permissible content of chemical elements including the content of deoxidizing and grain-refining elements, as well as of impurities depending on the steel grade (if the content of chemical elements depends on rolled product thickness and conditions of its supply, the relevant deviations shall be documented);

the maximum permissible carbon equivalent C_{eq} determined by the formula specified in 3.2.2, Part XIII "Materials" of the Rules for the Classification and Construction of Sea-Going Ships;

maximum P_{cm} determined for high-strength steel having the carbon content below 0,13 per cent, unless otherwise specified.

Statistics on chemical composition and mechanical properties (R_{eH}, R_m, A, %, KV) that shall demonstrate the manufacturer's capability to make products in compliance with the specified requirements;

.6 production of steel:

production process and capacity of the relevant equipment (steel furnaces and/or a converter);

raw materials used (charge materials);

deoxidation and alloying;

desulphurization and vacuum treatment, if any;

casting method: an ingot or continuous casting. If continuous casting is used, the information is submitted on the casting machine type, casting practice, methods preventing oxidization, segregation control and non-metallic inclusion control, electromagnetic stirring of molten metal, soft reduction, etc.

ingot or slab dimensions or weight;

surface treatment of ingots or slabs: cutting of an ingot head and removal of surface defects using flame cleaning;

.7 treatment and rolling:

furnace types and heating modes;

rolling: relation between slab/bloom/billet dimensions and a final product thickness, heating temperatures during rolling and time of its completion;

descaling during rolling;

capacity of the rolling mill;

.8 heat treatment:

type of furnaces, their temperature capacity, recording of parameters in performance of heat treatment of steel;

accuracy and calibration of devices for temperature control and maintenance;

.9 programmed rolling:

For semi-finished products supplied after controlled rolling (CR) or thermo-mechanical treatment (TM), the following additional information shall be submitted:

description of rolling process;

steel normalizating, recrystallization and (A_{r3}) and methods used in steel treatment;

standards for parameters controlled in steel rolling depending on the steel grade and thickness (the temperature and thickness at the beginning and end of passes, an interval between passes, reduction percentage, a temperature range and rate during accelerated cooling of metal (if used) and available techniques for monitoring the above parameters;

calibration of measuring and recording equipment;

.10 recommendations for bending and welding of steels delivered in the CR or TM condition:

for hot and cold bending, if required, in addition to handling steel at shipyards or works;

minimum and maximum values of heat input if they differ from ordinary values observed at shipyards or works (15 to 20 kJ/cm));

.11 additional information on transfer of a part of the manufacturing process to another production facility or to another Manufacturer, if possible, shall be submitted to the Register without fail;

.12 for recognition by the Register of a Manufacturer producing the semi-finished products such as slabs, blooms and billets, the information according to 2.2.1.2.11 to 2.2.1.2.1.6 shall be submitted to the Register;

2.2.1.2.2 Documentation to be submitted for changing the recognition.

The Manufacturer shall submit to the Register the documents about announced changes in conditions of recognition issued earlier, together with the documents listed in 2.1.2, in cases indicated below:

.1 when changing the technology associated with any of the production processes (heat, casting, rolling and/or heat treatment);

.2 when changing the maximum thickness (size) of rolled products;

.3 when changing the chemical composition (corrections in composition, introduction of micro alloying, etc.);

.4 use of other rolling mills, thermal or other equipment differing from that indicated earlier for recognition of the rolling technology by the Register;

.5 use of billets, slabs, blooms, and other products supplied by the manufacturers not recognized by the Register.

The documentation submitted earlier (refer to 2.1.4.2.1) and subjected to relevant changes shall be enclosed with the application.

As for the rest documentation submitted earlier during previous recognition or approval, the application shall contain the record of its invariability.

The tests program shall be submitted in any case (refer to 2.2.3.1).

2.2.1.3 Tests for recognition of manufacturing technology and quality of rolled steel.

2.2.1.3.1 Scope of tests.

In general, the scope of tests is specified in 2.2.1.3.4, 2.2.1.3.6 and 2.2.1.3.7.

The scope and number of tests may be elaborated by the Register based on the preliminary information submitted by the manufacturer in accordance with 2.2.1.2.1 and 2.2.1.2.2. In particular, the number of heats submitted for testing, semi-finished products of a certain thickness and steel grade may be reduced; on the whole, the tests may be omitted at the Register discretion.

The decisions are made taking into consideration the following:

.1 the production technology has already been recognized by other classification society and the documentation is available confirming the completion of relevant tests and their results;

.2 for steel grades, the recognition of production of which by the Register was applied for, some statistical data are available confirming the stability of chemical analysis results and mechanical properties of the steel;

.3 recognition of the production facility for any grade of steel may be extended to any lower grade of steel at the same strength level provided that the production technology, condition of supply, control and test procedures were not changed;

.4 recognition of production of one high-strength steel level may be extended to a steel of lower-strength level provided that the latter is produced with the use of the same manufacturing process, including deoxidation and grain-refinement as well as casting method and condition of supply.

.5 changes in conditions of works' recognition by the Register;

.6 recognition of production of semi-finished products, such as slabs, blooms and billets.

The number of casts and semi-finished products of different thickness submitted for tests may be increased in case of introduction of a new technology, new types of steel or rolled products.

2.2.1.3.2 Approval of test program.

In case the number of tests differs essentially from data given in 2.2.1.3.6 and 2.2.1.3.7, the program shall be submitted to the Register for approval prior to survey and testing, enclosing the documentation specified in 2.2.1.2.1 and 2.2.1.2.2.

2.2.1.3.3 Technical supervision.

The tests carried out at the manufacturer's shall be performed in accordance with 2.1.1.4.5 to 2.1.1.4.1.10.

If the manufacturer cannot conduct testing of the stated product, the tests needed shall be carried out in the laboratory recognized by the Register.

2.2.1.3.4 Amount of materials to be submitted for testing.

As a rule, for each grade of steel, each type of semi-finished product and each respective manufacturing process (covering the whole cycle: steel making, casting, rolling and condition of supply) one semi-finished product with the maximum thickness will be selected for the tests.

In case of initial approval, the Register may require additionally testing of a medium-thickness semi-finished product.

Selection of the casts, from which the semi-finished products are taken for testing, shall be based on the specified typical chemical composition, values of C_{eq} or P_{cm} and content of deoxidizing and grain refining micro alloying additions.

2.2.1.3.5 Sampling.

Unless otherwise specified, the samples for cutting out specimens from a semi-finished product (plate, flat, section, bar) shall be corresponding to the top part of the ingot; in case of continuous casting the samples are taken at random.

In accordance with the requirements of Table 2.2.1.3.6.1 the samples shall be taken from the "top" or "bottom" of the piece length and position of the samples in width of the product shall meet the requirements of 3.2.5.

2.2.1.3.6 Testing.

2.2.1.3.6.1 Types of tests.

The tests shall be carried out in accordance with the directions of Table 2.2.1.3.6.1.

2.2.1.3.6.2 Specimens and test procedures.

In general cases the specimens and test procedures shall meet the requirements of 2.2, Part XIII "Materials"

Table 2.2.1.3.6.1

Type of tests	Position of samples, direction of cutting[1] of specimens	Remarks			
Tensile test	Top and bottom transverse[2]	Values of R_{eH}, R_m, A_5, %, R, % are determined			
Tensile test (test relieved) for TM steels only	Top and bottom transverse[2]	Stress relieving at 600 °C (2 min/mm with minimum 1 h)			
Impact test[3] for steel grades: A, B, A32, A36, A40, D, D32, D36, D40, E, E32, E36, E40, F32, F36, F40	Top and bottom, longitudinal	Test temperature, °C			
		+ 20 0 0 −20	0 −20 −20 −40	−20 −40 −40 −60	— — −60 −80
A, B, A32, A36, A40, D, D32, D36, D40, E, E32, E36, E40, F32, F36, F40	Top, transverse[4]	+ 20 0 −20 −40	0 −20 −40 −60	−20 −40 −60 −80	— — — —
Impact test[3, 5] on strain aged specimens for steel grades: A32, A36, A40, D, D32, D36, D40, E, E32, E36, E40, F32, F36, F40	Top, longitudinal	Test temperature, °C			
		+ 20 0 −20 −40	0 −20 −40 −60	−20 −40 −60 −80	— — — —
Chemical analysis[6]	Top	Complete analysis including micro alloying elements			
Sulphur prints	Top	—			
Micro examination	Top	—			
Grain size determination	Top	Only for fine-grain steels			
Drop weight tests[4]	Top	Only for steels of grades E, E32, E36, E40, F32, F36, F40			
Tensile tests through thickness	Top and bottom	Only for Z-steel			

1 For hot-rolled strips — refer to 1.3.5.3.6.2.1

[2] Longitudinal direction for sections and plates having width less than 600mm — longitudinal.

[3] One set of three V-notch impact specimens is required for each impact test in accordance with 2.2.3.4, Part XIII "Materials" of Rules for the Classification and Construction of Sea-Going Ships.

[4] The test is not required for sections and plates having width less than 600 mm.

[5] Deformation — 5 % + 1 hour at 250 °C.

[6] Chemical analysis of ladle sample is also required.

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

In addition to the above, the following particular features of tests listed below shall be taken into account:

.1 tensile tests:

for plates made of hot rolled steel strip, one additional tensile specimen shall be taken from the middle of the strip constituting the coil;

for plates having thickness higher than 40 mm, when the capacity of the available testing machines is insufficient for testing of full thickness specimens, the tests shall be carried out using several specimens, the total thickness of which is equal to the plate thickness. As an alternative it is permissible to take two round specimens with the axes located at one quarter and at mid-thickness of the plate;

for testing of full thickness specimens the tests shall be carried out using several specimens, the total thickness of which is equal to the plate thickness. As an alternative it is permissible to take two round specimens with the axes located at one quarter and at mid-thickness of the plate;

.2 impact bending tests:

for plates made of hot-rolled strip, one additional set of specimens shall be taken from the middle of the strip constituting the coil;

for plates having thickness higher than 40 mm, one additional set of specimens shall be taken with the axes located at mid-thickness of the plate;

when conducting an impact bending test, besides the amount of energy required for specimen destruction, the percentage of the tough (brittle) component shall be determined additionally;

strain ageing sensibility tests, unless otherwise specified, shall be conducted according to 2.2.3.4, Part XIII "Materials" of Rules for the Classification and Construction of Sea-Going Ships. For rolled products having thickness more than 40 mm, the Register may require to conduct additional tests of specimens machined from the middle of rolled product. Standards of the test results – in accordance with Tables 3.2.2-1 and 3.2.3, Part XIII "Materials" of Rules for the Classification and Construction of Sea-Going Ships, depending on the steel grade;

.3 chemical composition:

the chemical analysis shall be carried out using both the ladle sample and rolled material submitted for testing. As the material for rolled material analysis the tensile test specimens are employed. As a rule, the content of the following elements shall be defined: C, Mn, Si, P, S, Ni, Cr, Mo, Al, N, Nb, V, Cu, As, Sn, Ti. For steels manufactured from electric and open-hearth furnaces the Sb and B content is defined additionally;

.4 sulphur segregation:

the segregation shall be estimated on samples taken from the plate edges, normal to the axes of the ingot or slab. The sulphur prints shall extend for about 600 mm and shall be taken from the center of the edge selected, i. e. on the ingot central line, and they shall include the whole plate thickness;

.5 micrographic analysis:

the photomicrographs shall be representative of the full thickness. For thick rolled products three control photographs shall be normally made at surface, one quarter and mid-thickness of the product;

All the photomicrographs shall be taken at X100 magnification, and where ferrite grain size exceeds the requirements of ASTM10, additional photomicrographs shall be taken at X500 magnification. The ferrite grain size shall be determined for each photomicrographs submitted.

.6 drop weight tests:

the test shall be carried out in accordance with the requirements of ASTM E208. The NTD shall be determined and photographs of tested specimens shall be taken and enclosed with the test report;

.7 through-thickness tensile test:

the tests shall be conducted in accordance with 2.2.2.5, Part XIII "Materials" of Rules for the Classification and Construction of Sea-Going Ships. The test results shall meet the requirements of 3.2 for respective steel grades.

2.2.1.3.6.3 Other types of tests.

Additional tests, such as CTOD or large scale brittle fracture tests or others may be required in case of newly developed steel types differing from those specified in 3.2, Part XIII "Materials" of Rules for the Classification and Construction of Sea-Going Ships, or when the Register deems it necessary.

2.2.1.4 Weldability test.

2.2.1.4.1 General.

The tests are required for normal (grade E) and higher strength steels.

The required weldability tests for steel plates shall be conducted on specimens of maximum plate thickness.

2.2.1.4.2 Preparation and welding of test specimens.

In general, the following tests are required:

.1 for one butt-welding specimen: welding with a heat input of approximately 15 kJ/cm;

.2 for one butt-welding specimen: welding with a heat input of approximately 50 kJ/cm;

The butt-test weld shall be prepared with the weld seam transverse to the plate rolling direction, so that impact specimens will result in the longitudinal direction.

The edge bevel shall be preferably 1/2V or K.

The welding procedure shall be as far as possible in accordance with the normal welding practice used at shipyards for the submitted type of steel.

The welding parameters including grade of welding electrodes and their diameter, preheating temperatures, interpass temperatures, heat input, number of passes, etc. shall be reported.

2.2.1.4.3 Types of tests.

The following test specimens shall be cut out from the samples:

.1 one cross weld specimen – for tensile test;

.2 four sets of specimens, each of three specimens – for impact bending tests (*KV*).

One set is provided with notches located at the fusion line, another set with notches at a distance of 2 and 5 mm from the fusion line, the third set with notches at a minimum distance of 20 mm from the fusion line (refer to Fig. 6.4.5, Part XIV "Welding" of Rules for the Classification and Construction of Sea-Going Ships). The fusion line boundary shall be identified after etching. The test temperature shall be the one prescribed for the testing of the specific steel grade;

.3 specimens for determination of HV5 hardness across the weldment:

the hardness shall be measured along the line crossing the weld, beneath the plate surface, on both the weld face side and weld root side, at a distance of 1mm from:

fusion line;

heat affected zone: at each 0,7 mm from the fusion line and into unaffected base metal (minimum 6 to 7 measurements for each heat affected zone).

The maximum hardness value shall not exceed 350 HV.

The test results shall be submitted together with a sketch of the weld joint groove dimensions, number of passes, measuring points, as well as photomicrographs of the weld cross section.

2.2.1.4.4 Other types of tests.

Additional tests, such as cracking tests (CTS), CTOD and some other may be required in case of newly developed type of steel outside the scope of 3.2, Part XIII "Materials" of Rules for the Classification and Construction of Sea-Going Ships or in the cases stated in Section 3, Part XII "Materials" of Rules for the Classification, Construction and Equipment of Mobile Offshore Drilling Units (MODU) and Fixed Offshore Platforms (FOP), or when deemed necessary by the Register.

2.2.1.5 Results.

All test results or test conditions shall comply with the requirements of the Rules and shall be approved by the Register: in the documents submitted for approval the results of tests (specified or not specified by the Rules) shall be recorded, as well as respective conditions of tests execution.

Besides, the manufacturer shall collect a set of documents, which contain all the information required by 2.2.1.2 on the semi-finished products subjected to tests. The set of documents shall include all the results of tests and analyses, operational records of such processes as production of steel, casting, rolling, heat treatment or thermomechanical treatment of material submitted for testing. The set of documents may also be requested by the Register for consideration.

2.2.1.6 Recognition.

2.2.1.6.1 Results of recognition.

In case the results of the works' surveys and testing are satisfactory, the Register will issue Recognition Certificate for Manufacturer.

2.2.1.6.2 List of recognized manufacturers.

The works having the Recognition Certificate for Manufacturer are entered by the Register into the List of manufacturers recognized by the Register. The List, besides the names of manufacturers, contains information on the products manufactured by them and recognized by the Register: grades and/or brands of steel and the main conditions, under which the Register formalized its recognition of the works.

2.2.1.6.3 Renewal of recognition.

Renewal of Recognition Certificate for Manufacturer validity may be performed on the basis of the analysis and the results of supervision during the validity term of the existing Certificate.

Where for operational reasons, the audit for renewal recognition (renewal of Recognition Certificate for Manufacturer validity) falls outside the validity period of recognition, the manufacturer may be considered as recognized by the Register only if agreement to this audit date is made within the original period of recognition validity.

In case of positive results of the audit the recognition validity term and the date of its renewal will correspond to the initially established terms.

The manufacturers that during the validity period of Recognition Certificate for Manufacturer did not produce and did not supply the grades/brands of steel and types of rolled products recognized by the Register shall conduct all necessary tests in order to renew the Certificate. At the Register discretion the renewal of recognition for such grades of steel and types of rolled products (their retention in the Recognition Certificate for Manufacturer) can be executed on the basis of the results of production of similar brands of steel and types of rolled products.

2.2.1.6.4 Reconsideration of recognition.

Recognition may be reconsidered during the validity period of Recognition Certificate for Manufacturer in the cases specified in 2.1.4.2.

2.2.2 Approval scheme for manufacturers of hull structural steels intended for welding with high heat input.

2.2.2.1 General provisions.

The present provisions specify the weldability confirmation scheme of normal and higher strength rolled hull structural steels intended for welding with high heat input over 50 kJ, at the Register recognition of the steel manufacturer in compliance with 2.2.1.

The weldability confirmation scheme shall be generally applied by the rolled steel manufacturer's option. On the basis and within the frame of the tests performed the Register issues the relevant document certifying that the steel has satisfactory weldability for high heat input welding.

The document covers a particular steel mill manufacturing a particular grade of steel to a specific chemical composition range, melting practice, rolling practice, heat treatment and control. The approval scheme does not apply to qualification of welding procedures to be undertaken by the shipyards.

2.2.2.2 Scope of application. Documentation.

When applying to the Register, except stated in 2.2.1.2.1, the following information shall be submitted:

manufacturing control points to prevent toughness deterioration in heat affected zone when welded with high heat input, relevant to melting, casting, rolling, heat treatment, etc.

Welding control points to improve joint properties on strength and toughness, if any.

2.2.2.3 Tests.

2.2.2.3.1 Scope of tests.

Unless otherwise agreed, scope testing and respective program for steel grades are specified proceeding from the following provisions:

.1 approval tests on the lowest and highest toughness levels (proceeding from the impact test parameters and temperatures) cover the intermediate toughness level (e. g. the test results for steel grades PCA 36 and PCE 36 apply to steel grade PCD 36);

.2 approval tests for normal strength level cover that strength level only;

.3 for high tensile steels approval tests on one strength level cover the strength level immediately below;

.4 tests may be carried out separately subject to the same manufacturing process (e.g. differences in melting

and/or casting method, and/or rolling, and/or heat treatment);

.5 results of surveys and tests carried out under the technical supervision of one of the Classification Societies and respective documentation approved by that Classification Society may be recognized and approved by the Register without additional testing.

2.2.2.3.2 Test program

The test program shall be drawn up in accordance with 2.2.1.4.3.

However, the test program may be modified proceeding from the local conditions and new tasks. In particular, additional test assemblies or types of tests may be required in case of newly developed steel types, welding consumables or welding methods, or, in well-grounded cases, at the Register discretion.

The program shall be approved at the Register prior to surveys and testing.

2.2.2.3.3 Requirements for the rolled products to be tested.

To be submitted for testing in accordance with the above mentioned program are the rolled products manufactured by the process approved in compliance with the requirements of 2.1.1.4. For each manufacturing process route, two test rolled products shall be selected. The thicker plate (t) and thinner plate (less than or equal to *t*/2) shall be proposed.

Small changes in manufacturing processing (e.g. within the TMCP process) may be considered for acceptance without testing, at the discretion of the Register.

2.2.2.3.4 Preparation of test assemblies.

One butt weld assembly shall be welded with heat input over 50kJ/cm and shall be generally prepared with the weld axis transverse to the plate rolling direction.

The dimensions of the test assembly shall be amply sufficient to take all the required test specimens specified in 2.2.1.4.3.

The welding procedures shall, as far as possible, be in accordance with the normal practices applied at shipyards for the test steel structures concerned.

Welding process, welding position, welding consumables (manufacturer, brand, grade, diameter and shield gas) and welding parameters including edge preparation, heat input, preheating temperatures, interpass temperatures, number of passes etc. shall be included in the appropriate test report.

2.2.2.3.5 Requirements to tests and examination.

Unless otherwise specified, the test assembly shall be examined and tested in accordance with the following:

.1 visual examination.

Overall welded surface shall be uniform and free from injurious defects such as cracks, undercuts, overlaps etc.

.2 macroscopic test.

At least one macroscopic photograph shall be representative of transverse section of the welded joint and shall show absence of fusion, cracks, lack of penetration and other injurious defects.

.3 microscopic test

Along mid-thickness line across transverse section of the weld, one micrograph shall be taken at each position of the weld metal centreline, fusion line and at a distance 2, 5, 10 and minimum 20mm from the fusion line. The test results shall be included in the report for information purposes only.

.4 hardness test.

Along two lines across transverse weld section 1mm beneath the plate surface on both face and root side of the weld, indentations by *HV5* shall be made at weld metal centerline, fusion line and each 0,7 mm position from fusion line to unaffected base metal (minimum 6 to 7 measurements for each heat affected zone).

The maximum hardness value shall not be higher than 350*HV.*

.5 transverse tensile tests.

At least Two transverse (cross weld) tensile specimens shall be taken from the test assembly. Test specimens and testing procedures are to comply with the requirements of 2.2. The requirements for retesting are set forth in 1.3.2.3, Part XIII "Materials" of the Rules for the Classification and Construction of Sea-Going Ships.

The tensile strength shall be not less than the minimum required value for the grade of base metal.

.6 bend tests.

At least two transverse (cross weld) test specimens shall be taken from the test assembly and bent on a mandrel with diameter of quadruple specimen thickness. Bending angle shall be at least 120°.

For rolled steel thickness up to 20 mm, one face-bend and one root-bend specimens or two side-bend specimens shall be taken. For rolled steel thickness over 20 mm, two side-bend specimens shall be taken.

After testing, the test specimens shall not reveal any crack nor other open defect in any direction greater than 3 mm.

.7 impact tests.

Charpy V-notch impact specimens (three specimens for one set) shall be taken within 2mm below rolled steel surface on face side of the weld with the notch perpendicular to the plate surface.

One set of specimens transverse to the weld shall be taken with the notch located at the fusion line and at a distance 2 and 5, and minimum 20 mm from the fusion line. The fusion boundary shall be identified etching the specimens with a suitable reagent. The test temperature shall be the one prescribed for the testing of the base metal.

For rolled steel with thickness greater than 50 mm or one side welding for plate thickness greater than 20mm,

one additional set of the specimens shall be taken from the root side of the weld with the notch located at each the same position as for the face side.

The average impact energy values as a result of the above tests shall comply with Tables 3.2.2.-1 and 3.2.3, Part XIII "Materials" of Rules for Classification and Construction of Sea-Going Ships depending on the steel grade.

At the Register request, additional sets of specimens shall be taken to evaluate the transition temperature curve of absorbed energy and percentage crystallinity. Temperature and the scope of testing are subject to special agreement by the Register.

Tests and specimen dimensions shall be in compliance with 2.2, Part XIII "Materials" of Rules for Classification and Construction of Sea-Going Ships.

The requirements for retesting and criteria for accepting the results of the tests performed are set forth in 1.3.2.3, Part XIII "Materials" of Rules for Classification and Construction of Sea-Going Ships;

.8 other types of tests.

Additional tests, such as wide-width tensile test, cold cracking tests (CTS, Cruciform, etc.), CTOD or other tests may be required by the Register in case of newly developed type of steel, when the steel is used in special structures and/or in the event of its intended in special conditions, etc.

2.2.2.4 Results.

The manufacturer shall submit to the Register the complete report on test results and conditions of tests. The report shall contain information the selection of the scope of testing. The Register shall review and evaluate the contents of the test report in accordance with the requirements of the present Section and the Rules in general and decide on the confirmation of weldability.

2.2.2.5 Recognition.

2.2.1.5.1 In case of satisfactory results of testing and respective evaluation of the submitted report, the Register issues a document (Recognition Certificate for Manufacturer) confirming recognition of the works as the manufacturer of hull structural steel intended for welding with high heat input.

This document shall contain the following information:

.1 manufacturer's name;

.2 grade designation with notation of heat input (refer to 2.2.2.5.2);

.3 deoxidation practice;

.4 fine grain practice;

.5 condition of supply;

.6 rolled steel thickness tested;

.7 welding process;

.8 welding consumables (with indication of manufacturer's name, brand and grade), if needed;

.9 actual heat input applied.

2.2.2.5.2 In the Recognition Certificate for Manufacturer, in documentation or on the order, in Quality System Certificates of the Manufacturer and at steel branding, the notation indicating the value of heat input applied in the required tests may be added to the grade designation of the test steel, e.g. "E36-W300" (in the case of heat input 300 kJ/cm applied). The value of this notation shall be not less than 50 and every 10 added.

2.2.3 Procedure for recognition of manufacturers producing rolled steel for welded chain cable lengths.

2.2.3.1 General provisions.

The present provisions specify the procedure for the Register recognition of the manufacturer producing rolled steel (rolled bars) for anchor chain cable lengths.

The recognition procedure forms the basis for the Register verification of the manufacturer's capability to provide the stable satisfactory quality of products ensured, in turn, by the production technology, including programmed rolling schedules, and the quality system adopted at the works in accordance with the requirements of 3.2.1.3 and 3.2.1.4, Part XIII "Materials" of the Rules for the Classification and Construction of Sea-Going Ships.

As a rule, recognition of a certain steel grade produced in accordance with the proposed production process flow chart, means recognition of a certain type of products supplied by the manufacturer and made of this steel grade meeting the requirements of the Register Rules.

2.2.3.2 Application for recognition. Documentation.

Generally, the documents specified in 2.2.1.2.1 and 2.2.1.2.2 together with the application shall be submitted.

2.2.3.3 Tests.

Scope, approval and performance of tests shall be carried out in accordance with the requirements specified in 2.2.1.3.

2.2.3.3.1 Sampling.

Unless otherwise specified, the samples for cutting out specimens (refer to 3.6, Part XIII "Materials" of Rules for Classification and Construction of Sea-going ships) from a semi-finished product (section, bar) shall be corresponding to the top part of the ingot; in case of continuous casting the samples are taken at random.

In accordance with the requirements of the following Table the samples shall be taken from the "top" or "bottom" of the piece.

2.2.3.3.2 Types of tests

The tests shall be carried out in accordance with the directions of Table 2.2.3.3.2.

2.2.3.3.3 The test results as well as the approval procedure shall correspond to the requirements specified in 2.2.1.5 and 2.2.1.6.

Table 2.2.3.3.2[1, 4]

Type of tests	Position of samples, direction of cutting[1] of specimens	Remarks			
Tensile test	Top and bottom transverse[2]	Values of R_{eH}, R_m, A_5, %, $R(A)$, % are determined			
Tensile test (test relieved) for TM steels only	Top and bottom transverse[2]	Stress relieving at 600 °C (2 min/mm with minimum 1 h)			
Impact test[3] for steel grades:		Test temperature, °C			
1, 2	Top and bottom, longitudinal	+20	0	−20	—
3 and higher		0	−20	−40	—
Impact test[3, 5] on strain aged specimens for steel grades:		Test temperature, °C			
1, 2	Top longitudinal	+20	0	−20	—
3 and higher		0	−20	−40	—
Chemical analysis[6]	Top	Complete analysis including micro alloying elements			
Sulphur prints	Top	—			
Micro examination	Top	—			
Grain size determination	Top	Only for fine-grain steels			

[1]Type, scope and results of testing shall be in compliance with the RS Rules requirements and documentation for rolled materials supply.
[2]For sections, plates and strip steels having width less than 600 mm — longitudinal.
[3]One set of three V-notch impact specimens is required for each impact test.
[4]In accordance with the RS Rules requirements the rolled material mechanical properties shall be identified after the rolled steel heat treatment similar to heat treatment of the chain of relevant grade).
[5]Deformation – 5 % + 1 hour at 250 °C.
[6]Chemical analysis of ladle sample is also required.

2.3 LIST OF APPROVED (RECOGNIZED) MATERIALS AND MANUFACTURERS

2.3.1 Manufacturers and products they supply which meet the RS rules requirements are entered in the List of Approved (Recognized) Materials and Manufacturers.

The List of Materials is available in an electronic form on the Register official site and on the site for personnel updated daily.

Recognition Certificate for Manufacturer confirms presence in the relevant List of Materials of a specific manufacturer and the product to be supervised by the Register, it supplies (refer to 2.1).

2.3.2 The List of Materials is primarily published with the aim to provide information on the suppliers of materials and products meeting the RS rules requirements.

The Register is interested in presenting such information to designers, builders and other firms and manufacturers needing it.

It is supposed that preparing orders for materials to be supervised during their manufacture, a consumer, guided by financial interests at least, is forced to take into account the technical capabilities of material suppliers enjoying the Register confirmation.

2.3.3 The List of Materials updated by the Register shall contain the following data:

name of a manufacturer;

location of a manufacturer (postal address, telephone, fax, e-mail);

product type and name;

material grade and brand.

Other information related to tests, technology, equipments, etc. is strictly confidential and may be provided only if agreed with the manufacturer.

2.3.4 Retaining and updating of information in the List of Materials is carried out by the RHO on the basis of data on issue, endorsement, reissue and cancellation of Recognition Certificates for Manufacturer incoming froWhere, due to technological reasons, the Certificate cannot be issued by due date, in order to retain the manufacturer in the List of materials, the manufacturer shall agree the new reissue date with the branch office, which issued the Certificate, during the document validity period, i.e. before the reissue date set. The branch office reports the new reissue date to the RHO Data Processing and IT Support Department (the Notice with the new endorsement/reissue shall be forwarded).

Within 30 days after the endorsement/reissue date set, if the RHO is not informed of the decision made by the location, the notice "Not confirmed" is retained alongside the document in the electronic version of the

List of Materials, and after 30 days, the manufacturer is excluded from that List.

2.3.5 Concurrent with the List of Materials, databases for each of the manufacturers at which the Register ever carried out supervision are compiled in the RHO.

2.3.6 If Recognition Certificate for Manufacturer is cancelled, the manufacturer may be excluded from the List of Materials.

2.3.7 Manufacturer exclusion from the List of Materials is executed only by the RHO decision based on the relevant statement of the location carrying out supervision at the manufacturer's.

2.4 TECHNICAL SUPERVISION DURING MANUFACTURE OF MATERIALS

2.4.1 General.

2.4.1.1 Materials subject to the Register technical supervision during their manufacture (refer to 1.3.2) are supplied by manufacturers having Recognition Certificate for Manufacturer (refer to 1.3.1 and 2.1) together with Certificates of Conformity (Forms 6.5.30 and 6.5.31).

If agreed with the Register branch office carrying out supervision, the manufacturer product may be supplied with manufacturer's certificates witnessed by the Register representative.

2.4.1.2 The Register documents specified in 2.4.1.1 shall be mandatory supplemented with manufacturer's certificates or pertinent reports on material tests. The numbers of reports or manufacturer's certificates shall be identified in Certificate of Conformity (Form 6.5.30).

The content of manufacturer's certificates shall comply with the requirements of procurement documents and Register agreed documentation and shall permit identification of the product supplied.

Additionally to an order number and manufacturer and customer requisites, general information on material (dimensions of semi-finished products, weight, brand and grade of material, the numbers of manufacturer's certificates/reports) is usually given in Certificate of Conformity issued by the Register.

2.4.1.3 Agreed with the RHO and promoted by the location carrying out technical supervision at the manufacturer's, materials may be supplied with the manufacturer's certificates witnessed by the Register. In this case, the latter shall be consistent with the requirements of EN 10204-3.2 the information issued in the Certificate shall be begened with the Register in advance.

2.4.2 Application.

2.4.2.1 The Register carries out technical supervision in all the following cases:

.1 material is subject to the RS rules requirements, and conformity with the requirements thereof is stated in a contract (order) for supply;

.2 material is subject to the RS rules requirements, and conformity with the RS rules and requirements of standards (national, international), specifications or other technical documentation is stated in a contract (order) for supply;

.3 material is subject to the RS rules requirements, and conformity with the requirements of standards (national, international), specifications or other technical documentation is stated in a contract (order) for supply;

.4 material is not subject to the RS rules requirements, but its conformity with the RS rules requirements is stated in a contract (order) for supply;

.5 material is not subject to the RS rules requirements, but its conformity with the requirements of the RS rules, standards (national, international), specifications or other technical documentation is stated in a contract (order) for supply;

.6 material is not subject to the RS rules requirements, but its conformity with the requirements of standards (national, international), specifications or other technical documentation is stated in a contract (order) for supply;

.7 standards (national, international), specifications or other technical documentation to be followed in material supply are agreed with the Register;

.8 standards (national, international), specifications or other technical documentation to be followed in material supply are not agreed with Register.

2.4.2.2 In all the cases mentioned in 2.4.2.1.1 to 2.4.2.1.6, at the manufacturers having the valid Recognition Certificate for Manufacturer, the technical documentation for material supply is subject to examination and approval by the Register prior to tests and survey of the manufacturer. The relevant amendments shall be made to that documentation according to the survey and test results before issuing Recognition Certificate for Manufacturer.

The following shall be taken into account:

in cases specified in 2.4.2.1.2 and 2.4.2.1.3, material shall simultaneously meet the relevant requirements of the RS rules, standards (national, international), specifications or other technical documentation to be followed in supply performance (preference shall be given to the most stringent requirements in case of different requirements specified in rules and documentation);

in cases specified in 2.4.2.1.4 to 2.4.2.1.6, material shall meet the requirements of documents specified in the contract (a standard, specification, etc.). Test procedures, sampling, manufacture of specimens, the test scope shall meet the requirements of Section 2, Part XIII "Materials" of Rules for the Classification and Construction of Sea-Going Ships. The case in 2.4.2.1.4 needs additional instructions from material consumer (customer) regulating material parameters and stated in the contract.

Where the standards (national, international), specifications or other technical requirements specified in the contract (order) are other than those previously agreed,

technical supervision of material may be carried out after reviewing the new requirements comparing them with the pre-agreed ones. Where fundamental differences occur affecting the terms of issuing Recognition Certificate for Manufacturer, the scope of application of the valid Certificate may be extended.

Alternatively, with due regard for 2.4.2.5, the Register location may decide to carry out technical supervision according to a specific contract (order).

2.4.2.3 The manufacturers not having Recognition Certificate for Manufacturer (refer to 2.4.2.4), along with the application for technical supervision performance, shall submit the documentation for material supply to be agreed (if not previously agreed and the validity period of documentation approval (5 years) not expired).

Such documentation (a standard, specification, special requirements, order, etc.) shall be reviewed with due regard for 2.4.2.2.

2.4.2.4 The Register may carry out technical supervision of manufacture, and approve materials for use, which are regulated by Rules for the Classification and Construction of Sea-Going Ships, but supplied by he manufacturer not having the valid Recognition Certificate.

The decision on performance technical supervision in this case shall be taken considering with the following:

the Register location shall have available the relevant information on the manufacturer's capacities to execute the relevant order;

the scope of order shall be limited;

the scope of technical supervision shall be separately agreed with a manufacturer and, if so, to serve as a basis for issuing Recognition Certificate for Manufacturer;

technical supervision shall be carried out according to the separate Agreement (contract).

Information on the manufacturer's capacity to execute the relevant order may be based on the following:

manufacturer and its product are known to the location and positively assessed;

manufacturer had its Recognition Certificate for Manufacturer non-renewed due to lack of orders;

manufacturer has the valid Recognition Certificate, but for the product other than the one in question (extension of the Certificate scope of application);

manufacturer is approved by other classification societies for manufacture of product in question or the one similar to it;

manufacturer is surveyed by the Register location, but the scope of tests is inadequate for issue/renewal of Recognition Certificate for Manufacturer.

2.4.2.5 In technical supervision, in order to eliminate doubts regarding quality stability of the product manufactured, the Register can issue additional requirements.

These may affect the scope of testing for the certain kind and amount of product if compared with that specified in Rules for the Classification and Construction of Sea-Going Ships or in a contract, and may also include the replacement/addition of test types and procedures.

The scope of additional requirements shall be agreed with the manufacturer, and their results may provide a basis for endorsement of Recognition Certificate for Manufacturer.

The reasons given in 2.5.4 may provide a basis for placing the additional requirements even if the cases mentioned in the item are not formally confirmed. Besides, the change of the tests scope and/or types may be demanded when the results of tests being adequate to the limit ones (close to or within the area of a tests error), or having a very wide amplitude of the spread of values for a common kind of product, are regularly received.

3 NON-METALLIC MATERIALS

3.1 PROCEDURE FOR APPROVAL OF PROTECTIVE COATINGS FOR HULL STRUCTURES

3.1.1 General.

3.1.1.1 This Section establishes the procedure for approval of the following protective coatings:

anticorrosive protective coatings of hull structures (for ballast tanks; cargo spaces, hatch coamings and covers of bulk carriers);

antifouling coatings of ship's hulls.

3.1.1.2 The approval procedure comprises the following stages:

3.1.1.2.1 Review and approval of the documentation defining the coating properties, composition and characteristics (Specifications, Technological regulations, Technical specifications or descriptions, etc., as appropriate). The documentation shall contain the applicable requirements of the RS Rules, International Conventions, IMO Resolutions, etc. including those associated with coatings testing. If the specific requirements for coatings are lacking in the RS Rules and other above-mentioned normative documents, the technical documentation is approved with the aim to set the parameters established in it.

3.1.1.2.2 Review and approval of the program of coating control tests. The extent of tests shall provide for verification of the requirements of the RS Rules, International Conventions, IMO Resolutions, etc. If these documents do not contain the specific requirements for tests, the extent of tests is specified according to the standard procedure of the coating manufacturer.

3.1.1.2.3 RS Surveyor's participation in coating tests according to the approved program. The results of tests carried out under the supervision of the Classification Society-IACS Member may be acceptable (test reports shall be witnessed by the latter). In this case, tests performed within the last five years are taken as good.

3.1.1.2.4 The survey of the coating manufacturer according to Part I, Section 7, "General Regulation for Technical Supervision" (when coatings are delivered with the copy of the Type Approval Certificate).

3.1.1.2.5 Issuance of the Type Approval Certificate for the coating with the positive results of the above stages of approval.

3.1.1.3 Renewal of Type Approval Certificate is carried out in a manner like the initial approval. In this case, the extent of surveys and tests may be reduced reasoning from the technical supervision experience at the given works (absence of claims or complaints, absence or unimportant nature of changes in the normative document requirements and documentation of the works, etc.).

3.1.2 Anticorrosive protective coatings of hull structures.

3.1.2.1 The documentation being submitted for approval, which defines the coating properties, composition and characteristics, shall also contain the following data:

type of a coating system (hard – epoxy, etc., semi-hard);

coating colour;

data on incompatibility with different media and/or cargoes;

application for structures being heated by sun rays or being boundaries of heated cargo spaces;

data on compatibility with the anodic protection against corrosion;

data on satisfactory coating performance. If these are lacking, the coating shall be tested according to the recognized standards for fitness for operational conditions (e.g. immersion test, accelerated hot salt fog test and adhesion test).

3.1.2.2 The documentation being submitted for approval shall include:

3.1.2.2.1 The list of manufacturer's technical data for each coating component (Technical specifications, Specification, Technical Data Sheet).

3.1.2.2.2 The instruction (standard, recommendations) on surface preparation for coating application which, as a minimum, shall specify:

that the instruction is based on the IMO Resolution A.798(19) recommendations;

methods of surface preparation;

ambient conditions if abrasive cleaning is used (relative humidity within 85%, the steel temperature is at least by 3°C above the dew-point temperature, absence of moisture or condensation signs);

procedures and extent of examinations of surface preparation;

assessment criteria for surface preparation.

3.1.2.2.3 The instruction (standard, recommendations) on coating application which, as a minimum, shall specify:

environment conditions during application of a coating system;

coating procedures;

thickness of each coating layer (wet and dry);

time interval between surface drying and application of the next coating layer;

use and amount of thinners;

controllable and set parameters during coating;

extent and periodicity of control;

repair of defective or damaged areas.

3.1.2.2.4 Information on potential risks for health and on precautions needed during coating (Material Safety Data Sheet).

3.1.2.2.5 The manufacturer's recommendations on in-service maintenance of the coating which shall take into account the IACS Recommendations 87 "Guidelines for coating maintenance and repairs for ballast tanks and combined cargo/ballast tanks on tankers" (Chapter 3) and contain, as a minimum, the data on:

recommended periodicity of in-service examinations of the coating by the shipowner;

ways to rectify defects identified during in-service examinations;

compatible and/or incompatible (with the existing coating) types of coatings which may be used for rectifying defects in service.

3.1.2.2.6 The form of a manufacturer's quality certificate issued for each batch (delivery) of the coating which specifies, as a minimum, the manufacturer's name, date of manufacture, amount and identification data of the batch delivered, as well as coating characteristics (type, brand, colour, etc.).

3.1.2.3 Semihard coatings shall have the following properties:

application should be possible within a wide temperature range;

the service limit should be minimum 65 °C;

good penetration qualities;

where applicable suitable for bonding to moist surfaces, e.g. water jetted/hydroblasted surfaces according to manufacturer's recommendations;

flexible properties throughout the service life;

resistant to foot traffic allowing easy access for inspection purposed;

resistant to ballast water;

ability to prevent corrosion for at least three years;

the wet film thickness should have an upper limit in order to avoid covering of cracks and

slipperiness caused by excessive film thickness;

light colour coating (distinguishable from rust) is preferable;

some semihard coatings may also minimize corrosion by passivating the metal surface with a corrosion inhibitor whilst also forming a film to prevent passage of moisture.

3.1.2.4 Beginning on 1 July 2008, protective coatings for sea water ballast tanks of all the shiptypes and for double side spaces of bulk carriers are approved according to IMO Resolution MSC.215(82).

3.1.3 Antifouling coatings of ship's hulls.

3.1.3.1 The documentation being submitted for approval, which defines the coating properties, composition and characteristics, shall also contain the following data:

type of the antifouling system[1];

name of the antifouling system manufacturer;

name and colour of the antifouling system;

active ingredient (-s) and its (their) number (-s) by the database "Chemical Abstract Service" (CAS number(-s));

detailed marking of packing containers used for coating delivery.

3.1.3.2 The documentation being submitted for approval shall include:

Material Safety Data Sheet;

form of a manufacturer's quality certificate issued for each batch (delivery) of the coating which shall provide for the above data.

3.1.3.3 Sampling and control test confirming absense of organotin compaunds in the coating (not less than for two coating batches) shall be carried out at the Surveyor's attendance.

3.1.3.3.1 As an alternative to the control tests, statistical data of given coating analyses may be considered (refer to also 3.1.1.2.3).

3.1.3.3.2 The analysis with regard to the total content of tin per kilo of dry paint is recommended to carry out by applying mass spectrometry with inductively coupled plasma (MS/ISP). Any other scientifically-recognized procedure for the tin analysis (e.g. AAS, XRF and ICP-OES) is also acceptable.

3.1.3.3.3 The analysis results shall be consistent with the IMO Resolution MEPC.104(49) requirements and are considered positive if:

.1 25 %, as a maximum, of the total number of samples yield the results exceeding 2500 mg total tin per kilo dry paint (2500 mg/kg); and

.2 no sample must exceed 3000 mg Sn/kg of dry paint.

3.1.3.3.4 The analysis of samples shall be carried out by the RS-recognized laboratory. If the latter is lacking, the analysis shall be carried out by the laboratory meeting ISO 17025 or by another works recognized/ accredited by a competent national body.

3.1.3.4 If the laboratory carrying out the regular analysis of coating tin content belongs to the coating manufacturer, that laboratory shall be surveyed simultaneously with the manufacturer according to Section 9 Part I "General Regulations for Technical Supervision".

4 WELDING. REGULATIONS FOR WELDERS' CERTIFICATION

4.1 GENERAL

4.1.1 The approval test for welders is the mandatory procedure used by the Register to confirm the skill of welders engaged in manufacturing objects being under the Register technical supervision.

4.1.2 Welder Approval Test Certificate (Form 7.1.30) is the document verifying that a particular welder meets all the requirements specified in Section 5, Part XIV "Welding" of Rules for the Classification and Construction of Sea-Going Ships and in this Section.

4.1.3 Successful passing theoretical and practical examinations by a welder provides the basis for issuing Welder Approval Test Certificate.

4.1.4 The procedure for welder's tests performance and issuance of Welder Approval Test Certificates shall comply with the requirements of Section 5, Part XIV "Welding" of Rules for the Classification and Construction of Sea-Going Ships and the requirements given below.

4.2 REQUIREMETNS FOR WELDERS' CERTIFICATION PROCEDURE AND ARRANGEMENT

4.2.1 Welders' approval tests shall be performed in a centralized way by the manufacturer-employer's request in the certification centres whose competence has been verified by the Register.

[1] Examples of appropriate wordings: self-polishing type without tinny organic compounds, ablative type without tinny organic compounds, common type without tinny organic compounds, silicone type biocide-free paint, etc. Regarding the antifouling system containing no active ingredients, the words "biocide-free" shall be used.

4.2.2 The certification centers may be established at manufacturers', educational institutions, specialized organizations and institutions having qualified welding specialists and training and testing base needed for welders' training and testing.

4.2.3 The structure of the certification centre shall provide the presence of the following key components ensuring its functioning:

management;

qualification panel;

administrative personnel to ensure the performance of all types of tests, and equipment functioning;

main and auxiliary production equipment for practical tests performance;

equipment, tools and measurement means for the performance of welded joints testing;

premises for practical and theoretical tests of welders.

4.2.4 The standing qualification panel is the working body of the certification centre that directly conducts welders' certification.

The Register surveyor carrying out the technical supervision of test performance is the member of the qualification panel and shall be present during performance of all types of tests verifying results thereof.

4.2.5 In survey of the certification centre to confirm its competence, the Register surveyor shall carry out the following:

.1 review the Regulation on the certification centre with appendices (with positive results, the stamp "DULY NOTED" is put on it);

.2 review and approve the program of theoretical training and the list of examination paper questions (to be stamped "APPROVED");

.3 review and approve the programme of welders' practical tests performance (to be stamped "APPROVED"), as well as the forms of welding procedure specifications completed for practical tests performance (to be signed by the surveyor and witnessed with a personal stamp);

.4 survey the material base including:

process of preparation of test assemblies for welders' practical tests (plates and pipes);

organization of storage and issuance of welding consumables for practical tests (the availability and technical condition of heating furnaces, heat chambers and heating cabinets for storage);

organization of the preliminary check of welding consumables quality prior to their issuance for tests (the availability of a press for T-shape test specimens fracture, the availability and serviceability of an instrument for checking the eccentricity of electrode coatings, equipment for measuring the moisture content of electrode coatings and fluxes, or for checking diffusion hydrogen content in weld metal, etc.);

check the availability and functioning of equipment for back chipping (gas-arc gouging, cutting-out with an abrasive tool or mechanical gouging);

check the availability and functioning of equipment for the non-destructive examination of welded joints (ultrasonic, radiographic, magnetic powder and dye penetrant examination).

N o t e . When the examination of welded joints is carried out by external organizations, an illuminator for radiographs inspection shall be available in the certification centre;

check the availability of instrumentation for the examination of welded joints by visual inspection and measurements (reports of instruments calibration shall be checked);

check the availability and functioning of equipment for mechanical testing of welded joints (reports of test machines calibration shall be checked).

N o t e . When welders are qualified for stainless steel welding, the equipment for performance of intercrystalline corrosion tests and the analysis of a ferritic component content in weld metal shall be available;

check the availability and serviceability of equipment for practical tests performance including the survey of stations for those welding methods which are presented for the welders' approval test;

check the serviceability of the local (welding stations) and general plenum-exhaust ventilation in spaces for practical tests;

check the serviceability of instrumentation for measurements of welding conditions parameters including an interpass temperature (reports of calibration shall be checked);

.5 survey the personnel qualification engaged in test performance including the members of the qualification panel and administrative personnel;

.6 survey the premises for the work of qualification panel members;

.7 check the availability of checking samples of the scientific documentation referred to in the Programs of theoretical and practical tests (including the lists of check questions).

4.2.6 Where the certification centre is established at the manufacturer's that joins structures by welding under the Register technical supervision, and its activity is limited to the qualification of welders of the very enterprise, the procedure for centre recognition by the Register with the drawing-up of proper documents may be ignored.

4.2.7 All the qualification centers engaged in training and/or qualification of welders from external organizations on a profit basis with or without the formation of a legal entity are subject to the Register recognition.

Following the results of certification, the Certificate on Form 7.1.27 is drawn up. In so doing, the mutual liabilities and responsibilities of the parties are regulated by the Agreement attached to the Certificate.

4.2.8 The welders' qualification is classified as initial, additional, periodical and occasional.

Subject for initial qualification are welders aged 18 years and older who did not previously pass approval tests for the welding of objects and equipment under the

Register technical supervision, who are certified as welders and have the work experience of welding performance according to the qualification assigned for at least 12 months, and also have undergone the special theoretical and practical training according to the programs drawn up individually for each type of works and for each type of a welding method with due regard for the specific nature of works for which the welder shall be qualified.

Additional qualification of welders who had undergone the initial qualification is carried out prior to their approval for performance of works other than those specified in the Welder Approval Test Certificate, as well as after a break over six months in performance of the relevant welding works.

All welders undergo periodical qualification to confirm their skills and prolong the validity period of Welder Approval Test Certificate in compliance with the requirements of 3.6. The welders are subject to the periodical qualification at least once in two years.

All welders undergo the occasional qualification prior to their approval for performance of welding after the temporary removal from work due to a poor quality and deviations from the welding procedure. The training period for the occasional qualification (for additional education and training) shall be at least a month since the date of being removed from the work.

In additional, periodical and occasional qualification, the special theoretical and practical training extent is established by the qualification panel and shall be individually agreed with the Register.

4.2.9 For the welders' approval testing by the Register, the manufacturer administration shall send to the Register regional location performing supervision of welding works at the manufacturer's an application in which the following shall be specified:

name and address of the certification centre where the welders will be qualified;

list of the workers to be qualified with their (for every worker) full names, year and place of birth, place of work, speciality and job skill, experience in the work to be qualified for;

copies of documents to confirm the job skill of the workers in the type of the work to be qualified for;

welding method, welding positions and other particulars needed for the qualification and completion of the Welder Approval Test Certificate;

guarantees of payment for the Register services according to the current rates.

Note. If the payment for the Register services, in accordance with the Agreement concluded (refer to 4.2.7), is carried out through the certification centre, the application for work performance may come directly from its Administration.

4.3 DEFINITIONS, TERMS AND SYMBOLS USED IN WELDERS' APPROVAL TESTING

4.3.1 Definitions and terms.

Certification is a combination of actions to determine the skill level of a welder with a view to ascertain the possibility of his approval for performance of the specific type of welding works.

Certification panel is a team of certification centre specialists that is responsible for the organization of works and the reliability of the results on welders' certification.

Certification centre is a competent body authorized by the Register for performing tests on welders' certification according to the requirements of the RS rules.

Approval test is a special procedure providing the determination of a welder's skill through his certification and the issuance of an official document, i. e. Welder Approval Test Certificate for verifying permission to perform welding in objects under the Register technical supervision within the range of approval specified by the Certificate.

Range of approval is the extent of welder's skill recognition by the Register basing on the tests carried out in certification.

Test specimen is the part of a test piece used for performance of destructive tests.

Test piece is a welded assembly used in practical tests for welder's certification.

Welder is a person performing the welding of metals. It is a collective term for a manual welder who welds by hand in different ways and for a welding operator who operates semiautomatic and automatic welding sets.

Welder Approval Test Certificate is the Register document verifying that a particular welder has successfully passed the approval test in the scope of the RS rules requirements and is approved for welding in structures under the Register technical supervision, within the range of approval specified by the Certificate.

4.3.2 Symbols relating to welding procedure and welding consumables.

4.3.2.1 The welders' approval testing is carried out separately for each of the following welding processes (numerical symbols comply with ISO 4063):

111 = manual metal-arc welding with covered electrode (SMAW or MMAW);

114 = flux-cored wire metal-arc welding without gas shield (FCAW);

121 = submerged arc welding with one bare-wire electrode (SAW);

131 = metal-arc inert gas welding (MIG);

135 = metal-arc active gas welding (MAG);

136 = flux-cored wire metal-arc welding with active gas shield (FCAW);

137 = flux-cored wire metal-arc welding with inert gas shield (FCAW);

141 = tungsten inert gas arc welding (TIG) with or without filler wire;

15 = plasma arc welding;

311 = gas (oxy-acetylene) welding;

73 = gas-arc welding;

72 = electroslag welding.

4.3.2.2 The welders' approval testing is carried out separately for each of the below listed welding processes which vary in the degree of welder's labour mechanization:

MW = manual welding wherein wire feed and the movement of a welding gun along and across the weld are carried out by the welder (by hand);

SA = semiautomatic welding wherein wire feed is mechanized, but the movement of a welding gun along and across the weld is carried out by the welder;

A = automatic welding wherein the processes of wire feed and welding gun manipulation are automated and carried out without welder's direct participation.

4.3.2.3 To specify the range of approval according to the results of welders' practical tests, covered metal electrodes are subdivided by the covering type as follows (letter indexes comply with ISO 2560 and EN 499):

A = acid (oxidizing) covering;

B = basic covering;

C = cellulose covering;

R = rutile covering;

RA (AR) = mixed rutile-acid covering;

RB = mixed rutile-basic covering;

RC = mixed rutile-cellulose covering;

RR = rutile thick covering;

S = other (special) types of coverings.

4.3.2.4 For designation of the composition of the shielding gas used for welders' practical tests, the alphanumeric indexes unified with EN 439 and given in Tables 4.3.2.4-1 and 4.3.2.4-2 are used.

4.3.2.5 For designation of the flux type used for welders' practical tests, the letter indexes unified with EN 760 which identify a manufacture method are used:

F = fused flux;

Table 4.3.2.4-1

Classification of shielding gases for arc welding and cutting according to EN 439

Composition designation		Content of components, vol. %						Usual scope of application (by welding methods)
Group	Code No.	Oxidizing		Inert		Reducing	Low-active	
		CO_2	O_2	Ar	He	H_2	N_2	
R	1	—	—	Base[1,2]	—	> 0 — 15	—	141, 15, protection of the weld root
	2	—	—	Base[1,2]	—	> 15 — 35	—	
I	1	—	—	100	—	—	—	131, 137, 141, 15 protection of the weld root
	2	—	—	—	100	—	—	
	3	—	—	Base[2]	> 0 — 95	—	—	
M1	1	> 0 — 5	—	Base[1,2]	—	> 0 — 5	—	135 and 136
	2	> 0 — 5	—	Base[1,2]	—	—	—	
	3	—	> 0 — 3	Base[1,2]	—	—	—	
	4	> 0 — 5	> 0 — 3	Base[1,2]	—	—	—	
M2	1	> 5 — 25	—	Base[1,2]	—	—	—	135 and 136
	2	—	> 3 — 10	Base[1,2]	—	—	—	
	3	> 0 — 5	> 3 — 10	Base[1,2]	—	—	—	
	4	> 5 — 25	> 0 — 8	Base[1,2]	—	—	—	
M3	1	> 25 — 50	—	Base[1,2]	—	—	—	135 and 136
	2	—	> 10 — 15	Base[1,2]	—	—	—	
	3	> 5 — 50	> 8 — 15	Base[1,2]	—	—	—	
C	1	100	—	—	—	—	—	135 and 136
	2	Base	> 0 — 30	—	—	—	—	
F	1	—	—	—	—	—	100	protection of the weld root
	2	—	—	—	—	> 0 — 50	Base	

[1] Helium may replace up to 95 % of argon. The helium proportion is indicated by an additional code index after the composition designation according to Table 4.3.2.4-2.

[2] The approval is valid only for mixtures of shielding gases with the similar or higher content of helium relative to the nominal composition of the mixture in approval tests.

In use of the gas mixtures ignored in the Table, they are designated by an index S followed by a composition interpretation. The approval is valid only within the nominal composition of the mixture used in the approval tests.

Table 4.3.2.4-2

Code indices for helium-containing R and M groups

Code index	Helium content in gases mixture, vol. %
(1)	> 0 — 33
(2)	> 33 — 66
(3)	> 66 — 95

A = sintered (ceramic) flux;

M = mixed fluxes (various types of mechanical mixtures and sintered fluxes).

4.3.2.6 For designation of the flux composition used for welders' practical tests, the letter indexes unified with EN 760 may be used according to Table 4.3.2.6.

Table 4.3.2.6

Classification of welding fluxes by the chemical composition of constituents according to EN 760

Index	Flux	Chemical composition	
		Constituents	Limit of constituent, %
MS	Manganese-silicate	$MnO+SiO_2$ CaO	Min 50 Max 15
CS	Calcium-silicate	$CaO+MgO+SiO_2$ $CaO+MgO$	Min 55 Min 15
ZS	Zirconium-silicate	ZrO_2+SiO_2+MnO ZrO_2	Min 45 Min 15
RS	Rutile-silicate	TiO_2+SiO_2 TiO_2	Min 50 Min 20
AR	Aluminate-rutile	$Al_2O_3+TiO_2$	Min 40
AB	Aluminate-basic	$Al_2O_3+CaO+MgO$ Al_2O_3 CaF_2	Min 40 Min 20 Max 22
AS	Aluminate-silicate	$Al_2O_3+SiO_2+ZrO_2$ CaF_2+MgO ZrO_2	Min 40 Min 30 Min 5
AF	Aluminate-fluoride-basic	$Al_2O_3+CaF_2$	Min 70
FB	Fluoride-basic	$CaO+MgO+CaF_2+MnO$ SiO_2 CaF_2	Min 50 Max 20 Min 15
Z	—	Any other constituents	

4.3.2.7 To designate the presence of filler involved in weld formation, the following letter indexes are used in welders' approval testing:

wm = welding with filler metal feed;

nm = welding without filler, i.e. the weld is formed through the melting of base metal only.

4.3.3 Symbols relating to base metal and joint type.

4.3.3.1 The welders' approval testing according to the results of practical tests is carried out with reference to the groups of base metal type composition in accordance with Table 4.3.3.1.

Table 4.3.3.1

Groups of type composition and properties of base metal

Group index	Type and description of materials being welded
W 01	Carbon and low-alloyed steels having the guaranteed yield stress of up to 360 MPa at the normal temperature (basically, heating in welding not needed).
W 02	Chromium-molybdenum and/or chromium-molybdenum-vanadium steels (basically, need preheating and heat input control, as well as heat treatment after welding).
W 03	Fine-grained structural steels normalized, quenched and tempered, as well as thermomechanically treated steels with a yield stress of over 360 MPa at the normal temperature, as well as similarly welded steels with a nickel content of 2 % to 5 % (basically, need preheating and/or heat input control).
W 04	Ferritic, martensitic and martensitic-ferritic steels with a chromium content of 12 % to 20 %.
W 11	High-alloy ferritic-austenitic and austenitic chromium-nickel steels.
W 21	Pure aluminium and aluminium-manganese alloys. For example, Al 99,8; Al 99,5; Al 99; Al Mn 1.
W 22	Non-heat-treatable aluminium-magnesium alloys. For example, AlMg 1 to 5, AlMg 3 Mn, AlMg 4,5 Mn and aluminium-silicon alloys (silumins).
W 23	Heat-treatable aluminium alloys. For example, AlMgSi 0,5 to 1; AlSiMgMn, AlSiMg; AlZn 4,5 Mg 1, AlSiCu.

Notes:

1. Group indexes comply with the European Standards EN 287-1 (for steel) and EN 287-2 (for aluminium and alloys).
2. For cast aluminium alloys, the filler material is to comply with the requirements of the RS Rules for materials of this group.

4.3.3.2 The welders' approval testing shall be carried out with reference to the specific type of a weld joint coded by a group of indexes according to Fig. 4.3.3.2.

4.3.4 Symbols relating to test piece types and welding positions.

4.3.4.1 For practical tests to approve welders, the unified check welded joints — test pieces complying with the instructions of Appendix 1, shall be used. Geometric parameters and dimensions of the test pieces shall be indicated using the following indices:

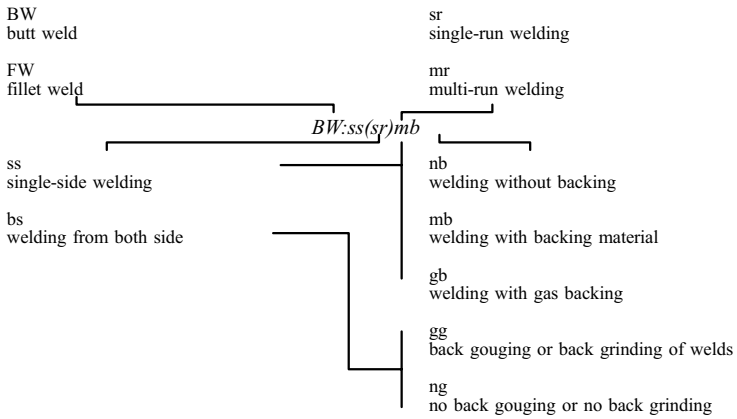


Fig. 4.3.3.2 Coding diagram for weld type and welding details

P = plate;
T = pipe;
D = outside diameter of a pipe;
t = thickness of a plate or pipe;
Z = leg;
a = throat thickness;
L = length of a test piece;
b = width.

4.3.4.2 The welding of welded joint test pieces is carried out in the unified welding positions complying with the instructions of Appendix 2.

4.3.5 Coding of results of welders' approval testing.

To make an entry in an appropriate column of the Approval Test Certificate and in the report of practical tests, an alphanumeric designation for conditions of welders' practical tests performance is recommended. The designation structure according to EN 287-1 and EN 287-2 provides for recording the following information blocks:

1	2	3	4	5	6	7	8	9

Where:
1 = rules and standard for test performance;
2 =welding method according to 4.3.2.1;
3 = test piece type according to Appendix 1;
4 = weld type (BW, FW) according 4.3.3.2;
5 = group of materials to be welded, according to 4.3.3.1;
6 = filler (for electrodes, the covering type shall be specified, for the rest, the presence of filler feed);
7 = test piece dimensions: plate or pipe thickness (t), outside diameter of a pipe (D);
8 = unified welding position of the test piece in welding according to Appendix 2;
9 = conditions of welded joint performance according to the right of the diagram in Fig. 4.3.3.2.

Examples:

1. RS Rules, EN 287-1: 111 P_1 BW WO1 Bt_{10}PF ss nb

Explanation:

the tests are performed according to the requirements of the RS rules and EN 287-1;
111 = welding process (manual metal-arc welding with covered electrode);
P_1 = type of a test piece (butt joint of plates);
BW = butt weld;
WO1 = steel group;
B = basic-covered electrodes;
t_{10} = thickness of the test piece metal 10 mm;
PF = vertical-upward welding;
ss = single-side weld;
nb = without backing.

2. RS rules, EN 287-2: 141 P_3 BW W22 wm (R3/I1) t_8D120 PF ss gb

Explanation:

the tests are performed according to the requirements of the RS rules and EN 287-2;
141 = welding process (tungsten inert gas are welding);
P_3 = type of a test piece (butt joint of plates);
BW = butt weld;
W22 = aluminium alloys group;
wm = welding with filler material feed (R3/I1: R3 grade rods, shielding gas – 100 % argon);
t_8 = thickness of a pipe wall 8 mm;
D120 = outside diameter 120 mm;
PF = welding position (fixed pipe, horizontal axis, vertical-upward welding from 6 to 12 hours);
ss = single-side weld with gas backing (gb).

4.4 PROCEDURE FOR APPROVAL TESTING OF WELDERS

4.4.1 General requirements for tests performance procedure.

The procedure for welders' certification comprises theoretical and practical examinations by the welder to be certified.

The certification shall be started with the practical examination. If the welder fails to pass the practical examination, he is not admitted to other examinations and is considered to have failed to be certified.

During the theoretical examination, the welder shall answer at least 15 questions covering the major sections of general and special (by profession) subjects. The questions are selected for each welding process by the certification panel.

In examining, the certification panel applies one of the following methods or the combination thereof:

written verification of knowledge;

oral questioning;

computer verification of knowledge;

written description followed by a practical demonstration on the relevant equipment.

The examination results are assessed by the certification panel as "Accepted/Not accepted". The designation "Accepted" corresponds to at least 80 % of the correct answers to the questions asked. The welder is considered to be certified when passing both practical and theoretical examinations.

If the welder has passed the practical examination, but has failed the theoretical one, he is allowed to resit the latter by an additional application within half a year since the day of the first examination, but not earlier than two weeks after the initial date of the theoretical examination. In case of reoccurring negative result of the theoretical examination, the welder is considered to have failed the certification.

4.4.2 Requirements for practical tests procedure.

4.4.2.1 Welders' practical tests are performed by welding the check welded joints given in Appendix 1.

The performance of the welding of check test pieces shall be witnessed by at least three members of the certification panel:

one certified welding engineer;

one representative of the technical control service having the qualification level permitting him to make conclusions on the control results through visual inspection and measurements;

one Register representative.

4.4.2.2 Prior to the welding, an identification number registered in the test report is stamped on test pieces of welded joints.

The assembly of joint parts for welding is carried out by the welder to be certified. The welding of the test piece is allowed by the certification panel member after accepting the quality of assembly for welding.

The certification panel can discontinue the practical examination if the welder has violated the welding conditions and procedure or it is obvious that he is unable to weld the test piece in accordance with the requirements of a specification and the RS rules.

4.4.2.3 In the performance of practical qualification tests for welders' approval testing, the welding shall be performed on the basis of the Welding procedure specification (of a manufacturer) of an established pattern which is completed in accordance with the actual conditions of welding under production conditions. The following requirements shall be fulfilled:

test pieces shall be welded using the welding processes applied in manufacture;

filler material shall be consistent with the peculiarities of the welding process and position;

structural components of edge preparation for welded joints of the test pieces for tests performance (a groove angle, root face, root gap) shall be representative for those used in manufacture;

test piece dimensions shall be stated in the Specification and comply with the requirements of Appendix 1;

welding equipment shall be of the same type as that used in manufacture;

test pieces welding shall be performed in the positions and angles of pipe branch connections normally used in manufacture;

welding conditions and the welding sequence in the groove shall to correspond to those used in manufacture;

combination of base metal, filler and auxiliary materials shall correspond to the conditions used in manufacture;

welding time for the test piece shall correspond to the standards applied in manufacture;

test piece shall have at least one stop and one re-start in the root run and in the top capping run and shall be identified in the inspection length to be examined; this requirement is mandatory for manual and semiautomatic welding;

where the pre-heat, controlled heat input are required or the requirement for the minimum/maximum interpass temperature is regulated for particular welded joints (combinations of base metal and welding consumables) in manufacture practice, these parameters of the technological process shall be met while welding the test pieces for the welders' approval test;

where the post-weld heat treatment is required for particular welded joints in manufacture practice, this operation becomes mandatory for the welder's test pieces only in case when the test program provides for the bend test of test specimens. For other cases, the post-weld heat treatment of welded joint test pieces may be omitted if agreed with the Register;

test pieces shall be unambiguously identified;

as agreed with the Register surveyor, it is allowed to remove minor surface imperfections of internal layer

beads of the weld by grinding or any other method used in manufacture. The removal of defects on the surface layer, as well as the continuous grinding or gouging of the root pass on the reinforcement side are not allowed.

4.4.2.4 The thickness of metal for the test pieces to be welded, their diameter for testing the pipes welding shall be specified with due regard for the actual range of these characteristic values in accordance with the manufacturer's application and for the range of approval by the Register according to the requirements of 4.5.9.

The assembly and welding of butt plate joints shall prevent angular deformations of the welded joint completed (its flatness).

In single-side single-run fillet welding of T-joints of plates and pipes, the effective throat thickness of the fillet weld a shall be within the following range depending on the base metal thickness t:

$0{,}5t \leqslant a \leqslant t$ at $t<6$ mm;

$a \leqslant 0{,}5t$ at $t \geqslant 6$ mm.

4.4.3 Types of test pieces for welders' practical tests.

4.4.3.1 The number, dimensions and structural elements of check test pieces for practical tests shall be specified by the certification panel according to the RS rules requirement depending on the range of the works, stated in the application, for which the welder is certified.

Specifying the type of a unified test piece among those given in Appendix 1, the requirements and explanations set forth below shall be followed.

4.4.3.2 P_1 test piece is the main test piece used for the approval testing of welders for the welding of plate structures which, depending on the range of approval, may be welded in various welding positions and with various structural elements of the edge preparation.

4.4.3.3 The T-joint test piece P_2 for plates is additional and is used in the cases specified in 4.5.5 for the approval testing of welders for the performance of single-run fillet welds without beveling.

4.4.3.4 Butt joint test piece P_3 in pipes is the main test piece used for the approval testing of welders for the welding of pipelines which, depending on the range of approval, may be welded in various welding positions and with various structural elements of the edge preparation.

4.4.3.5 P_4 test piece may be used for the approval testing of welders for the single-run fillet welding of pipe joints. The main cases of this test piece application are specified in 4.5.5.

4.4.3.6 The unified but joint test piece P_6 with a restricting ring shall be used for the approval testing of welders for the welding of T-, Y- and K-joints in pipes (pipe-to-pipe or pipe-to-plate) with full or partial joint penetration. The welding of the test piece, unless otherwise specified, is performed in the H-LO45 position.

N o t e . The J-LO45 welding position for the test piece P_6 may be used if the welder's range of approval provides (according to the application for qualification) for the downhill welding of pipeline ring butts (from 12 down to 6 hours).

4.4.3.7 In mounting of ship's pipelines, the welding is generally performed under conditions of the limited access to a welded joint what makes necessary for the welder to have the special training and relevant skill. The presence of entry "Approved for pipe welding at limited access" in column "Range of approval" (line "welding position/type of test piece") of Welder Approval Test Certificate is required when the following conditions (independently of each other or in total) are relevant in actual practice:

.1 access to the welding zone is bounded in the radial direction by the plane which is parallel to or inclined at some angle to the pipeline axis. The boundary condition: a minimum distance measured perpendicularly to the pipe axis in the plane of the welded joint from the outer pipe surface to the surface (one or more) bounding access to the welding zone does not exceed 400 mm. The welding positions, i.e. pipe axis orientation, shall correspond to the range of approval;

.2 access to the welding zone is longitudinally bounded by the surface that crosses the pipe in the immediate neighborhood of the welded joint. The boundary condition: a minimum distance measured perpendicularly over the outer pipe surface from the welding line to the pipe-crossing surface does not exceed 100 mm.

The extension of the range of approval in Approval Test Certificate to the pipe welding at limited access requires the mandatory performance of the welder's practical tests on P_5 test pieces. In so doing, in some cases, if agreed with the Register, the welding of P_6 test pieces may be needed only.

4.4.3.8 The test for pipe joint welding on the P_7 test piece supplements the welders' approval testing for the welding of high-loaded gridwork pipe structures and presumes the availability with the welder of the approval test for the welding of T-, Y- and K- pipe joints of the relevant diameter and wall thickness. This type of tests is mandatory in the welders' approval testing for the welding of pipe joints having the outside diameter of the branch to be joined $D_2 \geqslant 200$ mm, its wall thickness $t_2 \geqslant 12$ mm and the angle between pipe axes less than 70°.

The P_7 test piece dimensions recommended:

outer diameter of the main pipe $D_1 \geqslant 1{,}5D_2$;

outer diameter of the pipe being joined $D_2 = 200$ mm to 300 mm and its wall thickness $t_2 \geqslant 20$ mm.

The root run and at least four subsequent runs shall be performed within a sector of 180° from 6 to 12 hours position. The examination of the P_7 test piece is carried out using the magnetic particle/dye penetrant method together with the examination of macrosections. Four macrosections corresponding to the 3, 6, 9 and 12 hour welding positions shall be taken of the test piece.

N o t e s: 1. The ultrasonic examination of the P_7 test piece may be carried out according to the Register separate requirement using the additionally approved diagram and procedure of its performance.

2. For approval testing for the welding of pipe joint units having parameters not covered by the P_7 test piece, the performance of practical tests on the P_6 test piece is considered as adequate, while for thin-walled pipes (t_2<3 mm), the test pieces are various versions of the P_3 and P_4 type.

4.4.3.9 The P_8 test piece is used for the approval test of welders for repairing casting and forging defects. In so doing, the specific dimensions and material for test piece manufacture are subject to the additional clarification by the certification panel and individually agreed with the Register.

N o t e. It is recommended to combine the approval testing for repairing castings and forgings with that for the welding of plate structures or pipes using the same welding process and for the same group of base metal.

4.4.4 Methods for assessment of welders' practical test results.

4.4.4.1 After welding, each test piece completed shall be visually examined and measured. The scope of tests using other methods is established according to the requirements of Table 4.4.4.1.

Prior to mechanical testing, the remaining backing strips, where used, shall be removed. The test piece can be sectioned by thermal cutting or by mechanical means, depending on the type of the material used, discarding the first and last 25 mm of the test piece at the end of the plates (the test pieces P_1 and P_2).

4.4.4.2 Test pieces P_1 of butt plate joints.

The continuity of weld metal of butt plate joint test pieces shall be checked by the radiographic method or alternatively tested for static fracture. Interpreting X-ray photographs, the plate ends 25 mm wide from each edge may be ignored. When fracture testing is used, the plate to be tested shall be cut into several test specimens within the inspection length discarding the plate ends according to Fig. 4.4.4.2-1(*a*). In so doing, the entire test piece inspection length shall be tested by the bending failure of specimens dimensioned according to Fig. 4.4.4.2-1(*b*). In the case of single-sided welding without the remaining backing strips, half of the test piece inspection length shall be tested on specimens loaded on the face side of the weld and the other half on the root side according to Fig. 4.4.4.2-2.

When the weld metal quality is examined by non-destructive methods (rather than by a static fracture test), the testing of transverse bend specimens is mandatory for the slag-free methods of welding (131, 135, 141 and 311). With the base metal thickness 3 mm $\leqslant t <$ 12 mm, two root bend test specimens and two face bend test specimens shall be tested, and with $t \geqslant 12$ mm, four test specimens are tested for side bend. Test specimens dimensions and the diagram of the bend test shall be consistent with the requirements of Fig. 4.4.4.2-3.

N o t e. For slag-free methods of welding, if they are technically feasible (the thickness and type of base metal), the additional ultrasonic examination within the test specimen inspection length for the potential interpretation of the destructive test results is recommended.

4.4.4.3 Test pieces P_2 of plate T-joints.

The continuity of weld metal of plate T-joints test pieces shall be checked by test specimen fracture testing according to Fig. 4.4.4.3. For test performance, the test piece shall be out into several test specimens within the

T a b l e 4.4.4.1

Methods of examination of welded joint test pieces in welders' practical tests

Examination method		Type of check test piece									
		P_1		P_3		P_2 and P_4	P_5 and P_6		P_7	P_8	
		$3 \leqslant t < 12$	$t \geqslant 12$	$3 \leqslant t < 12$	$t \geqslant 12$		$3 \leqslant t < 12$	$t \geqslant 12$		C_1 and C_2	C_3 and C_4
Visual and measuring		+	+	+	+	+	+	+	+	+	+
Radiographic		+[1, 2]	+[1, 2]	+[1, 2]	+[1, 2]	—	+[1, 2]	+[1, 2]	—	+	—
Ultrasonic		+[2]	+[2]	+[2]	+[2]	—	+[2]	+[2]	+	+	—
Bend test (4 specimens)	Weld root and top	+[3]	—	+[3]	—	—	+[3]	—	—	—	—
	Side bend	—	+[3]	—	+[3]	—	—	+[3]	—	—	—
Fracture test		+[1]	+[1]	+[1]	+[1]	+[4]	+[1]	+[1]	—	—	—
Inspection of macrosections		—	—	—	—	+[4]	+ 1 pc	+ 1 pc	+ 3 pcs	+ 3 pcs	—
Magnetic particle/dye penetrant		—	—	—	—	+[4]	—	—	+	—	—
Other test methods		+[5]	+[5]	+[5]	+[5]	—	+[5]	+[5]	+[5]	—	—

N o t e s: 1. Radiography or static fracture test shall be used, but not both.

2. If agreed with the Register, radiography may be replaced by the ultrasonic examination for welded joints of W01, W02 and W03 group steels of 12 mm thick and over.

3. When the weld metal quality is examined by non-destructive methods (rather than by a static fracture test), the testing of transverse bend specimens is mandatory for the slag-free methods of welding (131, 135, 141 and 311).

4. Agreed with the Register, instead of the fracture test of a weld, it is allowed to examine the welding quality using the magnetic particle/dye penetrant method in combination with the examination of at least four macrosection.

5. For test pieces of butt welded joints of W11 group stainless steels, the weld metal may be tested for intercrystalline corrosion and a ferritic component content by the requirement of the Register.

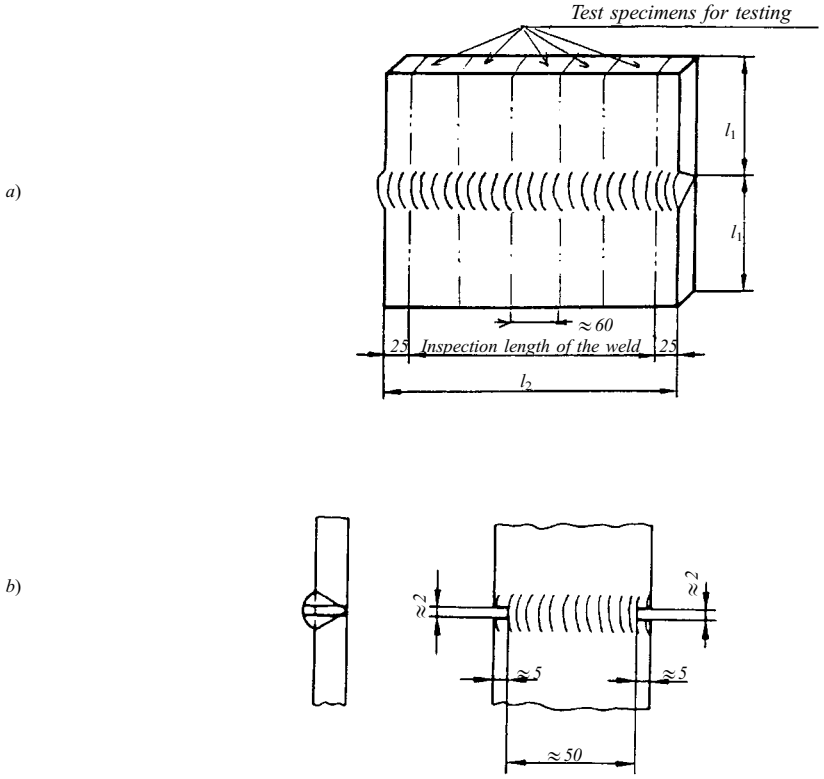


Fig. 4.4.4.2-1 Diagram of cutting-out (*a*) and test specimens from the test piece P_1 of the butt plate joint for weld metal fracture testing (*b*)

Fig. 4.4.4.2-2 Diagram of the fracture testing root-bend test (*a*) and fracture testing face-bend test (*b*) of the test specimens form the test piece P_1 of the butt plate joint

specified inspection length discarding the plate ends 25 mm wide from each edge according to Fig. 4.4.4.3 (*a*).

Agreed with the Register, the weld fracture testing may be replaced by the examination of the weld quality using magnetic particle/dye penetrant methods in combination with the macrosections examination. In this case, four macrosections, as a minimum, shall be cut out at regular gaps of the weld length (including the places corresponding to the stop/start operation).

4.4.4.4 Test pieces P_3 of butt pipe joints.

The continuity of weld metal of butt pipe joint test pieces shall be checked using the radiographic method or fracture test. When the fracture test is used, the full test piece inspection length shall be tested and to do this the test piece shall be cut into at least four test specimens dimensioned

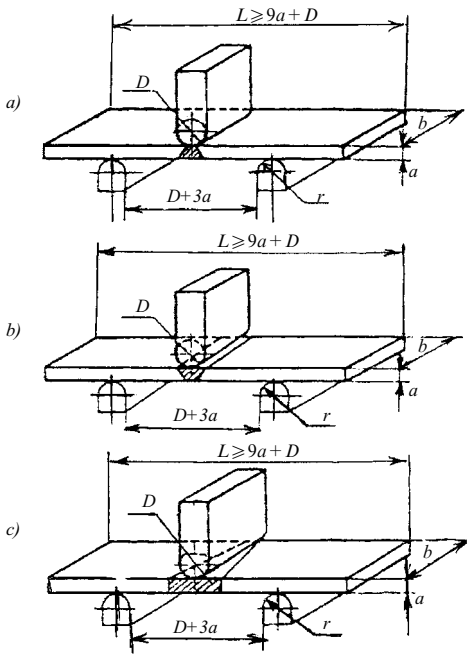


Fig. 4.4.4.2-3 Dimensions of test specimens form the test pieces of the butt plate joints (P_1) and butt pipe joints (P_3, P_5 and P_6), and the diagram of the static face-bend test (*a*), root-bend test (*b*) and side-bend test (*c*)

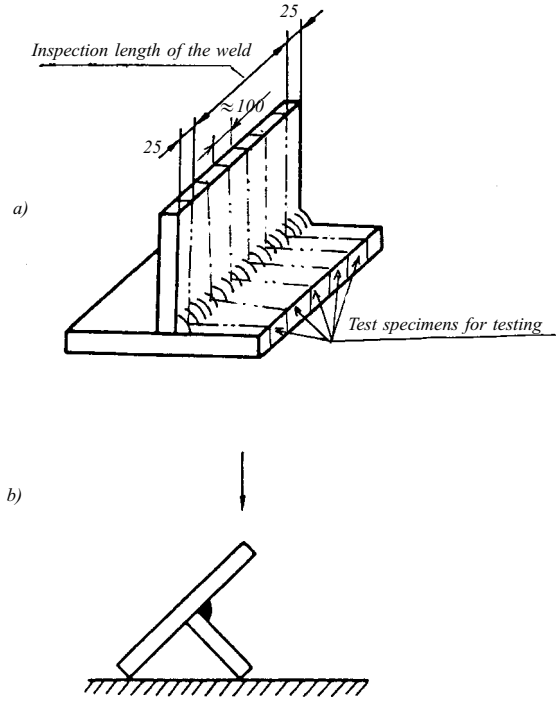


Fig. 4.4.4.3 Diagram of cutting-out (*a*) and test specimens from the test piece P_2 of the T-joint for weld metal fracture testing (*b*)

according to Fig. 4.4.4.4-1. If the pipe diameter is too small for testing all the test specimens, two or more test pieces shall be welded and tested. The inspection length of any test specimen shall be equal to about 40 mm.

If necessary, the weld reinforcement of the test specimen may be removed and additionally the weld edges may be notched to a depth of about 5 mm to facilitate fracture in the weld metal (refer to Fig. 4.4.4.4-1).

In the case of single-side welding without the remaining backing, half of the inspection length of the test piece shall be tested on test specimens looded on the face side and the other half on the root side (refer to Fig. 4.4.4.4-2).

In the approval testing of welders and in the welding of small diameter ($D < 25$ mm) pipes whose test specimens cannot be dimensioned according to Fig. 4.4.4.4-1, the fracture testing of pipes shall be replaced by the tensile failure testing on the test specimens according to Fig. 4.4.4.4-3.

To initiate the plane of a test specimen failure in weld metal, the weld reinforcement on the outer side of a pipe may be ground flush with the pipe surface. For test specimens testing, end parts of pipes are tightly stoppered (refer to Fig. 2.2.2.3, Part XIII "Materials" of Rules for the Classification and Construction of Sea-Going Ships) and pressurized.

In the case, when the weld metal quality is checked using non-destructive methods, the testing of transverse bend test specimens is mandatory for slag-free methods of welding (131, 135, 141 and 311). With the base metal thickness 3 mm $\leqslant t <$ 12 mm, two root bend test specimens and two face bend test specimens shall be tested, and with $t \geqslant 12$ mm, four test specimens are tested for side bend. Test specimens dimensions and the diagram of the bend test shall correspond to Fig. 4.4.4.2-3. For the sectioning of test pieces welded in position PF, PG, H-L045 and J-L045, test specimens shall be taken from the weld sections corresponding to different welding positions (refer to Fig. 4.4.4.4-1):

45° and 225° for face bend or side bend;

135° and 315° for root bend or side bend.

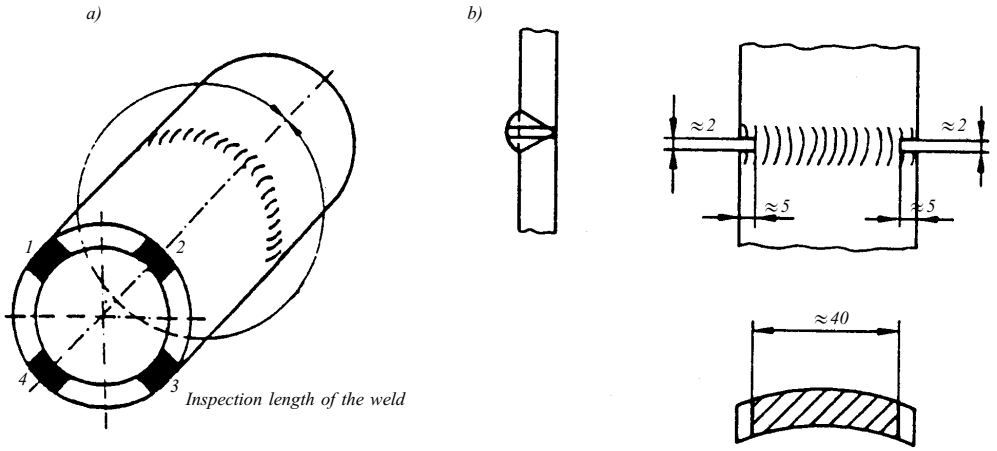


Fig. 4.4.4.4-1 Diagram of cutting-out (*a*) and test specimens from the test pieces P_3, P_5 and P_6 of butt pipe joints (*b*) for weld metal fracture testing;
1, *2*, *3* and *4* = places for the selection of static bend test specimens form the test pieces prepared using slag-free methods of welding.

Fig. 4.4.4.4-2 Diagram of fracture testing on the root reinforcement side (*a*) and o the face side (*b*) for test specimens from the test piece P_3, P_5 and P_6 of butt pipe joints

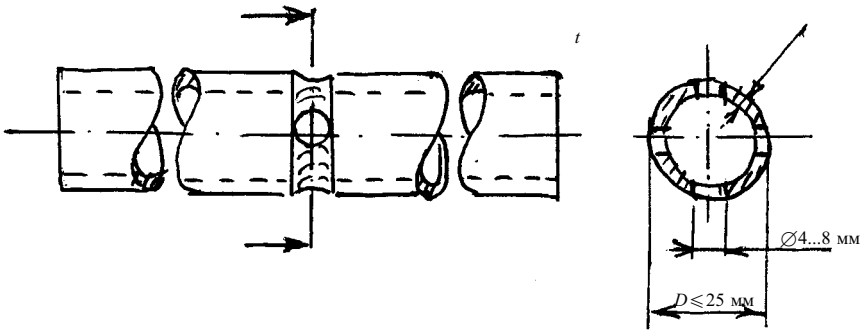


Fig. 4.4.4.4-3 Tension test specimen with 4 holes for testing butt joints of small diameter pipes

4.4.4.5 Test pieces P4 of fillet pipe joints.

The continuity of weld metal of fillet pipe joint test pieces shall be checked by fracture testing of at least four test specimens according to Fig. 4.4.4.5. Agreed with the Register, the fillet weld fracture testing may be replaced by the examination of the weld quality using magnetic particle/dye penetrant (for nonmagnetic materials) methods combined with the macrosections examination. For this, four macrosections, as a minimum, shall be cut out at regular gaps of the weld length (including the places corresponding to the stop/start operation). For sectioning of test pieces welded in position PF and PG, macrosections shall be taken from the weld sections corresponding to positions 0°, 90°, 180° and 270°.

4.4.4.6 Test pieces P_5 and P_6 for welding of butt pipe joints at limited access.

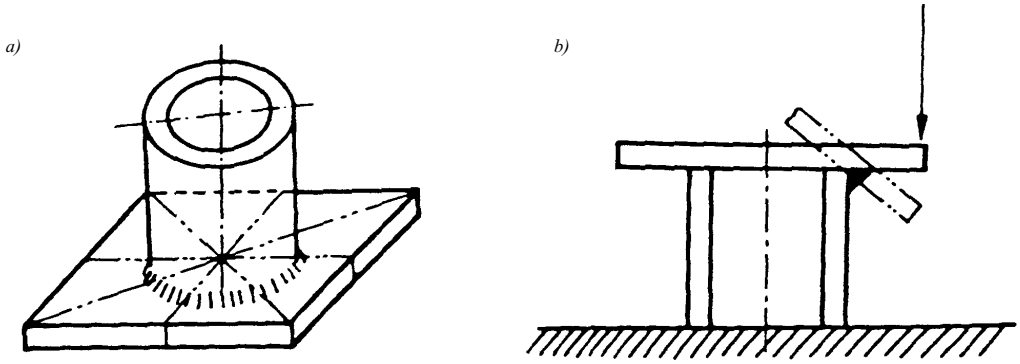


Fig. 4.4.4.5 Diagram of cutting-out (*a*) and fracture (*b*) testing of test specimens from pipe T-joint P_4 test pieces

The test pieces imitating pipe welding at limited access to the weld shall be checked in the same manner as in testing of butt joints P_3 test pieces. In so doing, one macrosection shall additionally be taken in the area of cutting-out within the range 225° to 270°.

4.4.4.7 Test pieces P_7 for welding of pipe assembly.

Welded joints of the pipe joint assembly shall be checked along the full weld inspection length using the following methods:

magnetic particle/dye penetrant (for nonmagnetic materials);

ultrasonic.

Additionally, three macrosections shall be taken from the welded joint sections corresponding to positions 135°, 180° and 225°.

N o t e . The procedure for ultrasonic examination of the P_7 test piece is subject to consideration and approval by the Register based on the results of pretesting for its attestation.

4.4.4.8 Test piece P_8 imitating repair of forgings and castings.

The continuity of test piece welds C_1 and C_2 imitating the elimination of lengthy and point defects shall be checked over their entire extent using the following methods:

radiographic,

ultrasonic,

examination of macrosections taken from the weld C_1 (2 pcs) and weld C_2 (1 pc).

Additionally, for materials highly prone to cracking (e.g. forgings and castings of W03 group medium alloy steels of the 38xGNi3MoVAl type), the magnetic particle method may be used by the Register requirement for the C1 and C2 welds checking.

4.4.5 Criteria for assessment of welders' practical test results.

4.4.5.1 Assessment of welded joint quality in visual examination and measurements.

4.4.5.1.1 General.

The weld surface as such and the adjacent zone of base metal within at least 20 mm from the fusion line along the entire extent of a welded joint shall be examined visually and by measurements.

The visual examination shall usually be carried out without use of any special optical devices. In doubtful cases, magnifying glasses of no better than 10 X magnification may be used.

If cracks or their indications are detected in the visual examination of a welded joint, it is recommended to carry out the further flaw detection of a test piece using:

magnetic particle method/dye penetrant examination;

grinding of the surface followed by the chemical cleaning with the reagent used for macrostructure detection.

A depth of undercuts, a height of scaling and unevenness shall be checked by the comparison of welds with standards using special templates or replicating the surface relief. The latter is cut so that the dimension being checked is in the notch plane. In so doing, the dips between beads, and between the weld and base metal shall be measured on the base of 12 mm, the scaling and unevenness, between tops of hillocks and scales.

The measurements of welded joints shall be made in places where deviations from the dimensions specified may be expected. Three measurements, as a minimum, of geometric parameters of a welded joint shall be made within the length of the check test piece. Agreed with the Register surveyor, multipurpose or special templates (fit/not fit) shall be used in measurements.

4.4.5.1.2 Criteria for defects assessment.

External defects of check welded joints, considered as inadmissible, include:

cracks of welds and the adjacent zone, faulty fusion, burnings, blowholes, rolls, accumulation of pores and inclusions, surfacing and non-rewelded craters and short-circuit spots on the surface of the completed weld and base metal;

nonconformity of the weld shape and dimensions beyond the scope of restrictions corresponding to national standards;

individual pores over 0,1 the minimum thickness of the parts to be welded at a thickness up to 20 mm, and the pores dimensioned over 2,0 mm at the thickness of parts 20 mm and over, as well as the pores of that and a lesser size if their number exceeds 3 pcs in any weld section 100 mm long, and 6 pcs, 300 mm long;

base metal undercuts over 0,3 mm deep at the metal thickness up to 20 mm inclusive and over 0,5 mm deep at the metal thickness over 20 mm. The maximum length of a single undercut shall not be over 0,5 the thickness of the metal to be welded, the total extent of undercuts therewith shall not exceed 10 % of the weld length;

shrinkage in the root of a single-side weld over 0,1 the thickness of the welded metal at the thickness of the edges joined up to 10 mm, and 1 mm at the parts thickness over 10 mm;

dips between beads, and also between the weld and base metal (non-smooth transition between the weld and base metal) over 1,5 mm.

Tolerances for weld dimensions shall be within the scope of the Welding procedure specification requirements and in any case shall not be beyond the scope of the national standard requirements.

4.4.5.2 Assessment of welded joints quality in radiographic control.

4.4.5.2.1 General requirements for control.

The radiographic method is preferable for the control of welded test pieces. The requirements of Table 4.4.5.2.1 for the examination sensitivity assessed with use of the wire-type image quality indicator shall be met.

The geometric parameters of the radiographic examination shall ensure the fulfillment of the following requirements:

Table 4.4.5.2.1

Requirements for absolute sensitivity of radiographic control (the wire-type image quality indicator is placed on the side of a radiation source)

Radiation thickness W, mm	Sensitivity (minimum visible diameter), mm
$0 < W \leqslant 1,5$	0,05
$1,5 < W \leqslant 2,5$	0,063
$2,5 < W \leqslant 4$	0,08
$4 < W \leqslant 6$	0,100
$6 < W \leqslant 8$	0,125
$8 < W \leqslant 12$	0,16
$12 < W \leqslant 20$	0,20
$20 < W \leqslant 30$	0,25
$30 < W \leqslant 35$	0,32
$35 < W \leqslant 45$	0,40
$45 < W \leqslant 65$	0,50
$65 < W \leqslant 120$	0,63

relative magnification of a radiographic thickness within the length of one radiograph shall not exceed 6 %;

geometric unsharpness of defect images in radiographs shall not exceed half the value of the examination sensitivity;

optical density of the radiograph shall be within the range of 2B to 3B. The optical density may be increased up to 3,5B if an illuminator having the screen glow luminance of at least 30000 kD/m^2 is used.

Note. The change of radiograph optical density in the range from –15 % to +30 % of the value corresponding to the place of image quality indicator installation is taken admissible.

4.4.5.2.2 Specifying permissible dimensions of defects corresponding to the grades III and IIIA1, the assessment of the welded joints quality according to the radiographic examination results shall be carried out in compliance with the requirements of 4.3 for steel welded joints and of 4.4 for aluminium alloy welded joints of Part XIV "Welding" of Rules for the Classification and Construction of Sea-Going Ships.

Notes: 1. The grade III — assessed weld has no internal defects or has:

individual gas or metallic (tungsten) inclusions, each dimensioned up to 0,1 the weld thickness, but not more than 2 mm;

individual slag inclusions, each dimensioned up to 0,3 the weld thickness, but not more than 3 mm and having an area of not more than 5 mm^2.

The average number of the above defects shall not exceed one per the weld length of 100 mm.

2. The grade IIIA1 — assessed weld has no internal defects or has:

individual pores with the maximum diameter $(0,1t + 0,55)$ mm, but not more than 2,5 mm. The maximum total area of pores within any weld section of 100 mm long to be examined shall not exceed $2t$ mm^2;

individual slag or oxide inclusions of the maximum length up to $0,2t$ mm, but not more than 5 mm or tungsten inclusions of the maximum length up to 0,05t mm, but not more than 0,8 mm. The number of inclusions shall not exceed one per the weld section of 100 mm long to be examined.

4.4.5.3 Assessment of welded joints quality by ultrasonic control results.

An ultrasonic control shall be performed according to the national standards recognized by the Register or to the procedures agreed. In so doing, the requirements for standards of tolerable defects detected in the ultrasonic examination shall be individually agreed with the Register.

4.4.5.4 Assessment of welded joints quality by static bend test results.

In testing of welded joint test specimens for static bend, the requirements of Table 4.4.5.4 shall be followed. After test specimen bending for the angle specified, no defects over 3 mm long shall be detected on the test specimen surface. Any defects up to 3 mm long formed on test specimen edges are ignored and omitted in the test report.

Note. For dissimilar welded joints, the procedure for performance and the assessment of test results are subject to special consideration by the Register.

Table 4.4.5.4

Requirements for static bend test performance

Group of base metal type composition		Proportion D/a	Bend angle to the first crack, °, min
W01, W11		3	120
W02, W03, W04	$320 < R_{p0,2} \leqslant 490$ MPa	3	120
	$490 < R_{p0,2} \leqslant 690$ MPa	4	120
	$R_{p0,2} > 690$ MPa	5	120
W21 and W21containing Mg $\leqslant$ 3,5 %		3	180
W22 containing Mg over 3,5% to 6,0%		6	180
W23		7	180

4.4.5.5 Assessment of welded joints quality by fracture test results.

4.4.5.5.1 After the performance of butt welded joint fracture tests, the fracture surface shall be visually examined and measured. The weld defects visible on the fracture surface are considered intolerable if their type, number and dimensions do not meet the criteria specified in 4.4.5.1 for internal weld defects in the radiographic examination.

4.4.5.5.2 In the fracture test of welded T-joints welded by a single-run fillet weld, the absence of intolerable internal defects including the inadequate root penetration shall be confirmed. Minor defects like small pores and slags may be allowed if their relative area does not exceed 6 % of the cross-section examined.

Note. Pores and slags are considered minor if their maximum linear dimension in the plane of failure does not exceed 0,2Z, but not more than 2,0 mm (where Z = leg of fillet).

4.4.5.6 Control of macrosections.

Macrosections shall be made so that their working surface covers the entire area of the weld and the part of base metal at least 15 mm wide adjacent to the fusion

line. The reagent used for etching is to allow the clear identification of weld and separate bead boundaries, the fusion line, heat-affected zone and also the adjacent part of the base metal. In inspection of macrosections, the following is subject to control:

weld shape and geometric dimensions;

base metal penetration shape and size;

presence of base metal undercuts and of the shrinkage in the root of a single-side weld;

presence of intolerable internal defects in the weld and adjacent zone within 10 mm from the heat-affected zone boundary.

Macrosections may have defects if their type and dimensions are not beyond the scope of the requirements in 4.4.5.1 and 4.4.5.2. In this case, the sum of all defect (external and internal) projections toward a design thickness shall not exceed 0,15*t* or 0,15*a*, but not more than 4,0 mm for all the groups of steels and aluminium alloys.

4.4.6 Procedure for retests performance.

4.4.6.1 In cases when the certification panel has reliably established that the unsatisfactory result of initial practical tests is due to the causes not associated with the welder's skill (e.g. welding equipment faults, defects of welding electrode coating, etc.), the welder shall be approved for retests on the same number of test pieces. In this case, the quality of base metal and welding consumables, as well as the serviceability of welding equipment shall be properly checked by the certification panel members.

4.4.6.2 If it is established that the unsatisfactory result of initial practical tests is attributed to the welder's lack of skill and is due to the unsatisfactory results of the tests on more than one test specimen, the welder may be approved for the repeat certification after the additional education and training totaled at least a week.

4.4.6.3 If the results of testing one of the test specimens tested do not meet the requirements specified for the given type of tests, the doubled number of that type test specimens shall be prepared and tested. The test specimens for additional tests may be selected from the store of the available test piece or the new test piece shall be welded under similar conditions.

4.4.6.4 The tests are assessed as satisfactory when the satisfactory results have been demonstrated on two additional test specimens prepared according to the requirements of 4.4.6.3.

If the results of retests for at least one of additional specimens are unsatisfactory, the welder fails the practical tests and shall undergo retesting in accordance with established procedure.

4.4.6.5 In additional bend tests of test specimens, as well as of sections prepared from fixed butt pipe joints (welding positions PF, PG and H-L045, J-L045 for test pieces P_3 and P_5, and also test pieces P_6 and P_7), the place on a test piece, where the test specimens were taken, corresponding to the position of the welding sector for which the unsatisfactory results were obtained in initial tests, shall be retained.

4.4.6.6 In case when the scope of initial tests provided for welding several test pieces (of one type for various welding positions or different types), but the unsatisfactory results were obtained only for one of those test pieces, the retests according to 4.4.6.2 may be performed only with use of the test piece for which the negative result was obtained. In this case, the Register may increase the scope of retests up to the double scope of initial tests.

4.4.6.7 With the unsatisfactory results of repeat practical tests, the welder is considered to have failed the certification. The welders are approved for the new certification by the certification panel individually with due regard for the professional shortcomings identified. In any case, the time between the certifications for training and acquiring the necessary practical skills shall be at least a month.

4.5 RANGE OF APPROVAL BASED ON TEST RESULTS

4.5.1 Specifying the range of approval for Welder Approval Test Certificate, the following parameters of a welding procedure shall be taken into account:

welding method and process;

structure (plate/pipe) and welded joint types;

base metal class/group;

filler type;

shielding gas composition and/or flux type;

electrode coating type;

structural dimensions of a welded joint (metal thickness, pipe diameter);

welding positions and accessibility of a welded joint zone for production operation performance.

4.5.2 Every practical test is generally limited by the range of approval for one welding process/method designated by indexes according to the requirements of 4.3.2.1 and 4.3.2.2.

The change of a welding method in the product manufacture calls for performance of new tests on welders' approval.

If a specific joint is welded in production by one welder using the combination of two welding methods, the practical approval tests may be performed as follows:

.1 a test piece is welded in testing using the combination of two welding methods in a similar way as in production (e.g. the root-single-side tungsten inert gas welding without backing, groove filling-manual welding with covered electrodes);

.2 in the approval testing, two test pieces are welded for the separate welder's certification for each welding method.

It must be taken into account that the use of a separate certification option shall not result in the reduced level of requirements for the scope of tests. For instance, if one of welding methods, as a minimum, is slag-free and the thickness range calls for side-bend tests (refer to Table 4.4.4.1), the use of the separate scheme rejecting that type of tests is incorrect.

Note. The welding and testing of test pieces using the combination of two or more methods of welding by one or different welders according to the options other than those specified in 4.5.2.1 and 4.5.2.2, are subject to special consideration by the Register.

4.5.3 The range of approval by a welding position depending on the conditions of check practical tests performance shall correspond to the provisions of Table 4.5.3.

4.5.4 Specifying the range of approval with due regard for the details of the weld type (refer to 4.3.3.2), the requirements of Table 4.5.4 shall be followed taking into account the following additions:

at the discretion of the Register, the approval of Welder Approval Test Certificate for butt welds in plates in all welding positions may be extended to butt welds on

Table 4.5.3

Range of approval for unified welding positions

Welding position of approval test piece					Range of approval by welding positions in Welder Approval Test Certificate																
					Plates										Pipes						
					Butt welds					Fillet welds					Butt welds					Fillet welds			
															0°			90°	45°	[1]	0°		90°
					PA	PC	PG	PF	PE	PA	PB	PG	PF	PD	PA	PG	PF	PC	H-L045	PB	PG	PF	PD
1					2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Plates	Butt welds (test piece P_1)	PA			*	—	—	—	—	×	×	—	—	—	×	—	—	—	—	×	—	—	—
		PC			×	*	—	—	—	×	×	—	—	—	×	—	—	×	—	×	—	—	—
		PG			—	—	*	—	—	—	—	×	—	—	—	—	—	—	—	—	—	—	—
		PF			×	—	—	*	—	×	×	—	×	—	×	—	—	—	—	×	—	—	—
		PE			×	—	—	—	*	×	—	—	—	×	—	—	—	—	—	×	—	—	—
		PE+PF			×	×	—	*	*	×	×	—	×	×	—	—	—	—	—	×	—	—	—
	Fillet welds (test piece P_2)	PA			—	—	—	—	—	*	—	—	—	—	—	—	—	—	—	—	—	—	—
		PB			—	—	—	—	—	×	*	—	—	—	—	—	—	—	—	×	—	—	—
		PG			—	—	—	—	—	—	—	*	—	—	—	—	—	—	—	—	—	—	—
		PF			—	—	—	—	—	×	×	—	*	—	—	—	—	—	—	—	—	—	—
		PD			—	—	—	—	—	×	×	—	—	*	—	—	—	—	—	—	—	—	—
		PF+PD			—	—	—	—	—	×	×	—	*	*	—	—	—	—	—	—	—	—	—
Pipes	Butt welds for pipe axis angle to the horizontal (test piece P_3)	0°	rotating	PA	×	—	—	—	—	×	×	—	—	—	*	—	—	—	—	×	—	—	—
			fixed	PG	—	—	×	—	—	—	—	×	—	—	—	*	—	—	—	—	×	—	—
				PF	×	—	—	×	×	×	—	—	×	×	×	—	*	—	—	×	—	×	×
		90°		PC	×	×	—	—	—	×	×	—	—	—	×	—	—	*	—	×	—	—	—
		45°		H-L045	×	×	—	×	×	×	×	—	×	×	×	—	×	×	*	×	—	×	×
		90°+0°		PC+PF	×	×	—	×	×	×	×	—	×	×	×	—	*	*	—	×	—	×	×
		45°		J-LO45	—	—	×	—	—	—	—	×	—	—	—	×	—	—	—	—	×	—	—
	Fillet welds (test piece P_4)	[1]		PB	—	—	—	—	—	×	×	—	—	—	—	—	—	—	—	*	—	—	—
		0°	fixed	PG	—	—	—	—	—	—	—	×	—	—	—	—	—	—	—	—	*	—	—
				PF	—	—	—	—	—	×	×	—	×	×	—	—	—	—	—	×	—	*	×
		90°		PD	—	—	—	—	—	×	×	—	—	×	—	—	—	—	—	×	—	—	*
	Test piece P_6 [2,3]	45°	fixed	H-L045	×	×	—	×	×	×	×	—	×	×	×	—	×	×	*	×	—	×	×
	Test piece P_5 [2]	90°+0°	fixed	PC+PF	×	×	—	×	×	×	×	—	×	×	×	—	*	*	—	×	—	×	×
	Test piece P_7 [3]	—	fixed	—	×	×	—	×	×	×	×	—	×	×	×	—	×	×	×	×	—	×	×

Symbols:
* the welding position for which the welder is approved in the approval test;
x those welding positions covered by the range of approval;
- those welding positions for which the welder is not approved according to the practical test results.

[1] Welding position PB for fillet pipe joints may be realized in two versions: PB_{rot} (pipe axis in a horizontal plane) and PB_{fix} (pipe axis in a vertical plane) according to Fig. 2 in Appendix 2.

[2] The welder is approved for pipe welding under conditions of limited access.

[3] The welder is approved for welding of T-, Y- and K-shaped units of tubular structures including special and main components of mobile offshore drilling units and fixed offshore platforms.

Table 4.5.4

Details of weld performance in tests			Range of approval of Welder Approval Test Certificate					
			Butt welds in plates				Butt welds on pipes	
			Single-side welding ss		Welding from both sides bs		Single-side welding ss	
			With backing mb	No backing nb	With gouging gg	No gouging ng	With backing mb	No backing nb
Butt welds in plates	Single-side welding ss	With backing mb	*	—	×	—	[1]	—
		No backing nb	×	*	×	×	[1]	[1]
	Welding from both sides bs	With gouging gg	×	—	*	×	[1]	—
		No gouging ng	×[2]	—	×	*	[1]	—
Butt welds on pipes	Single-side welding ss	With backing mb	×	—	×[2]	—	*	—
		No backing nb	×	×	×	×	×	*
T-, Y- and K[3]-shaped pipe joints	Single-side welding ss	No backing nb	×	×	×	×	×	T-, Y- and K-shaped pipe joints with full penetration

Symbols:
* details of welds performance for which the welder is approved in the approval test;
x details of welds performance covered by the range of approval;
- details of welds performance for which the welder is not approved.

[1] The range of approval for the details of welds performance specified is limited by 4.3.4a) and 4.3.4b).
[2] The range of approval for the details of welds performance specified is subject to special consideration by the Register.
[3] The approval for the welding of pipe joint units presumes the presence of the approval test of a welder for single-side butt welds on pipes without backing.

pipes having an outside diameter of at least 500 mm provided the other limitations on the range of approval are met;

at the discretion of the Register, the approval of Welder Approval Test Certificate for butt joints in plates welded by a single-side weld in the PA and PC positions may be extended to butt joints on pipes of an outside diameter 150 mm and over welded in similar positions (PA and PC) provided the other limitations on the range of approval are met.

4.5.5 Generally, the range of approval of Welder Approval Test Certificate for butt joints may be extended to fillet and T-joints. The separate type of testing on the welding of the P_2 or P_4 test T-joint is required in the following cases:

according to the manufacturer's application, the welder is certified for the welding of those types of joints only;

according to the Register separate requirement, when the welder's production work is predominantly fillet welding.

Note. The requirement does not apply to the fillet welding with full or incomplete penetration when the welding V is provided. As a rule, the approval test for the welding of such welds is conditioned by the extension of the range of approval to the welding of butt welds under identical conditions.

4.5.6 The practical tests performed using the specific brand base metal of one of type composition groups according to the requirements of 4.3.3.1 are valid for the welder's approval test for the welding of any other steels of that group.

The Certificate range of approval according to the base material groups is given in Table 4.5.6-1 for similar welded joints, and in Table 4.5.6-2, for the dissimilar ones. The ranges of approval specified in Tables 4.5.6-1 and 4.5.6-2 are valid only provided that the groups of

Table 4.5.6-1

Range of approval of Welder Approval Test Certificate according to base metal groups

Group of base metal used in tests	Range of approval according to base metal groups				
Steel	W01	W02	W03	W04	W11
W01	*	—	—	—	—
W02	×	*	—	—	—
W03	×	×	*	—	—
W04	×	×	—	*	—
W11	×[1]	×[1]	×[1]	×[1]	*
Aluminium and its alloys	W21	W22	W23		
W21	*	×	—		
W22	×	*	—		
W23	×	×	*		

Symbols:

* the material group for which the welder is approved in the approval test;

x the material group for which the welder is approved on the basis of the range of approval of Welder Approval Test Certificate;

— the material group for which the welder is not approved.

[1] The range of approval is valid provided that austenitic welding consumables intended for the welding of W11 group steels are used.

Table 4.5.6-2

Range of approval of Welder Approval Test Certificate according to base metal groups for dissimilar welded joints

Base metal group of check test piece for practical tests	Range of approval according to base metal groups for dissimilar joints
W02	W02 + W01 [1]
W03	W02 + W01 [1] W03 + W01 [1] W03 + W02 [1]
W04	W02 + W01 [1] W04 +W01 [1] W04 +W02 [1]
W11	W11 + W01 [2] W11 + W02 [2] W11 +W03 [2] W11 +W04 [2]
W21	W21 + W22 [1]
W22	W22 + W21 [1]
W23	W22 + W21 [1] W23 + W21 [1] W23 + W22 [1]

[1] For dissimilar welded joints, the filler material used is to correspond to the group of one of the base materials being joined.

[2] The range of approval is valid provided that austenitic welding consumables corresponding to the W11 base material group are used in welding.

base and filler materials coincide in practical tests (i.e. the filler and base metals have a similar chemical composition, and the weld has properties which are close to those of a base metal).

4.5.7 Specifying the range of approval for Welder Approval Test Certificate, the coating type for the electrodes used for the welding of test pieces in practical testing shall be taken into account. The unified code designations for electrode coating types according to EN499 are given in 4.3.2.3, and the relevant ranges of approval of Welder Approval Test Certificate are specified in Table 4.5.7.

Table 4.5.7

Range of approval of Welder Approval Test Certificate according to electrode coating types

Type of electrode coatings used for welding test pieces in practical tests	Range of approval according to electrode coating types				
	A, RA	R, PR, RB, RC	B	C	S
A, RA	*	—	—	—	—
R,PR,RB,RC	×	*	—	—	—
B	×	×	*	—	—
C	—	—	—	*	—
S[1]	—	—	—	—	*

Symbols:

* the covered electrode type for which the welder is approved in the approval test;

x the covered electrode types covered by the Certificate range of approval;

— the covered electrode types for which the welder is not approved.

[1] The approval applies to only that specific type of electrode coating (a trade mark), which was used in the approval test.

4.5.8 The practical tests using specific compositions or brands of shielding gas and flux are valid for the welder's approval test for the welding using other similar materials. In this case, the range of approval for Welder Approval Test Certificate shall be specified with due regard for the following requirements:

change of a gas composition within the range of approval shall not result in the change of the pattern of metal transfer in the arc gap and/or to exert an effect on the shape of base metal penetration;

change of a flux composition within the range of approval shall not result in the essential change of welding and technological properties in the welding with a wire/flux combination;

extension of the range of approval beyond the unified groups of weld able steels, and accordingly the use of welding consumables other than those used in the practical tests are subject to special consideration by the Register;

in individual cases, the Register may reduce the range of approval taking into account the details of welding and technological properties of the fluxed and/or shielding gases actually used in the tests.

Notes: 1. The above requirements are observed in the case when the shielding gas composition in the practical tests of welders and the range of approval belong to one of the groups R, I, M (M1 + M2 + M3), C or F according to Table 4.3.2.4-1.

2. The above requirements for the flux composition and brands are usually observed if the composition of the specific flux brand used in the welders' practical tests and the range of approval are within the following enlarged groups (refer to Table 4.3.2.6):

silicate fluxes (MS, CS, ZS and KS);
aluminate-containing fluxes (AK, AB, AS and AF);
fluoride-basic fluxes (FB);
approval for special types of flux (Z) may usually be extended only to that special flux (brand) which was used in the tests.

4.5.9 The range of approval of Welder Approval Test Certificate shall be specified with due regard for the following structural dimensions of welds:

thickness of base metal;

outer diameter of pipes to be joined;

design thickness of a fillet weld.

Each practical test for the welder's approval shall have the range of approval according to the requirements of Tables 4.5.9-1, 4.5.9-2 and 4.5.9-3.

Table 4.5.9-1

Material	Thickness of test piece metal in tests, mm	Range of approval by base metal thicknesses, mm
Steels	$t \leqslant 3$	from t to $2t$ [1]
	$3 < t \leqslant 12$	from 3 to $2t$ [2]
	$t > 12$	from 5 and over
Aluminium and its alloys	$t \leqslant 6$	from $0,7t$ to $2,5t$
	$6 < t \leqslant 15$	$6 < t \leqslant 40$ [3]

[1] For gas (acetylene) welding: from t to $1,5t$.
[2] For gas (acetylene) welding: form 3 to $1,5t$.
[3] With a thickness of parts over 40 mm, and individual qualification is needed and to be recorded in the Welder Approval Test Certificate and the test report.

Table 4.5.9-2

Material	Outside diameter of pipes in tests, mm	Range of approval by diameter of pipes joined, mm
Steels	$D \leqslant 25$	from D too $2D$
	$25 < D \leqslant 150$	from $0,5D$ to $2D$ but not less than 25
	$D > 150$	from $0,5D$ and over
Aluminium and its alloys	$D \leqslant 125$	from $0,5D$ to $2D$
	$D > 125$	from $0,5D$ and over

Note. For hollow building structures of a box section, the dimension D is determined by the dimension of the smallest side.

Table 4.5.9-3

Design thickness of fillet weld in welding of test pieces, mm	Range of approval by design thickness of fillet welds, mm
$a < 10$	from $0,75a$ to $1,5a$ [1]
$a \geqslant 10$	from 10 to $1,5a$ [1]

[1] For a procedure of downward welding (position PG), the upper limit of the range of approval is limited by a value of $1,1a$.

4.6 DRAWING-UP, VALIDITY AND ENDORSEMENT CONDITIONS OF WELDER APPROVAL TEST CERTIFICATE

4.6.1 According to the results of welders' theoretical and practical tests, the certification panel draws up the record on form recommended in Appendix 3.

4.6.2 The following shall be attached to the record:

the copy of the certificate of welder's qualification and the reference of a manufacturer's personnel department (in the initial qualification) or the copy of the welder's certificate in other types of certification;

the copy of an educational establishment document on welder's special training;

the copies of certificates for base material and welding consumables;

reports, conclusions and other documents on the results of quality control for welded joint test pieces.

Note. One record in the form of a table for a group of welders including all the information and data specified in Appendix 3 may be drawn up.

4.6.3 The record of welder's certification is executed in two copies. One copy is kept in the certification centre and the other is forwarded to the Register location carrying out technical supervision of tests performance.

4.6.4 Based on the record of welder's certification and provided all the above requirements are met, the Register draws up and issues Welder Approval Test Certificate (Form 7.1.30).

4.6.5 The Form 7.1.30 is executed and issued by the Register location carrying out the technical supervision during the construction of ships or structures. The document is signed by the head of the Register location and witnessed with the round anchor stamp. The registration of Welder Approval Test Certificates (Form 7.1.30) is performed in locations according to the place of issuance. Copies of the documents issued can be submitted to the RHO on its special demand only.

4.6.6 The validity period of Welder Approval Test Certificate is limited by the time period of up to two years. In addition, a manufacturer-employer shall note every six months the Certificate prolongation in its appropriate columns testifying the observance of the following Register requirements for a welder's skill:

the welder shall be continuously engaged on welding work within the current period of approval. In this case, an interruption in work over six months is not permitted;

the welder's work in production shall correspond in its complexity to the range of approval specified in the Welder Approval Test Certificate;

the welder's skill and knowledge shall not be questioned during working.

If any of these conditions are not fulfilled, the Register cancels Welder Approval Test Certificate. In this case, the matter of its renewal or issuance of the new one is handled individually in each particular case.

N o t e . In accordance with the practice adopted in the national legislation, the welder shall pass regular medical examination and get positive conclusion of a medical commission on professional fitness.

4.6.7 The validity of Welder Approval Test Certificate may be prolonged by the Register for the next period of two years omitting the new practical tests and not changing the range of approval in the event that the conditions listed in 4.6.2 were observed and the following requirements are fulfilled:

quality of welds performed by the welder in production meet the requirements of Section 3, Part XIV "Welding" of Rules for the Classification and Construction of Sea-Going Ships;

manufacturer-employer can document the correspondence of the welder's skill with the level specified in Welder Approval Test Certificate to the satisfaction of the Register Surveyor.

The documents submitted to the Register surveyor shall include the data on the non-destructive examination results with a conclusion of the manufacturer's responsible official.

4.6.8 The monitoring of welder's performance in production rests with the manufacturer-employer who shall designate an official (performer) in charge of that function.

A card index for every certified welder shall include:

copy of an education document;

copy of a special training document;

reference on continuous welding experience;

records of passing the examinations specifying the members of the certification panel, additional questions, marks received, examination dates, practical examination results;

conclusion of the panel on examination results;

copies of the test reports for welded joints made by the welder during an accountable period with the conclusion of a manufacturer-employers responsible official on a possibility to prolong the Certificate for the next six months.

Any of the above documents shall be shown to the Register Surveyor if required.

4.6.9 Agreed with the Register, the validity period of Welder Approval Test Certificate can be prolonged for the manufacturer-employers having the Register approved system of product quality assurance within the framework of the special survey of the manufacturer's quality system as a whole.

4.6.10 In the event that the welder shall be approved for the works, which are beyond the scope of the initial range of approval according to the Certificate on Form 7.1.30, the new approval tests shall be performed in accordance with the above requirements.

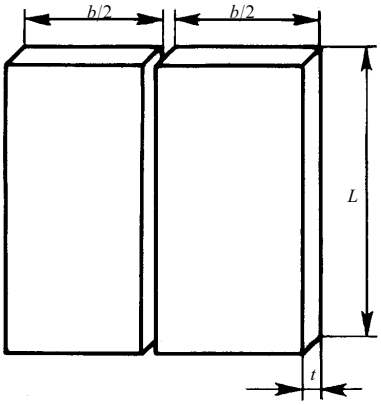
When the welder's skill or knowledge is questioned (refer to 4.6.6 and 4.6.7), the Register surveyor can cancel the valid Certificate and/or demand the performance of unscheduled approval tests.

4.6.11 The prolongation of Welder Approval Test Certificate validity period according to the requirements of 4.6.7 for the next two-year period is allowed no more than two times in succession. The welder's regular certification in full scope shall be carried out on expiring three two-year validity periods of the Certificate (i.e. carried out in the replacement of the Certificate Form).

4.6.12 Practical recommendations for completing the Certificate Form are given in Appendix 4.

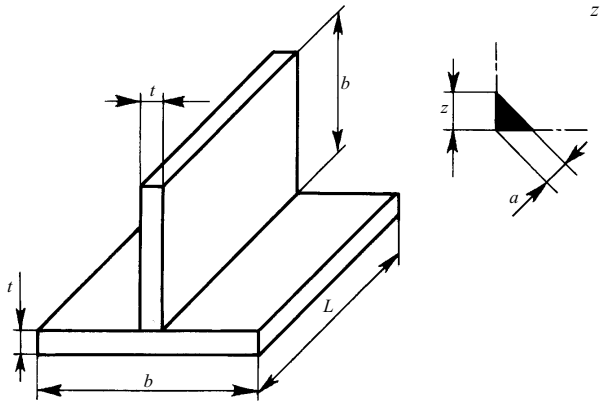
APPENDIX 1 (Mandatory)

TYPES OF WELDED JOINTS TEST PIECES USED IN PRACTICAL TESTS FOR WELDERS' APPROVAL



Welding process	Dimensions of test piece, mm	
	L	*b*
MW, SA, A	⩾350 ⩾800	⩾250 (300)[1] ⩾300 (400)[1]
[1] Values *b* in brackets are given for aluminium and its alloys.		

Fig 1. Test piece of P_1 plate butt joint

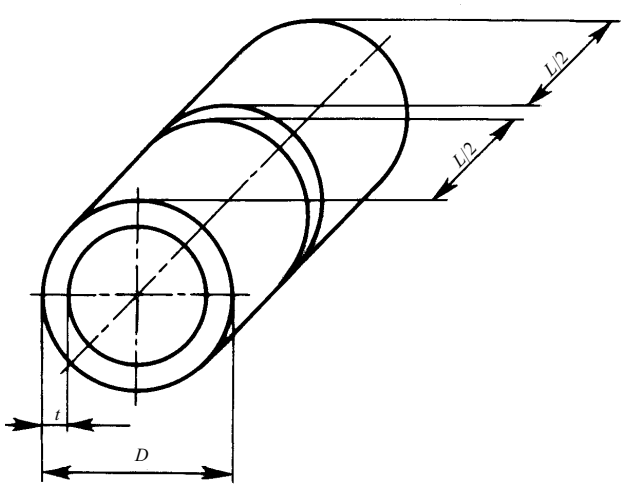


$z = a\sqrt{2}$

$t \geqslant 6$ mm, $a \leqslant 0{,}5t$
$t < 6$ mm, $0{,}5t \leqslant a \leqslant t$
$(z \approx 0{,}7t)$

Welding process	Dimensions of test piece, mm	
	L	*b*
MW, SA, A	⩾350 ⩾800	⩾125 (150)[1] ⩾125 (200)[1]
[1] Values b in brackets are given for aluminium and its alloys.		

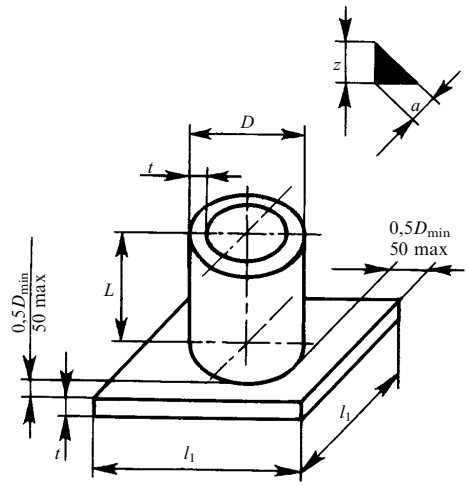
Fig 2. Test piece of P_2 plate T-joint



Welding process	Dimensions of test piece, mm	
	L	*b*
MW, SA, A[1]	$\leqslant 25$ $25 < D \leqslant 150$ > 150	$\geqslant 150$ $\geqslant 250$ (300)[2] $\geqslant 300$ (400)[2]

[1] The test piece size is to be sufficient for reliable equipment operation.
[2] Values *L* in brackets are given for aluminium and its alloys.

Fig 3. Test piece of P_3 butt joint in pipes



$z = a\sqrt{2}$

$t \geqslant 6$ мм, $a \leqslant 0{,}5t$
$t < 6$ мм, $0{,}5t \leqslant a \leqslant t$
$(z \approx 0{,}7t)$

Welding process	Dimensions of test piece, mm	
	L	*b*
MW, SA, A[1]	$\leqslant 25$ $25 < D \leqslant 150$ > 150	$\geqslant 75$ (100)[2] $\geqslant 125$ (150)[2] $\geqslant 150$ (200)[2]

[1] The test piece size is to be sufficient for reliable equipment operation.
[2] Values *L* in brackets are given for aluminium and its alloys.

Fig 4. Test piece of P_4 fillet-welded pipe joint

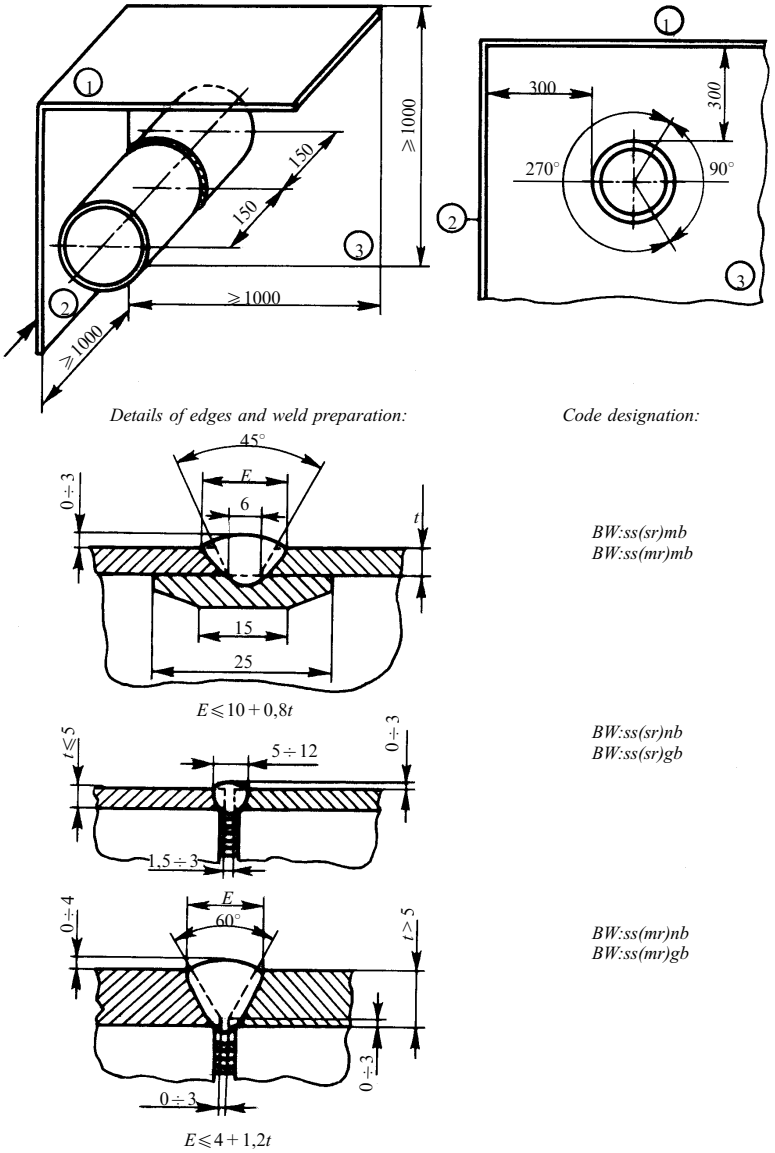


Fig 5. Test piece of pipe joint with a limited access to the welding zone P_5

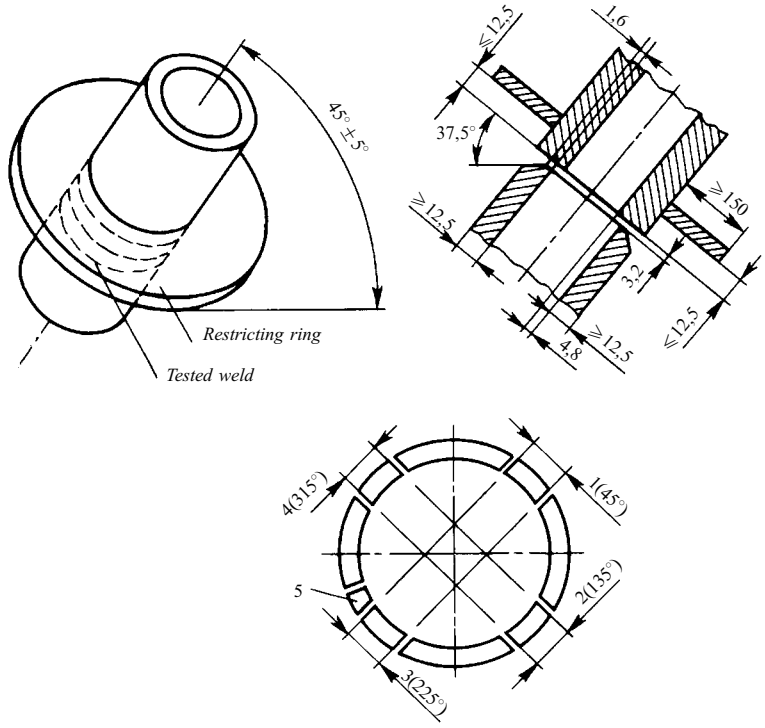


Fig 6. Test piece of P_6 pipe joint with a restricting rings:
1, *2*, *3*, *4* = places for taking test specimens for static bend;
5 = place for taking a macrosection

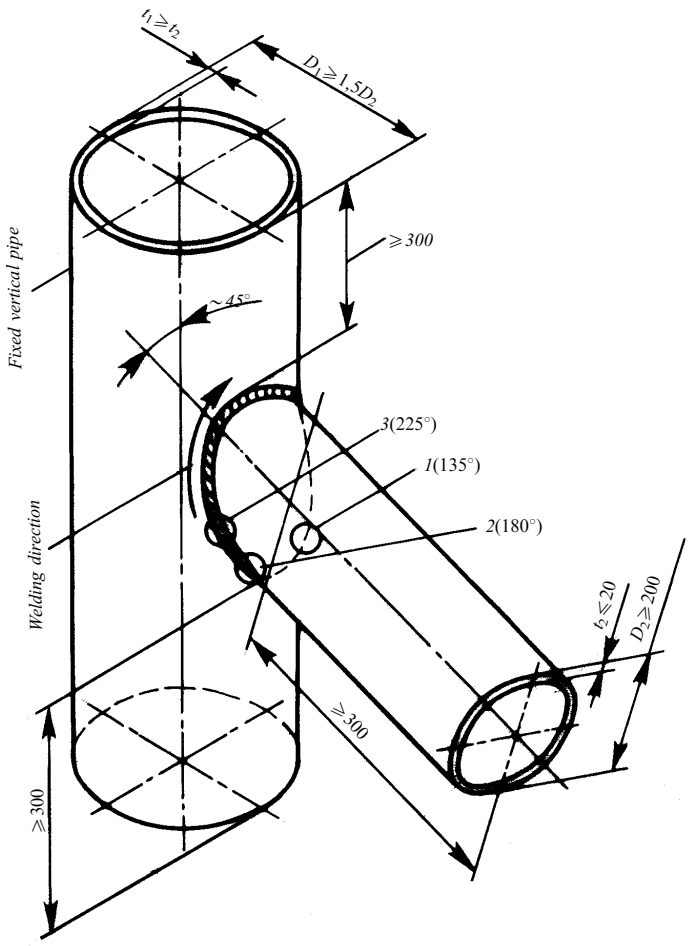


Fig 7. Test piece of P_7 pipe joint unit
1, *2*, *3* = place of taking macrosections

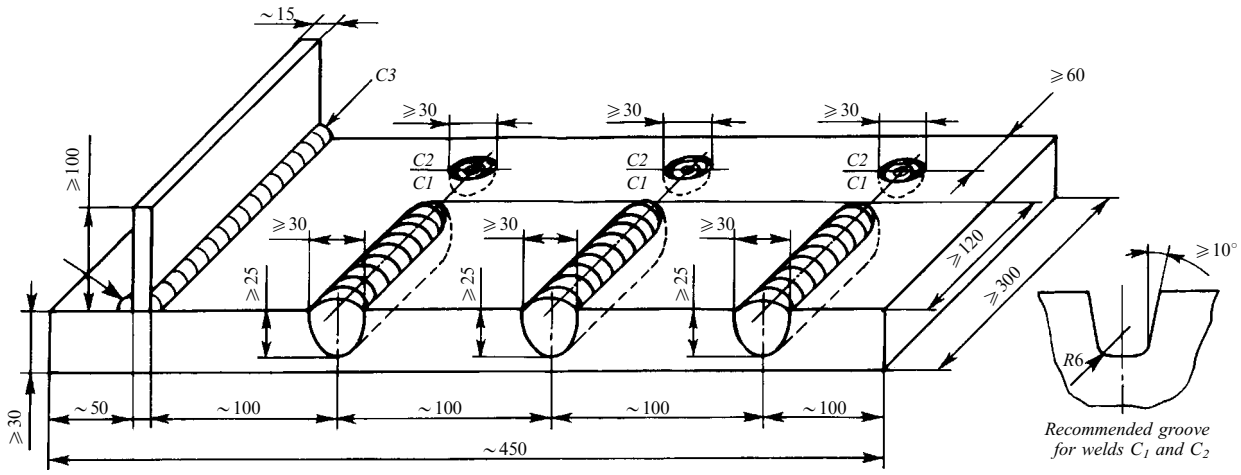
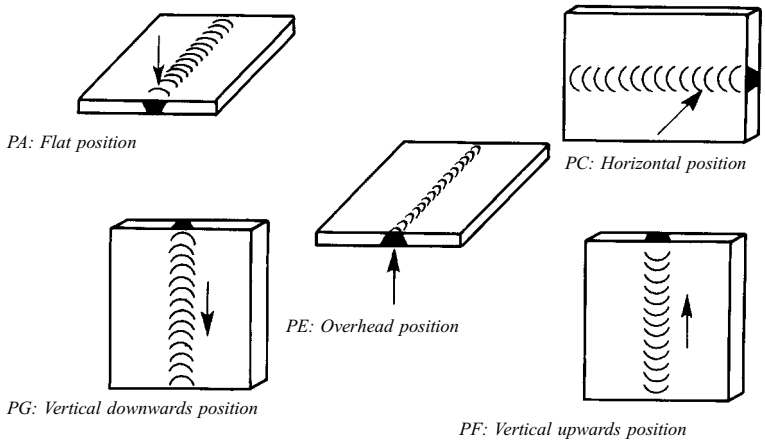


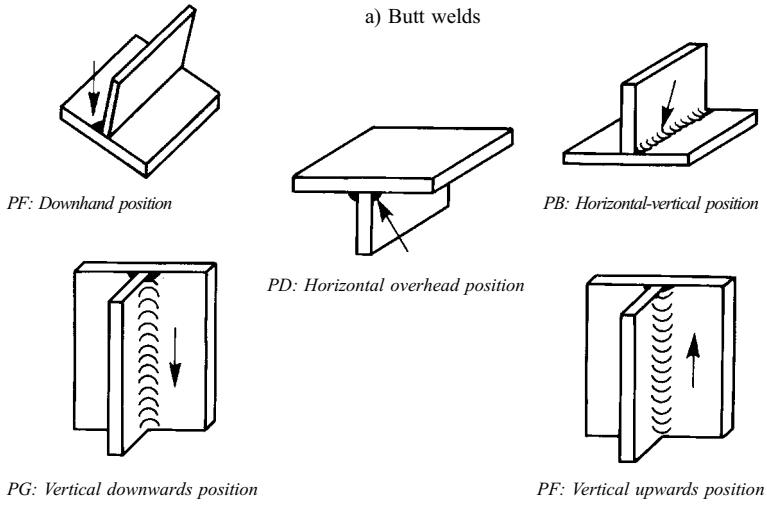
Fig 8. Test piece — simulator P_8 of castings and forgings repair

APPENDIX 2 (Reference)

UNIFIED WELDING POSITIONS ACCORDING TO ISO 6947

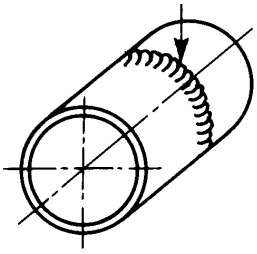


a) Butt welds

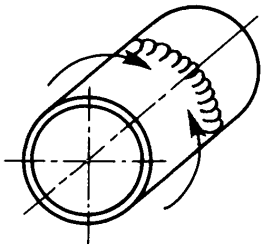


b) Fillet welds

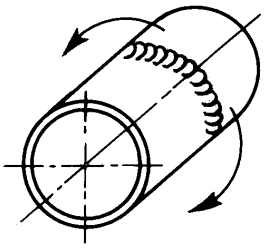
Fig. 1 Welding positions for plates



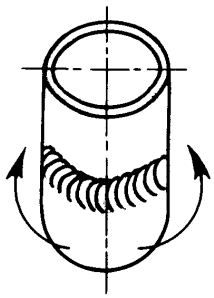
PA: Flat position
Pipe: rotating
Axis: horizontal



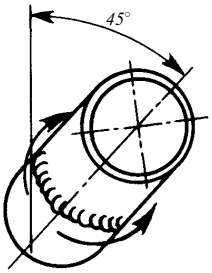
PF: vertical upwards position
Pipe: fixed
Axis: horizontal



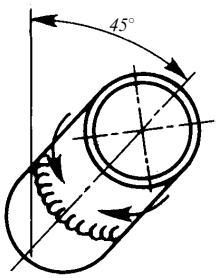
PG: Vertical downwards position
Pipe: fixed
Axis: horizontal



PC: Horizontal position
Pipe: fixed
Axis: horizontal

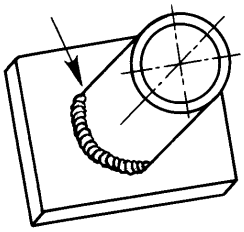


H-L045: Inclined upward position
Pipe: fixed
Axis: inclined

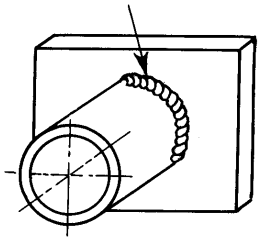


J-L045: Inclined downwards position
Pipe: fixed
Axis: inclined

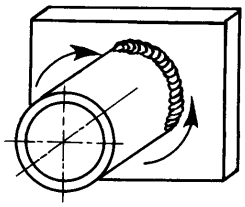
Fig. 2 Welding positions for pipes (butt welds)



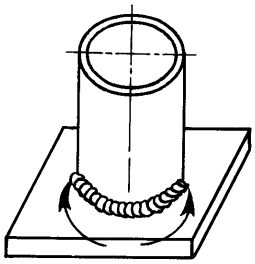
PA: Flat position
Pipe: rotating
Axis: inclined



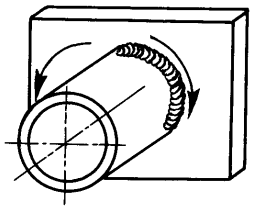
PB: Horizontal-vertical position
Pipe: rotating
Axis: horizontal



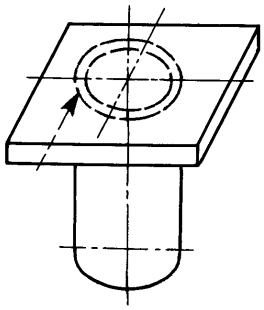
PF: Vertical upwards position
Pipe: fixed
Axis: horizontal



PC: Horizontal-vertical position
Pipe: fixed
Axis: horizontal



PC: Horizontal-vertical position
Pipe: fixed
Axis: horizontal



PC: Horizontal overhead position
Pipe: fixed
Axis: vertical

Fig. 3 Welding positions for pipes (fillet welds)

APPENDIX 3 (Recommended)

(certification body)

RECORD
of certification panel meeting

_____ 200___
(date, month, year)

Panel members:

Chairman _____
(surname, initials)

members _____
(surname, initials)

_____

_____

_____

Issue considered: *certification of welders* _____
(titles of normative documents whereby

_____
the certification is carried out)

1 Surname _____
Name _____
Patronymic _____
2 Year of birth _____
3 Welder's qualification document No. or previous qualification certificate No.

_____
4 Welding experience _____
5 Type of certification _____
6 Details of check welded joint: _____
6.1 Marking of test specimen (stamp) _____
6.2 Welding method _____
6.3 Type of parts welded _____
(plate (P) or pipe (T);
6.4 Type of weld, type and details of welded joint _____
6.5 Welding positions _____
6.6 Preheating and additional heating _____
(yes, no)
6.7 Heat treatment _____
(yes, no)
7 Material of test specimen:
7.1 Brand and group _____
7.2 Test specimen thickness (mm) _____
7.3 Outside pipe diameter (mm _____
8 Welding consumables:
8.1 Electrode or filler wire _____
(brand and type)
8.2 Shielding gas or flux _____
(brand)
9 Results of test specimen quality control:
9.1 Visual examination _____
(satisfactory, unsatisfactory)

(record No. and date)

9.2 Radiographic examination _____
(satisfactory, unsatisfactory)

(report No. and date)

9.3 Ultrasonic examination _____
(satisfactory, unsatisfactory)

(record No. and date)

9.4 Bend test _____
(satisfactory, unsatisfactory)

(record No. and date)

9.5 Metallographic test _____
(satisfactory, unsatisfactory)

(record No. and date)

9.6 Additional methods of examination _____

10 Title of normative document on quality assessment standards _____

11 Assessment of theoretical knowledge _____
(credited, not credited)

12 Decision of certification panel _____
(certification: designation and range of approval;

details of approval test)

13 Date of periodical certification _____

Chairman of panel _____
(signature, surname, initials)

Members of panel _____
(signature, surname, initials)

APPENDIX 4 (Mandatory)

PRACTICAL RECOMMENDATIONS FOR COMPLETING FORM 7.1.30 "WELDER APPROVAL TEST CERTIFICATE"

1 The separate Welder Approval Test Certificate shall, as a rule, be drawn up for each particular version of welding performance, namely:

for one process and method;

separately for the welding of plates and pipes;

for one version of base metal regarding the range of approval.

2 In the event that the welder, according to the manufacturer's application, shall be certified for different versions of welding performance, several Certificates on Form 7.1.30 are drawn up for each version. For instance, the welder is to be approved for the welding of W03 group steel plates using the welding processes 111, 12 and 131. In this case, three Certificates on Form 7.1.30 are drawn up for each welding process.

Note. This requirement results from problems associated with completing one form when the approval test covers the welding in different positions for various welding processes, from differences of filler metal types, structural dimensions and welded joint types, etc.

3 One Certificate may be drawn up for welding methods or versions of one method and/or process (e.g. for different compositions of shielding gas mixtures), which are similar in their performance. In particular, the following combinations are feasible:

welding methods 131 + 135; 131 + 136; 135 + 136;

welding processes SA and A for welding methods 131, 135, 136 and 12 subject to the additional demarcation of welding positions for each item in the Form text;

various compositions of shielding gas mixtures for welding methods 131, 135 and 136.

4 Explanations for completing the separate items of the Welder Approval Test Certificate on Form 7.1.30 are given below.

5 In column "Employer", the full name of the manufacturer is entered where the welder works and which applied for his certification.

6 In column "Code/Testing Standard", Rules for the Classification and Construction of Sea-Going ships of Russian Maritime Register of Shipping are entered, and EN 287 Part 1 for the approval test for steel welding or Part 2, for aluminium and its alloys welding is referred to.

Note. In the welder's approval test for the welding of copper and its alloys, nickel and alloys on its base, and also titanium and its alloys, the requirements of the relevant international (if any) or national standards and guidance documents shall be followed.

7 The completion of columns of the main table "Range of Test and Approval" is detailed in Table П-4-1.

8 Table "Test Results" is executed as follows: in column "Job knowledge", the words "сдано" ("passed") are entered, and in the other columns, "удовл." (passed"). In so doing, the tests ignored are marked with a line (-).

Note. In those cases when practical tests were carried out on the base metal of several thicknesses, the thickness of the test specimens used for static bend test is additionally indicated in brackets.

9 Table "Validity and Prolongation for Approval".

The left half of the Table is completed by the employer's official in charge according to the requirements of 4.6.6 and 4.6.7 of this Part of the Rules.

The prolongation of the Certificate validity period according to the requirements of 4.6.6 to 4.6.8 shall be noted in the right side of the Table by the Register surveyor and certified by his personal stamp.

10 The "Location and date of issue" column specifies the name of the certification centre wherein the welder's approval tests were carried out by Russian Maritime Register of Shipping and the actual date of Certificate issue.

Table

Form 7.1.30, columns	Weld test details (to be entered)	Range of approval (to be entered)
1 Welding procedure specification	Nos. of appropriate СПС/WPSs if drawn up for practical tests (otherwise, insert a dash (-))	Insert a dash (-)
2 Welding process	Coded process designation (refer to 4.3.2.2)	Coded process designation or its full name
3 Welding type	Coded welding type designation (refer to 4.3.2.1)	Coded welding type designation and its full name
4 Plate or pipe	Coded designation P or T (refer to 4.3.4.1)	Coded designation and reference "see welding positions"
5 Joint types[1]	Full coded designation of joint types of test pieces welded in tests (refer to 4.3.3.21)	To shorten the entry, the reference to an appropriate item of EN 287.1 is permitted, e.g. BW and FW (refer to 4.6.3, EN 287.1)

Table — continued

Form 7.1.30, columns	Weld test details (to be entered)	Range of approval (to be entered)
6 Parent metal group/ designation	Coded designation according to EN 287.1 and EN 287.2 (refer to Table 4.3.3.1) for the class of metal to be welded and its designation/ship steels grade according to Part XIII "Materials" of Rules for the Classification and Construction of Sea-Going Ships. Brands of other steels and alloys are designated in accordance with the national standards	Coded designation of classes of parent metal to be welded according to Table 4.3.3.12
7 Filler metal type/ designation	In numerator: coded designation for filler metal presence:wm = welding with filler metal; nm = welding without filler metal.In denominator: grade of welding consumable according to Part XIV "Welding" of the Rules for the Classification and Construction of the Sea-Going Ships and its designation according to the national standards (a dash (-) is inserted for nm)	Entry "similar filler materials" ("welding consumables of the same type")[2, 3]
8 Shielding gas composition/ flux	Group of shielding gas composition in use according to EN 439 (refer to Tables 4.3.2.4-1 and 4.3.2.4-2) for welding processes 15, 131, 135, 136 and 141. For welding process 12 (121), flux designation (brand) and its index according to Table 4.3.2.6 are indicated	Composition groups with due regard for requirements of 4.5.8[4] for welding processes providing for use of shielding gases and fluxes. For other welding processes, insert a dash (-)
9 Type of flux or electrode covering	Coded designation of electrode covering composition (refer to 4.3.2.3), and method of flux manufacture according to 4.3.2.5 for welding process 121 (12)	Type of electrode coverings within the range of approval according to 4.5.7 (refer to Table 4.5.7), and for fluxes, indexes of manufacture procedure[5]
10 Auxiliary materials	Data on auxiliary materials, namely: backing type and material, various pastes and fluxes for oxy-acetylene welding, composition of shielding gas for backing on the back of weld, etc.	Range of approval by auxiliary materials of the same type as that used in testing
11 Parent metal thickness	Actual thickness of parent metal of test pieces welded[6]	Range of thicknesses of parent metal the welder is approved for according to 4.5.9 (refer to Table 4.5.9-1)[6]
12 Pipe outside diameter	Actual values of diameters for pipes of test pieces welded	Range of pipe diameters the welder is approved for according to 4.5.9 (refer to Table 4.5.9-2)
13 Welding position(s)/ type of test piece1	In numerator: ISO 6947 - unified welding positions for test pieces welded in practical tests (refer to Appendix 2). In denominator: coded designations of test pieces types the welder performed in practical tests (refer to Appendix 1)	Welding positions the welder is approved for based on practical tests according to 4.5.3

[1] Depending on the relevant range of approval by thicknesses of metal to be welded and/or pipe diameters, and also for meeting the conditions according to 4.5.5, more than one test piece having various joint types may be welded in practical tests.

[2] To simplify entries for dissimilar welded joints, and appropriate table in EN 287.1 ("for dissimilar joints, see Table 5, EN 287.1") or EN 287.2 (Table 5) may be referred to.

[3] Additional restrictions for varieties of steels welded and filler materials used may be entered in columns 6 and 7 of the range of approval at the discretion of the Regional Location. For instance, stainless duplex steels, maraging high-alloy steels having $R_{p0,2} \geqslant 890$ N/mm^2, etc. may additionally be picked out in the class of W11 steels.

[4] For gas-shielded welding using the C1 or C2 gas composition, the latter does limit the range of approval. For other cases, the range of approval is usually limited by gas mixture compositions similar to those used in practical tests and an entry is made (e.g.):

M21 = gas mixtures similar to M21 according to EN 439, namely M1 and M2 or

M22 = gas mixtures of the M2 and M1 type according to EN 439.

It shall be taken into account that the separate welder's approval test performance is needed for each group of gas compositions for gas-shielded welding with use of essentially different compositions (refer to 4.5.8).

[5] Because the way of flux manufacture exerts no crucial effect on welding and technological properties if compared with the flux composition, an entry may be made in column "range of approval", e.g.:

A and F fluxes of similar composition.

[6] For test pieces of fillet-welded joints, the effective throat thickness value "a" is given in brackets, and its values according to Table 4.5.9-3 are shown in column "range of approval".

APPENDIX 5 (Mandatory)

REGULATIONS ON WELDER'S CERTIFICATION CENTRES

1 APPLICATION

1.1 These Regulations establish the organizational and legal form, rights and responsibilities of certification centers, the procedure for their recognition by the Register and the main requirements for their operation, as well as for their training and testing base.

The Regulations are intended for use by:

the Register Branch offices carrying out technical supervision of welders' approval testing;

the organizations or enterprises interested in their recognition as certification centers;

certification centers in their practical activities.

2 GENERAL

2.1 The status of a certification centre may be given to an independent organization/enterprise being a legal entity of any organizational and legal form, and of property forms provided that it meets all the requirements of these Regulations and Rules for the Classification and Construction of Sea-Going Ships.

2.2 The recognition of certification centers authority is effected by the Register as follows:

submission to the Register of an application containing the data and enclosures specified in 2.3;

Register review of the application and documents regulating certification centre activities;

Register survey of the training and testing base of the certification centre;

elimination by an applicant of nonconformities identified in documentation and at the training and testing base;

issuance by the Register of documents on the recognition of certification centre authority, and direct participation in the centre activity.

2.3 The application for certification centre accreditation shall include:

certification centre name and full postal and financial details;

full names of the head and the official in charge of contacting the Register;

list of welding processes the welders will be certified for, and the list of groups of a base metal type composition;

guarantee of payment for the Register services.

The following documents shall be attached to the application:

copy of the Charter of the certification centre;

draft Regulations on certification centre;

sets of programs of preparation for certification, and of collections of examination questions, and also of practical exercises for all the types of examinations to be performed.

2.4 The Regulations on certification centre shall include:

information on the availability of spaces for theoretical and practical examination;

information on the organizational structure of the centre;

information on the material base including the welding equipment, stock of machine tools and outfit available and used in certification, on the equipment and means of welded joints quality control, computer equipment;

information on the centre personnel including examiners and certified specialists on non-destructive examination methods;

information on certification activities organization;

information on the procedure for sending and examining appeals;

procedure of keeping the register of certified welders, and of archiving.

3 CERTIFICATION CENTRE STRUCTURE AND FUNCTIONS

3.1 The certification centre is managed by a head appointed on the contract basis or by order of founder(s) in accordance with the procedure established by the RF legislation.

3.2 Certification panels conducting theoretical and practical examinations are part of the certification centre.

The main objectives of the certification panel include:

organization and control over the welders' preparation for approval testing;

development of programs of welders' special theoretical and practical training for certification;

setting target times for certification performance;

preparation of the relevant training and testing base;

preparation of the collection of examination questions on welding processes and the base metal type;

establishment of the procedure for theoretical examination performance;

performance of the theoretical examination and assessment of its results;

development of the welding procedure specifications for the performance of test welding joints;

inspection of materials to be used for welders' practical test;

monitoring of welders' performance in welding and of welded joints marking;

organization of welded joints quality control performance and assessment of their quality in accordance with the RS rules requirements;

execution of a test report and taking decision on the results of the welder's approval test;

preparation of proposals for updating normative documents on welder's certification issues.

The certification panel is authorized to:

remove welders from an approval test if they do not fulfill the requirements of a welding procedure or violate the procedure for test performance;

give a conclusion on the possibility to prolong the validity period of Welder Approval Test Certificate;

set up working groups to review the activities of the locations ensuring control over welders' performance at manufacturers;

submit proposals on updating the welders' certification procedure.

3.3 The certification panel members are approved by the head of the certification centre and agreed with the Register Branch offices.

The certification panel includes:

chairman and his deputy being certified specialists in welding;

authorized representative of Russian Maritime Register of Shipping;

certified specialist on non-destructive examination authorized to sign the conclusions on the results of inspection by visual examination and measurements, and also on X-ray examination (or ultrasonic examination).

The following persons may also be drawn into activities of the certification panel on the permanent or temporary basis (depending on the certification centre status):

the person in charge of welding at an employer's (a senior welder, the head of a welding shop, etc.);

the person in charge of monitoring welders' performance at the employer's;

the authorized representative of an employer's technical control service;

highly qualified specialists in the area of individual welding processes or in the groups of a base metal type composition (e.g. specialists in the welding of non-ferrous metals and their alloys, etc.).

3.4 The certification centers include a training and testing base which provides and opportunity to perform theoretical and practical tests for welders approval.

Generally, the training and testing base needs the following spaces for its normal functioning:

welding shop with working stations for practical tests performance;

space for preparing parts for welding;

space for power supply (gas and electrical supply, ventilation and heating) equipment;

space for studies (lectures);

domestic spaces;

spaces for mechanical testing and welded joints quality control.

3.5 The main functions of the certification centre are the welders certification, and also office work performance and keeping a record of the welders certified.

In certification performance, the centre ensures:

drawing up of welders certification programs;

forming certification programs;

approval testing for specific welding processes and groups of a base metal type composition;

keeping up of the operational status of the training and testing base;

control over the observance of requirements unity and over the objectivity of the examination results assessment.

The office work performance provides for keeping a card index for every certified welder, which includes the following:

application for certification;

copy of a document on education;

copy of a document on special training;

reference on work experience in welding (an extract form the work-record card);

reference on the state of health;

examination sheets;

copies of reports of welded joints quality control;

report on passing the examinations by the welder being certified with the conclusion of the examination panel;

3 by 4 cm photograph and the signature pattern of a certified welder;

copy of Welder Approval Test Certificate.

N o t e. The extent of the card index may be reduced for the certification centers established at manufacturers and providing services to their employees.

The information on certified welders shall be retained within two validity periods of Welder Approval Test Certificate following the last certification.

If the welder fails examinations, the information about this is kept in the certification centre a year after the decision has been taken by the certification panel.

APPENDIX 6 (Recommended)

SECTIONS OF THE PROGRAM OF WELDERS' PREPARATION FOR CERTIFICATION

To assess the welder's knowledge, the list of examination questions shall include information from the following sections.

1 The basics of fusion welding (essence of processes, stresses and deformations in welding, concept and indexes of weld ability).

2 Welded joints and welds (classification, welding positions, edge preparation).

3 Base materials and welding consumables (brands, characteristics, application).

4 Welding equipment and apparatus (purpose, types, design, operating instructions).

5 Procedure for welding of welded joints (preparation and assembly for welding, heating, welding conditions, welding methods, heat treatment).

6 Control of welded joints quality (methods of control, standards for quality assessment).

7 Details of welded joints repair (defects rectification) procedure.

8 Welding organization, guidelines and technical documentation on welding.

9 Health and Safety regulations in welding performance.

10 Qualification tests of welders (standards and rules, performance procedure, requirements, designations and range of qualification extension).

PART IV. TECHNICAL SUPERVISION DURING MANUFACTURE OF PRODUCTS

1 GENERAL

1.1 APPLICATION

1.1.1 The provisions of this Part apply in the technical supervision during design and manufacture of products subject to the technical supervision of the Register according to the RS Nomenclature given in Appendix 1 to Part I "General Regulations for Technical Supervision".

1.1.2 The provisions of this Part may be applied with due regard for details and distinctions in the processes of products design and manufacture which are inherent in the country wherein the Register carries out technical supervision.

1.2 TERMS AND DEFINITIONS, ABBREVIATIONS

1.2.1 Terms and their definitions, abbreviations are given in Part I "General Regulations for Technical Supervision".

1.3 THE SCOPE OF TECHNICAL SUPERVISION

1.3.1 The scope of supervision is specified according to the provisions given below in this Section.

The scope of supervision for specific types of products is given in Sections 3 to 17.

1.3.2 In the process of product design and production launching, the Register generally carries out supervision during the following:

.1 development of technical and normative-technical documentation;

.2 manufacture and tests of production prototypes (pilot specimens) of the product.

1.3.3 In supervision performance, the Register takes into account the requirements of the current standards establishing the procedure for development of technical documentation and testing of products at stages of their manufacture.

The Register does not form part of inspection boards and carries out its functions in the course of tests according to the test program approved and technical documentation keeping under control the fulfillment of the RS requirements. The Register relevant documents are executed according to the supervision results.

1.3.4 In development of a product and launching its production, some particular stages of design documentation development or work stages may be ignored (depending on product complexity or novelty), this is generally to be agreed in the technical documentation for the product.

1.3.5 Considering the possibility of use on ships the products manufactured without the RS technical supervision, 5.7, Part I "General Regulations for Technical Supervision" shall be single approval shall be made in compliance with. When the product was manufactured without the RS technical supervision, but the documents of another Classification organization, issued without the RS authorization, are provided, 2.16, Part I "General Regulations for Technical Supervision" shall be followed.

1.4 TECHNICAL DOCUMENTATION

1.4.1 General.

1.4.1.1 General provisions on the Register technical supervision during development of technical documentation, including the provisions on the execution of its review results, validity periods of approval and on amendments to the technical documentation approved, are set forth in Part II "Technical Documentation".

1.4.1.2 This Chapter specifies the procedure for submitting technical documentation for products to the Register, as well as the procedure for the Register reviewing separate types of documents at various stages of technical documentation development.

1.4.1.3 The technical documentation for products is submitted to the Register for review and approval according to 5.1, Part II "Technical Documentation" in the scope specified in the relevant parts of the RS rules (for the list of the Register rules, refer to 1.3, "General Regulation for the Classification and Other Activity").

1.4.1.4 The product names "production prototype (first lot)" and "pilot specimen (pilot lot)" are introduced by a developer under the agreement with a customer and the Register.

1.4.1.5 When engines are produced under a license according to the licensor's documentation approved by the Register, a licensee shall submit for the Register reviewing the list of drawings according to 1.2, Part IX "Machinery" of Rules for the Classification and Construction of Sea-Going Ships specifying the drawing numbers assigned and the licensor's relevant drawing numbers.

Where the licensor introduces minor changes in a design, the relevant documents about this shall be submitted to the Register for approval. In the event of

major changes in the design, the licensor's confirmation shall additionally be submitted to the Register. In any case, the licensee shall submit the full set of approved documents to the Register.

1.4.2 Performance specification, concept design, sketch design.

1.4.2.1 These documents are reviewed by the Register at its discretion only when radically new structural designs are implemented. However these documents need neither approval nor agreement. Proceeding from the review results, the Register draws up a written conclusion (reference) with the recommendations or requirements (if needed) to be taken into account by a designer in the following development of a product (refer to 3.6, Part II "Technical Documentation").

1.4.3 Technical design.

1.4.3.1 Proceeding from the technical design review, a conclusion letter is drawn up wherein the following shall be specified:

.1 technical requirements (if any) to be met and taken into account by a designer at the following stages of working documentation development and product manufacture;

.2 the RS Regional Branch office authorized to review and approve the working documentation, as well as to verify the implementation of comments and requirements on the technical design;

.3 the RS Regional Branch office authorized to supervise the manufacture of the prototype (pilot specimen) and first (pilot) lot production;

.4 participation of the Head Office representative (if needed) in acceptance tests of the product prototype (pilot specimen);

.5 deviations (if any) from the rules requirements permitted by the Register according to 1.4.3.2.

The conclusion letter copies shall be sent to the RS Regional Branch offices specified in 1.4.3.1.2 and 1.4.3.1.3.

1.4.3.2 Deviations from the rules requirements are considered by the Register Head Office if formally addressed by a developer with the justification of the deviations made and proposals for implementing pertinent structural measures or alternative decisions.

1.4.3.3 With the positive conclusion on the technical design including the comments and requirements available whose implementation can be permitted by the Register at the subsequent stages of product development (refer to 1.4.3.1.1), the technical design documentation is approved and the appropriate Register stamps are put on the documents according to Section 8, Part II "Technical Documentation".

1.4.3.4 With the negative conclusion, i.e. the engineering design cannot be approved due to a failure to meet the Register requirements on key issues, the technical design documentation is returned to a designer for modification (for taking into account the Register requirements set forth in the conclusion letter whose implementation cannot be rearranged to other stages of product development).

1.4.4 Detailed (design) documentation.

1.4.4.1 The detailed (design) documentation for a product is submitted to the Register for review and approval at the stage of pilot specimen/production or prototype (if pilot specimen development is not provided for) development.

Hereinafter, only those detailed (design) drawings are submitted for the Register approval which were amended according to the results of manufacturing and testing the production prototype (pilot specimen) or products of the first-off production batch, as well as in case of the change of a serial products design.

1.4.4.2 The detailed (design) documentation is submitted to the RS Regional Branch office authorized by the Head Office for its approval (refer to 1.4.3.1.2).

If manufacturing the product prototype (pilot specimen) is supervised by another Regional Branch office, one set of the approved detailed (design) documentation shall be forwarded to that Regional Branch office (refer to 1.4.3.1.3).

1.4.4.3 The detailed (design) documentation shall be approved with no outstanding comments, i.e. all the requirements of the RS rules and the requirements set forth in the conclusion letter on the technical design (refer to 1.4.3.1.1) shall be taken into account in the detailed (design) documentation.

1.4.5 Technical specification.

1.4.5.1 Technical specification shall generally be submitted for review as part of the product technical design. In the absence of design documentation (if not developed), the technical specification shall include the full package of the Register requirements for the given product.

1.4.5.2 Generally, the content of technical specification is determined by the adopted standardization system, but in any case, for the Register supervised products they shall include the following instructions on:

.1 product conformity with the RS requirements;

.2 necessity of the Register approval for the technical documentation for products including test programs;

.3 necessity of the Register supervision during products manufacture and tests.

1.4.5.3 The technical specification shall be approved with no outstanding comments, i.e. all the findings identified in the technical specification review shall be taken into account in the text of the technical specification prior to their approval. With the outstanding comments, the conclusion letter is drawn up without approval stamping the technical specification.

1.4.5.4 The technical specification amended according to the results of testing the product prototype (pilot specimen) shall be submitted again for the Register approval, or a notice shall be issued approved by the Register concerning the alterations made in the technical specification.

1.4.5.5 The technical specification absence, while the necessary information is available, does not impede

the review and approval of documentation for a set number of products.

In such cases the documentation is subject to the single approval (refer to 8.6, Part II "Technical Documentation").

1.4.6 Test program.

1.4.6.1 The program of product prototype (pilot specimen) testing is reviewed and approved by the Register Head Office or Regional Branch office (refer to 5.1, Part II "Technical Documentation").

1.4.6.2 The program of product operational testing onboard ship is generally reviewed and approved by the Register Head Office.

In particular cases, the RS Head Office can delegate the review and approval of the program of product operational testing to the Regional Office.

1.4.6.3 The programs of first-off production batches and serial products testing are reviewed and approved by the RS Regional Branch office supervising products manufacture.

1.4.6.4 The test programs shall generally provide for the following:

.1 verification of product conformity with the Register approved drawings, technical conditions and standards;

.2 determining product quality indexes regulated by the Register;

.3 functional tests;

.4 duration and conditions of tests, including measurements in testing;

.5 means of control and limiting deviation values;

.6 examinations and inspections;

.7 check tests after inspection (if needed);

.8 methodical instructions on test performance (test procedure may be submitted as a separate document which shall be indicated in the test program).

1.4.6.5 With the positive review results, the Register appropriate approval stamp is put on the front page of the test program.

1.4.6.6 The test programs reviewed by the Register Head Office may be approved with the outstanding comments or requirements given in the conclusion letter wherein the Regional Branch office in charge of their implementation control is also specified.

1.5 PRODUCT PILOT SPECIMEN

1.5.1 This Chapter contains the regulations on supervision during manufacture and testing pilot specimens (batches) or single products.

1.5.2 Use of pilot specimens on ships, if agreed with a shipowner, shall be approved by the Register.

1.5.3 Tests of pilot specimens and single products are carried out under the Register supervision according to the approved program.

1.5.4 The technical supervision during manufacture and testing pilot specimens is carried out by the Regional Branch office. The participation of the RHO representative is agreed in the reviewing of the test program.

1.5.5 Prior to testing product pilot specimen, a manufacturer submits to the Register:

.1 pertinent technical documentation approved by the Register, the test program inclusive;

.2 the Register documents confirming the manufacture of components under the Register supervision;

.3 item under test;

.4 test, measuring and inspection equipment;

.5 results of preliminary (shop) tests of a pilot specimen; procedure for the above tests if needed;

.6 document of a manufacturer's control body on readiness for testing.

1.5.6 Based on the outcome of the familiarization with the documents and equipment specified in 1.5.5, the Register takes decision on a possibility to supervise product specimen testing.

1.5.7 If the check of a pilot specimen according to an approved program is not deemed feasible, separate items of the bench test program for the pilot specimen, if agreed with the RHO, may be carried over to the extended program of the ship mooring and sea trials. Tests performance onboard the ship shall be pre-arranged by the product manufacturer with the shipyard and its customer.

1.5.8 If the product has failed any test and its design has been properly modified, the tests shall be repeated. The conclusion of a manufacturer on causes of unsatisfactory tests shall be submitted to the Register.

When justified, only those tests affected by the modifications made may be repeated.

1.5.9 If pilot specimen tests have not adequately confirmed the product conformity with the Register approved technical documentation, the product is not approved for use onboard.

1.5.10 On tests completion, a report on survey of the pilot specimen on an established form is drawn up. The following shall be indicated in the report conclusion:

.1 conformity (nonconformity) of the given product specimen with the RS requirements;

.2 approval (disapproval) of the given product specimen for use onboard ship if intended for this purpose;

.3 requirements (if needed) on the relevant updating of technical documentation;

.4 necessity to carry cut operational tests of the specimen if those are specified in 1.8.

1.5.11 The Register issues certificates for product pilot specimens approved for use onboard ship. In this case:

.1 if the pilot specimen is subject to operational tests (refer to 1.5.10.4), the report is a mandatory appendix to the certificate which shall be duly noted in the latter;

.2 where the tests are carried out in two stages (test bench-ship: refer to 1.5.7), on completing the first stage, the report on pilot specimen survey is drawn up with a conclusion on the approval of the specimen for the second stage of test onboard ship. In this case, the report is a mandatory appendix to the certificate which shall be duly noted in the latter.

The report on pilot specimen tests onboard ship is drawn up with due regard for the report on the results of the first stage of tests. With the positive results of tests at the second stage, the fulfillment of requirements at this stage is specified in the certificate.

1.5.12 With the positive results of the manufacturer's bench tests for product (batch) pilot specimens other than those which are independent functional units, the report on (batch) pilot specimen survey is drawn up with a conclusion on the approval of the (batch) specimen for further testing as part of the equipment the product is intended for.

In this case, the final conclusion is made on completing tests of the main product fitted with the specimen.

1.6 PRODUCT PROTOTYPE

1.6.1 This Chapter contains the regulations on supervision during manufacture of a product prototype.

1.6.2 The necessity in supervision of the prototype is determined in review and approval of documentation.

1.6.3 If the mandatory drawing up of Type Approval Certificate is specified in column 4 of the RS Nomenclature, the technical supervision of the prototype of such product is carried out by the RS Head Office or Regional Branch office as authorized by the RHO.

1.6.4 Prior to the beginning of prototype testing, the manufacturer submits to the Register:

.1 documentation specified in 1.5.5;

.2 product prototype test results, if any;

.3 data on the product previous use, if relevant.

1.6.5 According to the results of the technical supervision of the prototype with due regard for the mandatory Type Approval Certificate, the latter is drawn up taking into account the provisions of 1.6.3 or Certificate of Conformity, in single approval.

1.6.6 With the unsatisfactory results of testing the product prototype to be provided with Type Approval Certificate, the Report is drawn up to state that the product has failed the tests and is not approved for use onboard ship. The requirements are put forward in the Report, which shall be met for product retesting approval.

1.7 SERIAL PRODUCTS AT ESTABLISHED PRODUCTION

1.7.1 This Chapter contains the regulations on supervision during manufacture and tests of serial products at established production.

1.7.2 The Register supervision during manufacture and tests of serial products at established production is carried out in accordance with the requirements of the relevant Sections of this Part of the Rules and RS Nomenclature.

1.7.3 Serial products are tested according to the Register approved normative and technical documentation or the Register approved test program.

1.7.4 In the course of serial production, products can periodically be tested in accordance with the requirements of the normative and technical documentation agreed.

1.7.5 According to the Register supervised periodical tests results, the Report is drawn up to confirm the conformity of the product with the RS requirements, the stability of Register regulated properties and characteristics.

If the product periodical tests were carried out without the Register supervision due to its decision, a manufacturer shall submit test results to the Register for review.

1.7.6 If the serial product is modified so that the Register regulated properties and characteristics are affected, the first product modified shall be tested according to the Register approved program. These tests may be combined with the manufacturer's type tests of the product.

The scope of tests is specified by the Register in each case with due regard for the specific character and scope of the changes made, and for the production conditions.

1.7.7 According to the results of testing after the modification (refer to 1.7.6), the Report is drawn up to confirm the conformity of the modified product with the Register requirements and feasibility of its further manufacture under the Register technical supervision.

1.7.8 Following the results of the technical supervision of serial products, the RS documents are drawn up according to the RS Nomenclature and the provisions of Part I "General Regulations for Technical Supervision".

1.8 OPERATIONAL TESTS OF PRODUCTS

1.8.1 Operational tests of a product onboard ship are carried out to confirm the product conformity with the RS requirements for operational conditions.

The product tests onboard ship according to the program of mooring and sea trials are not considered as operational tests.

1.8.2 The following products are subject to operational tests:

.1 as specified by a developer or shipowner for checking in the course of the trial operation on ships;

.2 as required by the Register;

.3 according to the RS rules requirements.

1.8.3 Product operational tests are specified in cases when comprehensive test bench trials of the ultimately new design product specimen is not deemed feasible and therewith there is no reliable operational experience in use of similar products on ships. In this case, the test bench trials cannot be replaced by calculations.

1.8.4 The conditions to be observed in operational tests onboard ship shall be specified in the test program developed by the product designer (manufacturer), agreed with a shipyard and shipowner, and approved by the Register Head Office or Regional Branch office as authorized by the RHO.

The program shall include the following:

product name and its purpose onboard ship;

name of the ship engaged in test performance;

number of products onboard the ship;

test objective;

tests conditions and duration;

types of measurements, surveys and their frequency;

instructions on product submitting for the Register survey.

1.8.5 The necessity of product operational tests performance in accordance with the approved program shall be specified in the relevant report while drawing up Register ship's documents after completion of mooring and sea trials.

1.8.6 On completion of operational tests, a designer (manufacturer) submits to the Register, according to the location of a product survey onboard ship, the records on these tests wherein the accomplishment of the tests program approved shall be confirmed and the following shall be specified:

test results;

number, nature and causes of failures;

designer's and customer's opinion on the product according to the operational test results.

The total duration of operational tests shall not include the time when the ship was out of service.

1.8.7 On completion of operational tests, a report on product survey is drawn up to specify the results of operational tests and to infer on the product further application feasibility onboard in accordance with the product designated purpose.

1.8.8 With the unsatisfactory results of intermediate product surveys at any stage of operational tests performance, the Register discontinues the supervision of tests and in each particular case takes a final decision on the given product specimen after reviewing the operational tests materials submitted in accordance with 1.8.6, as well as on the conditions of the ship further operation.

1.9 TECHNICAL SUPERVISION DURING MANUFACTURE OF MASS-PRODUCED INTERNAL COMBUSTION ENGINES

1.9.1 Application.

1.9.1.1 The provisions of this Chapter apply to internal combustion engines having a cylinder diameter of 300 mm and below.

1.9.2 Approval procedure for mass-produced products.

1.9.2.1 Request for approval. Amount of documentation to be submitted.

Requesting for approval, a manufacturer shall submit for review the following documentation for the particular type of an engine:

drawings;

specifications for main parts materials;

instructions on the engine maintenance and operation;

list of main parts sub-suppliers.

1.9.2.2 Survey of production and quality control system.

The manufacturer shall submit the comprehensive information on the processes applied in production and procedures for quality control. The processes and procedures shall be surveyed by the Register, as well as:

the organizational structure of the quality management system;

ensuring of quality control by stages;

the skill and independence of the personnel carrying out control of the product quality.

1.9.2.3 Type tests.

One engine of a series in an assembling line shall be checked in operation on a test bench during at least 100 h according to the Register approved program.

After tests completion, disassembled engine parts shall be submitted to the Register for survey.

At the discretion of the Register, exceptions may be made for long-known engines of well-proved types.

1.9.2.4 Approval validity period.

The Register reserves the right to limit the approval validity period. The engine manufacturer shall inform the Register without delay about changes in the engine design, use of materials, the organization of a quality management system.

1.9.3 Continuous survey system.

1.9.3.1 The Register shall have free admission to the following locations of the manufacturer's:

production,

design,

service.

1.9.3.2 The production survey is carried out in the following stages:

the results of tests, checks and examinations carried out shall be submitted to the Register for agreeing and taking into consideration;

the system of accessories identification shall be agreed;

the manufacturer shall submit the comprehensive information on the quality management system of the sub-suppliers of accessories and parts subject to survey.

If need be, the Register reserves the right to survey the accessories and parts delivered by sub-supplier.

1.9.3.3 Single test bench trials.

When needed, the Register can require the performance of additional test on the manufacturer's test bench witnessed by its representative.

1.9.4 Technical supervision.

The technical supervision during manufacture of engines shall be carried out in accordance with the Agreement on Technical Supervision (refer to 4.5, Part I "General Regulations for Technical Supervision").

The manufacturer shall supply engines for the Register classed ships with Certificates (Form 6.5.31) with the data in the appendix relating to testing the engine sample in accordance with 1.9.2.3, as well as the manufacturer's number and the results of manufacturer's tests of the engine.

The appendix form shall be agreed with the Register.

In individual cases, Certificates (Form 6.5.30) may be drawn up for engines at the surveyor's discretion.

2 HULL

2.1 GENERAL

2.1.1 The provisions of this Section apply in the technical supervision during design and manufacture of parts, units, panels and other hull components, if they are manufactured as separate products for delivery to the shipyard where the ship's hull is built, including hull structures being independent assembly units or parts thereof in modular (modular and unit-type) construction of ships.

2.1.2 Supervising the manufacture of hull products, the requirements of 2.1 to 2.10 shall be met, and also of 2.11 as far as practical, and of Part V "Technical Supervision During Construction of Ships" with due regard for the provisions specified below.

2.1.3 Concluding the contract on the Register supervision during manufacture of hull products, the contract between a shipyard — customer and supplier of products shall be submitted to the RS Regional Branch office, as well as other documentation on the terms of the order. If these latter do not ensure proper continuity in ensuring hull construction quality or performing supervision functions by the Register, the right to impose the additional requirements upon order terms in the supervision contract is reserved to the Regional Branch office.

2.1.4 Products for ship's hulls at the manufacturer's are considered as finished product. They shall be fully checked by the manufacturer's technical control body and provided with the documents issued.

2.1.5 The Surveyor effects the survey or products according to the list of supervision items[1] drawn up to fit the conditions of the manufacturer (refer to 12.2, Part I "General Regulations for Technical Supervision").

2.1.6 Additionally to agreeing with the Register, changes and deviations from the approved technical documentation for products shall be agreed with a shipyard – customer and a document about this shall be submitted to the Surveyor.

2.1.7 The manufacturer's technical control body shall issue the document of an established form for a finished product.

The product shall be provided with the Register certificate or manufacturer's document confirmed by the surveyor wherein the essentials of the product are given: name, purpose, characteristics including dimensions and other data on materials, drawings and other technical documentation. Additionally, the pertinent technical materials are attached: expansion, margin diagram, results of weld control and necessary tests, as well as the documents on deviations and replacements made and agreed with the Register, etc. To be also attached for castings and forgings are the results of a chemical composition analysis, testing mechanical properties of material, and the data on heat treatment. The document form for the product and the list of appendices thereto shall be agreed with the Register for each type of products.

[1] Hereinafter referred to as "list of items".

3 EQUIPMENT, ARRANGEMENTS AND OUTFIT

3.1 GENERAL

3.1.1 The provisions of this Section apply in technical supervision during design and manufacture of equipment, arrangements and outfit listed in the RS Nomenclature.

3.1.2 The Section contains the technical supervision requirements during manufacture of preproduction and serially produced articles of equipment, arrangements and outfit in steady production.

3.1.3 The materials used for manufacture of products shall comply with the requirements of Part III "Equipment, Arrangements and Outfit" and Part XIII "Materials" of Rules for the Classification and Construction of Sea-Going Ships.

3.1.4 The general provisions on the organization of technical supervision during manufacture of articles specified in 3.1.1 are given in Part I "General Regulations for Technical Supervision", on technical documentation, in Part II "Technical Documentation".

3.2 REGISTER SUPERVISION

3.2.1 The technical Supervision during manufacture of equipment, arrangements and outfit products is carried out at the manufacturer's in case a contract has been made between the Register and manufacturer or the applications according to Section 4, Part I "General Regulations for Technical Supervision".

3.2.2 The Register issued documents are specified in the RS Nomenclature.

3.2.3 The technical supervision is effected by surveying according to the list of items being the main working document of the supervision.

3.2.4 The list of items is developed by the manufacturer based on the RS Nomenclature and Table 3.2.4 for each preproduction (one-off) article of equipment, arrangements and outfit, and also for serial-lyproduced articles, and is agreed with the RS Regional Branch office.

Table 3.2.4

Nos.	Item of technical supervision	Verification of technical documentation	Control of material		Visual examination	Measurements control	Control of flow detection	Tests				Control of operation
			Register certificates and/or other documents	Marking, stamping				hydraulic	dropping	breaking	proof load	
1	Rudder and steering gear:											
1.1	rudder stocks including their flanges	+	+	+	+	+	+[1]					
1.2	rudder shafts including their flanges	+	+	+	+	+						
1.3	rudder blade and steering nozzle in assembly	+	+	+	+	+	+	+				
1.4	rudder and steering nozzle pintles	+	+	+	+	+						
1.5	tillers, rudder quadrants	+	+	+	+	+	+[3]					
1.6	emergency steering gear	+	+	+	+	+						+
1.7	active means of ship's steering	+	+	+	+	+						+
2	Anchor arrangement:											
2.1	Anchors	+	+	+	+	+			+		+	+
2.2	anchor chains and parts of their coupling	+	+	+	+	+				+	+	+
2.3	anchor stoppers	+	+	+	+	+						+
2.4	device for securing and releasing the inboard end of the chain cable or rope	+	+	+	+	+						+
2.5	anchor hawses[2]											
3	Towing and emergency towing arrangement:											
	Tow hooks and rails with fastenings for their securing to ship's hull, tow line releasing device, chain devices, tow lines, tow securing arrangements	+	+	+	+	+					+	+
4	Openings in hull, 1st and 2nd tiers of superstructures and deckhouses, and their closing appliances:											
4.1	side and flush deck scuttles, round and rectangular wheel house windows	+	+	+	+	+		+				+
4.2	doors in outside plating	+	+	+	+	+	+	+[4]				+
4.3	outside doors in superstructures and deckhouses	+	+	+	+	+		+				
4.4	covers of companion hatches, skylights and ventilation trunks	+	+	+	+	+	+	+				+
4.5	doors in subdivision bulkheads	+	+	+	+	+	+	+				+

Nos.	Item of technical supervision	Verification of technical documentation	Control of material		Visual examination	Measurements control	Control of flow detection	Tests				Control of operation
			Register's certificates and/or other documents	Marking, stamping				hydraulic	dropping	breaking	proof load	
4.6	hatch covers of dry cargo holds fitted for alternate carriage of bulk liquid and dry cargoes, of tweendecks, and also of cargo tanks	+	+	+	+	+						+
5	Arrangements for securing decks, platforms, ramps and other similar structures when unused	+	+	+	+	+						+
6	Ship's steel, fiber and synthetic wires of all applications	+	+	+	+	+				+	+	
7	Studless chains used in ship's arrangements the anchor ones	+	+	+	+	+				+	+	

[1] For welded flanges.
[2] Technical supervision is effected according to Section 2 of this Part and Section 2 of Part V "Technical Supervision during Construction of Ships".
[3] At tiller mass over 100 kg.
[4] Subject to special consideration by the Register in each particular case.

The RS Regional Branch office can change the list of items to extend the scope of control or for its cutting being guided therewith by production conditions and products quality, as well as by the results of supervision during the ship construction and operation.

3.2.5 Surveys according to the list of items are carried out by the surveyor after the manufacturer's technical control body presents the technical supervision item finished and provided with the documents issued therefore or the completed scope of works finally checked by the manufacturer and ready to be presented to the Register.

The main objective of surveys according to the list is the final check of the technical supervision item in the condition of full readiness and its approval for subsequent fitting in an arrangement and for use for equipment and outfit.

The scope of technical supervision and the prescribed types of checks, examinations and inspections performed by the surveyor in surveying technical supervision items according to the list are given in Table 3.2.4.

Depending on the conditions of the Register technical supervision, the surveys as per Table 3.2.4 are effected by the surveyor or personnel of the manufacturer's technical control body.

Moreover, the checks, examinations and inspections specified in the Table are carried out by the surveyor in surveys of manufacturers.

To control the observance of the Register technical supervision conditions by a manufacturer or to check the terms of Agreement on Supervision or Contract on Supervision, the provisions of Section 4, Part I "General Regulations for Technical Supervision" shall be followed.

3.2.6 Periodical inspections are carried out by the surveyor irrespective of the list of items and not related to the formal presentation by the manufacturer's technical control body. Special consideration in their performance shall be given to the identification of drawbacks and flaws that cannot be detected in surveys as per the list after completing the relevant works.

The instructions on periodical inspections performance are given in appropriate Chapters of the Section. However, they may be extended proceeding from specific conditions.

In surveying, the following shall be effected:

.1 review of technical documentation, i.e. availability of:

approved (agreed) technical documentation relating to the technical supervision item under survey (working drawings, technological processes, standards and other normative and technical documents);

permits or other documents allowing deviations from drawings or other technical documentation agreed with the Register;

documents of the technical control department for the products presented which include pertinent data on the operational control performed in accordance with the technical documentation requirements;

.2 inspection of material: verification of availability of the Register certificates and stamping in the cases specified in the RS Nomenclature, and/or of other documents for the material and marking; establishing the correspondence of material brands with those specified in technical documentation;

.3 visual examination: verification of products conformity with technical documentation, of absence of external defects whose character and permissible value exceed those specified in appropriate Chapters of this Section; when necessary, the examination with disassembly in a scope agreed with the surveyor is carried out; for welded structures, welds are checked;

.4 control of measurements: verification of main dimensions using devices and instruments ensuring the necessary measurement accuracy (with the main dimensions are classed the product dimensions regulated by the RS Rules and requirements specified in technical documentation); for welded structures, weld dimensions are checked;

.5 control of flaw detection: verification of the weld flaw detection results obtained in use of X-ray, gamma-ray, ultrasonic and other approved methods;

.6 tests: hydraulic, dropping, breaking and proof load;

.7 inspection in operation: functional check-out of products, as well as the check of mobility of product parts in compliance with the requirements of technical documentation and the instructions of relevant Chapters of this Section.

3.2.7 In addition to surveys (as per the list of items), the surveyor effects inspections not associated with the formal presentation of a finished technical supervision item by the manufacturer's technical control body.

Periodical inspections are carried out in the course of production at intermediate stages of products manufacture.

In so doing, special consideration shall be given to the identification of drawbacks and flaws that cannot be detected in surveying (as per the list of items) the finished product.

Instructions on periodical inspections performance are given in appropriate Chapters of this Section. The RS Regional Branch office can extend them or specify with due regard for specific conditions of production.

Additionally to the requirements of 3.2.4, the results of periodical inspections are used in handling the problems of concluding Agreement on Supervision and of keeping the terms of its validity.

3.2.8 In performance of periodical inspections, the surveyor determines the character and number of samples, specimens and check inspections proceeding from specific production conditions, quality of work performance, details and importance of the technical supervision item and its components provided the requirements of rules and this document are met.

3.2.9 Prior to the beginning of serial production of arrangements, equipment and outfit products under the surveyor's technical supervision, the production prototype and the first-off production series of products in amounts agreed between the manufacturer and the Regional Branch office shall be manufactured and tested.

In manufacturing the production prototype (first-off production series), detailed periodical inspections are carried out. Separate checks, examinations and inspections carried out periodically in serial manufacture of products shall be included for the preproduction series (production prototype) in the list and to be presented to the surveyor in survey according to the list.

The surveyor shall make sure that the manufacturer has mastered the procedure adopted for manufacturing products, and with the positive results of specified surveys, to settle the question of potential supply of products under steady production for the ships being subject to the Register technical supervision.

3.3 DOCUMENTATION

3.3.1 Prior to the beginning of manufacture of arrangements, equipment and outfit products, the manufacturer delivers to the RS Regional Branch office the Register approved (-agreed) technical documentation for the technical supervision item according to 3.3.3, Part I "Classification" and 1.3.4, Part III "Arrangements, Equipment and Outfit" of Rules for the Classification and Construction of Sea-Going Ships.

3.3.2 Approval of technological processes for manufacture of products at large, as well as for welding, heat treatment and assembly of essential parts and units is effected by the Regional Branch office.

3.4 RUDDER AND STEERING GEAR

3.4.1 Manufacture of products and the related parts specified in Table 3.2.4 is subject to the Register supervision.

3.4.2 In survey according to the list, in addition to the requirements of Table 3.2.4, attention shall be drawn to the following.

3.4.2.1 In a rudder blade or steering nozzle manufacture, the following is checked:

.1 fastening to the rudder blade of the flange for coupling with the rudder stock, and of hinges for pintles;

.2 fastening to the steering nozzle of the flange, welded-in bush and other welded-in parts for coupling of the nozzle with the rudder stock and pintle, as well as fastening of the fin to the nozzle;

.3 absence of abrupt changes for structure cross-sections;

.4 tightness of the structure according to Appendix 9 to Section 2 of Part V "Technical Supervision during Construction of Ships";

.5 anticorrosive protection of products according to instructions or their filling with a filler if the Register imposes special requirements.

3.4.2.2 In rudder stock, rudder shafts and pintles manufacture, the following is checked:

.1 quality in making keyways, of keys adjustment, shank thread, nuts, tapered ends and fixing devices;

.2 fastening to the rudder stock of the flange for coupling with the rudder blade flange;

.3 material of rudder stock, rudder shaft and pintle liners, absence of liner defects and quality of their fit to mounting surfaces after cooling down; in built-up welding of bearing journals – quality of the built-up welding;

.4 sealing liner ends.

3.4.2.3 In shop assembly of flange and cone couplings of rudder blades or steering nozzles with rudder stocks and pintles, as well as of rudder post and stern frame couplings, the following is checked:

.1 quality of rudder stock and pintle cones fitting to mounting places in rudder blades or steering nozzles by means of the bluing check; in so doing, any area of 25 mm by 25 mm shall have at least two spots;

.2 quality of keys fitting to keyways in parts being matched;

.3 quality of flanges fitting in couplings of rudder stocks with rudder blades or steering nozzles, as well as of rudder shafts;

.4 quality of machining holes for templet bolts;

.5 alignment of rudder stocks and pintles, rudder blade bearing holes for the rudder shaft after their final assembly with rudders or steering nozzles;

.6 fit of bolt heads and nuts to the flange surface in flange couplings of rudder stocks with rudder blades or steering nozzles, and in rudder shaft couplings, locking of bolts and nuts, fit of pintle and rudder stock nuts to the surface of rudder blade or steering nozzle parts in cone couplings.

3.4.3 The Register technical supervision during manufacture of bushes of pintels and rudder stock bearings, parts for couplings of rudder stocks, of rudder stocks with rudder blades or steering nozzles, a rudder shaft with a stern frame, a tiller or quadrant with a rudder stock, of limiters of putting a rudder blade or steering nozzle over either side with their parts, of parts of roller laying of steering gear and chains of steering ropes is limited to the examination of the relevant technical documentation including manufacturer's quality certificates for the above products and certificates for materials thereof.

3.4.4 The periodical inspection of welded metal structures of a rudder blade or steering nozzle is effected according to Section 2 of this Part and Section 2 of Part V "Technical Supervision during Construction of Ships".

3.4.5 Active means of the ship's steering are considered by the Register only in terms of their design, fitting, etc. impact on the ship's general safety. In the event specified in 2.1.3.2, Part III "Equipment, Arrangements and Outfit" of Rules for the Classification and Construction of Sea-Going Ships, the machinery and propellers of active means of the ship's steering are checked as per 3.2.4, and also proceeding from the additional instructions given by the RS Regional Branch office depending on the design details and manufacture procedure.

3.5 ANCHOR ARRANGEMENT

3.5.1 Anchors.

3.5.1.1 The manufacture of forged, cast and welded anchors of the Hall, Gruson's and admiralty type is subject to the Register technical supervision according to Table 3.2.4. The technical supervision during manufacture of other type anchors is subject to special consideration by the Register in each particular case.

The technical supervision during manufacture of forgings and castings for anchor parts, i.e. flukes, shanks, pin and shackle axles, is carried out according to the Rules requirements.

3.5.1.2 In survey according to the list, the following shall be verified in addition to those specified in Table 3.2.4:

.1 documents on dropping tests;

.2 quality of welded anchors welding;

.3 quality of anchor parts welding: welding-on around the perimeter of anchor shackle pins, stop pins of a Hall's anchor, etc.;

.4 curvature of an anchor shank which shall not be more than 3 mm per 1 m of length;

.5 anchor mass by weighing; in this case, the deviation of a theoretical anchor mass as a unit shall range between – 4 % to +7 %; in individual cases, the weighing may be selective numbering 5 % of all anchors, but not less than two anchors of the same standard size provided the proved models are used.

3.5.1.3 The proof load tensile tests of an anchor and cast anchor shackle are carried out in accordance with Appendix 3.

3.5.1.4 In periodical inspection, the following is checked:

.1 manufacture of anchor parts. In so doing, attention is drawn to absence of cracks, pits, scabs, sand marks and other flaws on the surface of parts, which may impact the anchor strength. Acceptable flaws on cast parts are given in Appendix 1, on forged and welded ones, in the technical requirements of drawings;

.2 observance of the manufacturer technology for machining and heat treatment of parts for the purpose of detecting possible hidden flaws, and also the causes impairing mechanical properties of metal;

.3 assembly of welded anchors: edge preparation for welding and welding gaps, welding consumables and observance of the basic requirements of welding according to the Rules requirements;

.4 conditions of heat treatment if specified in a production process;

.5 performance procedure and the results of dropping tests of cast and welded anchors or their parts in accordance with Appendix 2.

3.5.1.5 In technical supervision during manufacture of the production prototype and first-off production batch of anchors (refer to 3.2.9), additionally to the surveys specified in 3.5.1.2 to 3.5.1.3, the following is checked:

.1 manufacture of parts;

.2 assembly of welded anchors;

.3 heat treatment;

.4 dropping tests;

.5 validity of sampling to check mechanical properties of metal;

.6 preparation of casting flaws for welding.

3.5.1.6 To admit a high holding power anchor as such, comparative tests are additionally carried out together with a Hall's or Gruson's anchor of the same mass on the different grounds according to the Register approved program.

3.5.1.7 With the positive results of an anchors survey, the surveyor checks the marking, puts the Register stamp and issues certificates.

3.5.2 Chain cables and parts of their connections.

3.5.2.1 The manufacture of chain cables, units and parts thereof are subject to the Register technical supervision.

Units and parts of chain cables include:

chain lengths;

common link and enlarged stud link;

end link;

swivel;

end shackle;

connecting shackle;

connecting link.

The products can be manufactured by flash-butt welding, casting and forging.

In use of arc welding for products manufacture, the procedure and scope of supervision are subject to the special agreement with the Register.

Studs shall be reliably secured in links by the careful adjustment of touching surfaces. Studs securing by welding is permitted by a special agreement with the Register. In this case, studs are welded on at one end only that is opposite to the link weld and weld dimensions and welding consumables used shall ensure joint dependability. Flaws may be rectified by welding using the processes and procedure agreed with the RS Regional Branch office. The welding shall be carried out before the final heat treatment of a chain cable. Technical supervision during the manufacture of hot-rolled and drawn rounds for the fabrication of welded chain cables is carried out according to the Rules requirements.

3.5.2.2 In survey (according to the list), the following shall be verified additionally to the requirements of Table 3.2.4:

.1 certificates of conformity and/or reports with the results of testing the chemical composition and mechanical properties of metal for castings, the presence of a welding procedure approved, certificates of conformity for welding consumables, the RS certificates of approval test for a welder;

.2 results of additional sample tests for macrostructure carried out on surveyor's demand, longitudinal microsections of forged links for checking a seal in the joint zone, etc.;

.3 charts of permit for the deviations made and of flaws elimination;

.4 document on products mass[1];

.5 mating of unit parts in locations of their contiguity to one another and their intermobility when arranged along a straight line, and also at a right angle;

.6 free rotation of the swivel pin in its link;

.7 alignment of holes in the eyes of end and connecting shackles and passage of the pin;

.8 shots length, which shall be within 25 m to 27,5 m;

.9 limiting deviation of a chain cable diameter from a nominal value which shall not exceed those specified in Table 7.1.3.9.1 of Part XIII "Materials" of Rules for the Classification and Construction of Sea-Going Ships.

The limiting deviations of other geometric dimensions of chain cable links, units and parts shall not exceed $\pm$ 2,5 % of their nominal dimensions. The cross-section area of a link along its longitudinal axis therewith shall be not less than the theoretical cross-section corresponding to a nominal diameter, and a length of any chain cable section consisting of five links, not more than + 2,5 % of the nominal length of this section (a lesser section length is not accepted).

3.5.2.3 In survey according to the list, the following is verified:

in manufacturing welded products:

.1 absence of cracks, segregations, fissures and other defects on the surface of parts after bending;

.2 quality of rag removal in welding locations;

.3 quality of arc welds (cracks and segregations are not accepted);

.4 securing of studs in links (checked by a hammer test), welding-in of studs (permitted if heat treatment follows);

.5 mating of the link and stud surfaces;

.6 deflection in a longitudinal plane after welding which shall not exceed 2 mm;

.7 butt displacement of ends being welded which shall not exceed:

for chain cables having a diameter

13	0,7
44 — 62	2,0
14 — 26	1,0
68 — 81	2,5
28 — 40	1,5
87 — 102	3,5
over 102	4,0;

.8 height of a bead over the outer surface of a link, in mm, which shall not exceed after rag cutting:

for chain cables having a diameter

[1] Not needed if products mass stability meets the standard.

13 0,8
44 — 62 2,5
14 — 26 1,0
68 — 81 3,0
28 — 40 1,5
87 — 102 3,5

provided the link width is kept in-tolerance. In this case, the inner rag at studless links shall not exceed 1,5 mm;

.9 locations of welding machine electrodes sticking to a link which shall be dressed. A local recess in dressing over 5 % of a link diameter or body thickness is unacceptable;

in manufacturing cast products:

.10 cleaning from moulding materials (gate runners, seams, flashes and other irregularities due to moulding shall be removed, and their locations on castings shall be cleaned);

.11 absence of pinhole porosity, cracks, segregation and other flaws;

.12 depth of gradual fettling as the result of head removal or the height of bulges which shall not exceed 0,05 a chain cable diameter or 1 mm respectively. Casting flaws for products at a depth and of extent of 5 % of a part diameter or thickness, as well as pits within one cross-section if their total depth and extent are over 5 % of a part diameter or thickness are unacceptable if not welded up;

.13 link displacement in the plane of a joint, in mm, along the transverse axis, which shall not exceed:

for chain cables having a diameter

44 — 50 1,5
78 — 107 3,5
54 — 73 2,5
111 — 152 4,0

Excessive shoulders therewith shall be fettled, but the cross-section dimensions shall remain unchanged;

in manufacturing stampings:

.14 absence of scale, flashes, cracks, dents, scabs, hair-line cracks and other defects;

.15 absence of gaps between connecting half-links;

.16 fairness of transitions from one half-link to another;

.17 value of a butting plane displacement for the link half-stud from the link axis, which shall not exceed 0,1 its diameter;

.18 local gaps between half-studs, in mm, which shall not exceed:

0,5 for links of 13 — 34 in diameter,
1,0 for links of 37 — 49 in diameter,
2,0 for links of 58 — 62 in diameter.

For chain cables over 62 mm in diameter, the gap values are specially agreed with the Register.

3.5.2.4 The tests of anchor chains are subject to the Register technical supervision (refer to 3.6, Part XIII "Materials" of Rules for the Classification and Construction of Sea-Going Ships).

Prior to the tests beginning, the surveyor shall make sure that: chain-testing presses are recognized by the Register and certified by a competent body; the dimensions of press grippers where they mate with the specimens being tested are close to the dimensions of parts and units the specimens are connected with in the chain cable; the chain-testing presses ensure the gradual and uniform elevation of specimen loading.

3.5.2.5 In periodical inspections, the following is verified:

in manufacturing welded products:

.1 billets, prepared for welding, for the absence of flaws, presence of a shrinkage tolerance, proper edge preparation for welding, quality and finish of the surface of the edges to be welded;

.2 conditions and progress of the welding process;

.3 conditions of products heat treatment;

in manufacturing cast products:

.4 pre-chipping-out of defects to sound metal;

.5 weld preparation of casting flaws over 5 % of a part diameter or thickness in depth and extent;

.6 welding consumables used for defects rectification;

.7 process of defects welding up;

.8 conditions of castings heat treatment given the defects (these latter are rectified prior to the heat treatment);

in manufacturing stampings:

.9 dimensions and quality of surfaces of recesses and branches with ring bulges;

.10 percent reduction of the link joint.

3.5.2.6 In technical supervision during manufacturing the first-off production batch (production prototype) of anchor chain cables and parts of their connecting (refer to 3.2.9), additionally to the surveys specified in 3.5.2.2 and 3.5.2.3, are verified:

.1 half-link weld preparation;

.2 heat treatment;

.3 pre-chipping-out of defects and casting flaws weld preparation;

.4 dimensions and quality of surfaces of recesses and branches with ring bulges of stampings.

3.5.2.7 With the positive results of surveying shots and parts of their connecting, the surveyor checks the marking, puts the Register stamp and issues the Certificate of Conformity.

3.5.3 Anchor equipment.

3.5.3.1 The manufacture of anchor or chain cable stoppers and devices for securing and releasing the inboard end of the chain cable is subject to the Register technical supervision.

3.5.3.2 In survey according to the list, the surveyor shall follow the requirements of Table 3.2.4.

3.5.3.3 In test of functioning, the ease of mutual movements of parts, absence of misalignments and seizures (handwheel force shall not exceed 160 N) are checked. Additionally, the trial laying of the chain cable in a friction stopper and locking, the bringing of the first

shot link in the device for chain cable securing and releasing are performed.

3.6 MOORING ARRANGEMENT

3.6.1 The Register technical supervision during manufacture of bollards, cleats, fairleads, hawses, rollers, stoppers and other devices is limited to the examination and approval of technical documentation, and the issuance of the relevant certificates.

3.7 TOWING ARRANGEMENT

3.7.1 The Register technical supervision of products and all the related parts is executed according to the requirements of Table 3.2.4.

3.7.2 In test of functioning, the operation of the tow line-releasing device for each tow hook with no pull is checked. The force to open the mechanical lock lever (not to exceed 50 N) is measured.

3.7.3 Testing of tow hooks is carried out according to Appendix 4.

3.7.4 In periodical inspection, a recognized manufacturer shall ensure the quality control at the relevant stages of product manufacture following the technical documentation approved.

3.7.5 The first towing hook of each standard size made at a given manufacture is considered as a production prototype. In technical supervision during manufacture of the production prototype of the towing hook and tow line releasing device (refer to 3.2.9), the provisions set forth in Appendix 4 shall be followed.

3.7.6 The Register technical supervision during manufacture of bitts, bollards, fairleads, hawses, stoppers, rollers, cleats, towing notch blocks and tow rails is limited to the examination of the relevant technical documentation.

3.7.7 The products being part of the emergency towing arrangement are tested according to the Register approved program (refer to 5.7, Part III "Equipment, Arrangements and Outfit" of Rules for the Classification and Construction of Sea-Going Ships).

3.8 SIGNAL MASTS

3.8.1 The Register supervision during manufacture of masts, metal, wooden and glass-reinforced plastic masting, irremovable parts of masts and their standing rigging is limited to the examination of the relevant technical documentation.

3.9 OPENINGS IN HULL, SUPERSTRUCTURES AND DECKHOUSES AND THEIR CLOSING APPLIANCES

3.9.1 The Register technical supervision during manufacture of products is effected according to the requirements of Table 3.2.4. In surveys performance as per the list, the surveyor also carries out inspections according to the requirements of Table 3.9.1.

3.9.2 In survey during manufacture of product prototypes, additionally to the surveys specified in 3.9.1, the tests according to the program approved which includes the verification of strength, rigidity and watertightness shall be carried out.

3.9.2.1 The tests of side scuttles, doors, companion hatches, skylights and ventilating trunks for strength and watertightness are carried out by a hydrostatic head according to Appendix 5.

3.9.2.2[1] The hatch covers of dry cargo holds are tested for strength and rigidity by the loads increased by 25 % as compared with the design ones.

Watertightness is checked by a hose test without hatch cover loading according to Appendix 9, Section 2, Part V "Technical Supervision during Construction of Ships".

3.9.2.3 The covers of oil tankers are tested for strength, rigidity and tightness by a hydrostatic pressure according to Appendix 9 to Section 2, Part V "Technical Supervision during Construction of Ships".

3.9.2.4 The hatch covers of holds intended for the carriage both dry and bulk liquid cargoes are tested for strength by the load increased by 10 % as compared with the design one determined according to 7.13.4, Part III "Equipment, Arrangements and Outfit" of Rules for the Classification and Construction of Sea-Going Ships.

Watertightness is checked by a hose test according to Appendix 9 to Section 2, Part V "Technical Supervision during Construction of Ships" and by an air test at the air pressure equal to the maximum one for breathing valves actuation.

The units of each newly-run-in type of the closure seal shall be tested for tightness by a hydrostatic pressure according to 7.13.7, Part III "Equipment, Arrangements and Outfit" of Rules for the Classification and Construction of Sea-Going Ships.

3.9.2.5 After testing, product parts shall be free from residual deformations and failures detected in surveying by visual examination with products disassembly when needed.

[1] Strength and rigidity tests may be carried out in cases when scantlings have been determined according to the approved procedures.

Table 3.9.1

Nos.	Types of closing appliances	Side scuttles					Side doors	Outer doors in superstructures and deckhouses	Hatches			Doors in watertight subdivision bulkheads			Doors in bulkheads of vehicle carrying ships			Cargo hatch covers of:			
																		Dry cargo holds tightness is ensured by:		Holds for dry and bulk liquid cargoes using gaskets for tightness	Compartments of oil tankers
		heavy	normal	light	rectangular (deckhouse windows)	deck scuttles			companion	skylights	ventilating trunks	hinged	sliding	rolling	hinged	sliding	rolling	tarpaulins	packing gaskets		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
	To be verified:																				
1	Absence of defects on metal products surface[1]	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+[8]	+	+[8]	+[8]	+
2	Absence of defects and damages on working surfaces of seals[2]	+	+	+	+	+	+	+	+	+	+	+			+		+		+	+	+
3	Presence of rounding off working edges of packing collars	+	+	+	+	+	+	+	+	+	+	+			+	+	+		+	+	+
4	Fit of packing gaskets to working edges of collars in the closed, but not secured position[3]	+	+	+	+	+	+	+	+	+	+	+			+	+	+		+	+	+
5	Alignment of working edges with the middle of packing gaskets[4]	+	+	+	+	+	+	+	+	+	+	+			+	+	+		+	+	+
6	Evenness of packing gaskets fit in the secured position												+	+[5]			+[5]				
7	Compactness of packing gaskets fitting in recesses	+	+	+	+	+	+	+	+	+	+	+			+	+	+		+	+	+
8	Flatness of frames, covers, plates according to instructions of the agreed procedure	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		+	+	+
9	Depth of packing gaskets indentation when secured[6]	+	+	+	+	+	+	+	+	+	+	+		+	+	+	+		+	+	+
10	Ease and smoothness of opening, closing and securing	+	+	+	+	+	+[9]	+	+	+	+	+	+	+	+	+			+	+	+
11	Tightness by a hose test	+	+	+	+	+		+	+	+	+	+[12]	+[12]	+[12]		+[10]			+[9]	+[9]	+[7]
12	Weld tightness testing															+	+		+	+	
13	Structural measures preventing sparking																		+[11]	+	+

[1] Cracks, burrs, sharp edges, dents, cavities and other defects are unacceptable.
[2] Cracks, cavities, stratifications, paint, and oil are unacceptable.
[3] Fit continuity is checked by a chalk test and shall be ensured at the indentation depth not over 1 mm excepting the closures, specified in columns 7, 19, 20, having an area of 15 m^2 and over.

Table 3.9.1 — continued

[4] Displacement of packing collars relative to the gasket axis shall meet the technical documentation requirements.
[5] Gaps are checked by feelers or using other Register-agreed methods.
[6] The denting value shall not exceed the dimensions specified in technical documentation.
[7] Cockings and seizures are unacceptable; a hand wheel force in manual cover hoisting/lowering using additional tools and devices shall not exeed 157 N.
[8] Metal structures are checked according to Section 2.
[9] Where side doors and cargo hatch covers are opened at sea, the Register supervision of a drive manufacture is effected according to Section 5.
[10] Testing on a stand with a head of water at the pressure specified in technical documentation; the standard of water filtering in such test shall not exeed 10 l/min.
[11] Only for cargo hatches of dry cargo holds designed for the carriage of dangerous cargoes (refer to 7.10.8.6, Part III "Equipment, Arrangements and Outfit" of Rules for the Classification and Construction of Sea-Going Ships).
[12] Testing on a stand with a head of water at the pressure specified in technical documentation; for doors fitted with non-metal seals, no down flows are followed; for doors fitted with metal seals, the standard of water filtering shall not exceed 1 l/min.

Testing of large doors may be replaced by their structural analysis. In this case, when non-metal seals are used, the prototype of these shall be tested to confirm that the compression of the seal material agrees with the corresponding value of the indentation obtained in the result of the structural analysis.

3.9.3 The Register technical supervision during manufacture of cowl ventilators and covers of hull tank manholes is limited to the examination of the relevant technical documentation.

3.10 ARRANGEMENT AND EQUIPMENT OF SHIP'S SPACES, VARIOUS EQUIPMENT AND ARRANGEMENTS, EMERGENCY OUTFIT

3.10.1 The Register technical supervision is limited to the examination of the relevant technical documentation for manufacturing the following products:

.1 plating, sparring, cargo hold planking, doors of ship's spaces along escape routes, stairways and vertical ladders, guardrails, bulwark and catwalks, guides in containership's holds;

.2 knockdown temporary separating longitudinal and transverse bulkheads and feeders used for holds (tween-decks) separating and bounding in longitudinal and transverse directions during the carriage of grain cargoes dangerous due to their shifting; stanchions, spacers, stay ropes, non-detachable and detachable parts of stays;

.3 soft and hard mats with outfit, tools and inventory, emergency outfit materials;

.4 strengthenings of the bulwark or guardrails, sockets and other fixtures for securing uprights and stanchions for securing the deck timber cargo, eyes, lashings.

The types of checks, inspections and examinations in surveys are specified by the manufacturer in compliance with the technical documentation approved.

3.10.2 Essential parts of arrangements for securing movable decks, platforms, ramps and other similar structures, as well as for lifting gear of ship's lighters being hoisted aboard the barge carrier (lugs, eyebolts, eyes, shackles, clamps, etc.) shall be specified by the manufacturer relying on the technical documentation approved, and included in the list of items.

Besides, additional checks shall be taken in account if needed. According to the results of the surveyor's supervision of product prototypes, the scope and details of serial products surveys and checks are specified.

3.11 STUDLESS CHAINS USED IN SHIP'S (OTHER THAN ANCHOR) ARRANGEMENTS

3.11.1 Studless chains used in the cargo handling gear, rudder and steering gear and other ship's (other than anchor) arrangements are subject to the Register technical supervision. They shall be manufactured according to the standards or other technical documentation approved by the Register.

3.11.2 The Register technical supervision of chains including all the related parts is effected according to Table 3.2.4. Additionally to the Table requirements and with due regard for the procedure of chains manufacturing and for their design, the checks prescribed by the requirements of 3.5.2.2 to 3.5.2.4 are carried out. If some requirements of these items are unlike those of the standards approved (or technical documentation), these latter shall be followed.

3.11.3 The test loads and instructions on sampling for tests are specified in 7.1.4, Part XIII "Materials" of Rules for the Classification and Construction of Sea-Going Ships.

3.12 WIRE ROPES

3.12.1 The survey of wire ropes included in the list of items shall be carried out taking into account the technical requirements of the valid state standard for wire ropes.

3.12.2 Critical-purpose wire ropes for hoisting, lowering and moving people and cargoes are subject to a compulsory break test at large.

Such tests shall be carried out in surveying production prototypes and periodically once in two years, or in executing and periodical confirming Agreement on Supervision (once in two years) unless the demand for an extraordinary test arises during the supervision.

3.12.3 Wire ropes ignored in 3.12.2 and included in the list of items may be subjected to the break tests at large only in supervising the manufacture of their specimens.

3.12.4 The determination of the actual breaking strength of a wire rope shall be carried out on testing machines properly checked what is confirmed by the relevant documents of competent bodies.

3.12.5 The requirements of the Register agreed national standards may be used instead of those specified in 3.12.1 to 3.12.3.

3.13 NATURAL FIBRE AND SYNTHETIC FIBRE ROPES (CABLES)

3.13.1 In survey (according to the list of items), the following is verified in addition to the requirements of Table 3.2.4:

.1 competent body documents for testing machines;

.2 correctness of completing a set of batches and of sampling for tests performance;

.3 absence of ropes of brown spots, mould, the smell of rot or burning, and also of melted parts;

.4 colour of ropes, which shall be the same over their entire length, and correspond to the colour of the yarn or synthetic material the rope is made of;

.5 presence of distinctive colourful threads or yarns indicating the strength group and treatment if specified by a standard;

.6 circumference of rope;

.7 lay of ropes;

.8 actual breaking strength;

.9 documents on mass and moisture content;

.10 elongation in breaking a synthetic fibre rope.

3.13.2 Supervising the manufacture of rope production prototypes, excepting the surveys specified in 3.13.1, rope specimens are tested according to the program approved by the RS Regional Branch office. The experimental determination of the factor shall be included in the program (refer to Appendix 6).

APPENDIX 1

ACCEPTABLE VALUES OF FLAWS ON CAST PARTS OF ANCHORS

1. Gentle dents and roughness less than 3 % of a casting thickness in length, but not over 5 mm.

2. Single sand holes, blow-holes and slag blow-holes less than 5 mm in diameter and less than 5 % of a casting body thickness in depth, but not over 8 mm with their number not more than 3 pcs within an area of 100 cm^2.

3. Scabs below 200 mm in length and 2 mm in depth.

4. Displacements of surfaces without a fair transition from one surface to another for anchors having mass up to 500 kg — below 3 mm, for anchors having mass over 500 kg and up to 5000 kg — below 5 mm, and for anchors over 5000 kg — below 8 mm.

5. The total area of holes and blow-holes, dents, scabs, etc. shall not exceed 5 % of the area of a part surface.

APPENDIX 2

DROPPING TESTS OF ANCHORS AND THEIR PARTS

1. All the cast or welded anchors or their parts shall be tested by dropping onto a steel plate of at least 100 mm thick. The height of dropping is given in Table.

The flukes of Hall's, Gruson's, super high and high holding power anchors are dropped onto the plate the crown downwards; the shanks of Hall's, Gruson's, super high and high holding power anchors, and also the shanks with the flukes of an admiralty anchor are dropped in a horizontal position.

Table

Anchor mass m, kg	Height of dropping (measured from plate up to lower edge of anchor or its part), m
$m < 750$	4,5
$750 \leqslant m < 1500$	4,0
$1500 \leqslant m < 5000$	3,5
$m \geqslant 5000$	3,0

2. Moreover, each cast or welded shank with flukes of an admiralty anchor shall be suspended in a vertical position, the flukes down wards, and dropped on two steel blocks put on the plate in such a manner that the distance between them is half the span of the flukes (refer to Figure). The blocks thickness shall be such as to prevent the anchor crown from striking against the plate.

3. After the drop test, the anchors or their parts shall be suspended and subjected to a hammer test with the hammer having mass of at least 3 kg; in so doing, they must give out a clear ringing sound.

If the sound is not clear, the part shall be inspected for defects using non-destructive methods of examination. If needed, the defects shall be rectified and the test shall be repeated.

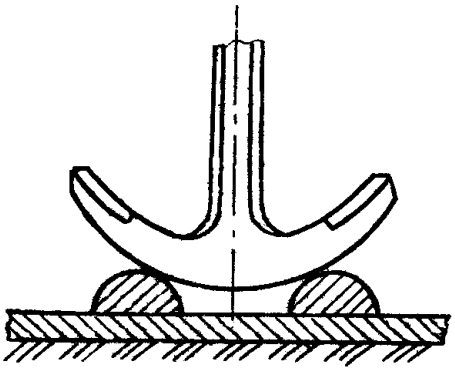


Fig.

APPENDIX 3

TENSILE TEST OF ANCHORS AND ANCHOR SHACKLES BY PROOF LOAD

1. Each cast anchor shackle shall be tested without an anchor with the non-standard pin secured in it applying a proof load F_2, N:

$$F_2 = 2F_1$$

where F_1 = proof load for the anchor determined according to the Table and specified in the technical requirements of a drawing.

In some cases, this test may be carried out selectively in amounts of 5 % of a batch, but not less than two shackles.

The batch is taken as the shackles made of one steel brand after the joint heat treatment or heat treatment as per the same conditions with the compulsory fixing of temperatures. In proof load testing, no cracks and permanent set are acceptable.

2. Each anchor, irrespective of the method of its manufacture, shall be made subject to the tensile test by applying a proof load on a special chain-testing machine or by a load suspended to the flukes. The anchors shall not be made subject to loading prior to testing.

3. Hall's Gruson's super high and high holding power anchors shall be tested by the simultaneous gripping of both flukes (refer to Fig. 1) initially turning to one side, and then to the other.

4. The admiralty anchors shall be tested by applying the load to each fluke in succession (refer to Fig. 2). The test may be carried out both with and without the stock.

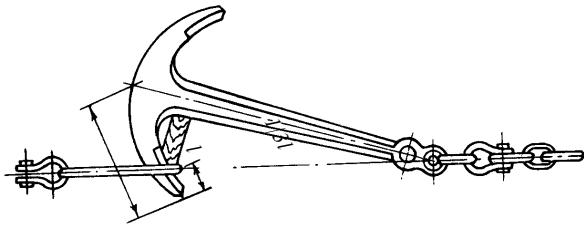


Fig. 1

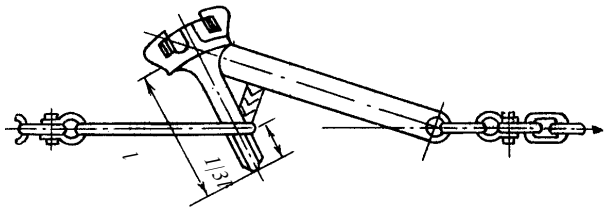


Fig. 2

Table

Anchor mass, kg	Proof load, kN	Anchor mass, kg	Proof load, kN	Anchor mass, kg	Proof load, kN	Anchor mass, kg	Proof load, kN
50	23,2	1250	239	5000	661	12500	1130
55	25,2	1300	247	5100	669	13000	1160
60	27,1	1350	255	5200	677	13500	1180
65	28,9	1400	262	5300	685	14000	1210
70	30,7	1450	270	5400	691	14500	1230
75	32,4	1500	278	5500	699	15000	1260
80	33,9	1600	292	5600	706	15500	1270
90	36,3	1700	307	5700	713	16000	1300
100	39,1	1800	321	5800	721	16500	1330
120	44,3	1900	335	5900	728	17000	1360
140	49,0	2000	349	6000	735	17500	1390
160	53,3	2100	362	6100	740	18000	1410
180	57,4	2200	376	6200	747	18500	1440
200	61,3	2300	388	6300	754	19000	1470
225	65,8	2400	401	6400	760	19500	1490
250	70,4	2500	414	6500	767	20000	1520
275	74,9	2600	427	6600	773	21000	1570
300	79,5	2700	438	6700	779	22000	1620
325	84,1	2800	450	6800	786	23000	1670
350	88,8	2900	462	6900	794	24000	1720

Table — continued

Anchor mass, kg	Proof load, kN	Anchor mass, kg	Proof load, kN	Anchor mass, kg	Proof load, kN	Anchor mass, kg	Proof load, kN
375	93,4	3000	474	7000	804	25000	1770
400	97,9	3100	484	7200	818	26000	1800
425	103	3200	495	7400	832	27000	1850
450	107	3300	506	7600	845	28000	1900
475	112	3400	517	7800	861	29000	1940
500	116	3500	528	8000	877	30000	1990
550	124	3600	537	8200	892	31000	2030
600	132	3700	547	8400	908	32000	2070
650	140	3800	557	8600	922	34000	2160
700	149	3900	567	8800	936	36000	2250
750	158	4000	577	9000	949	38000	2330
800	166	4100	586	9200	961	40000	2410
850	175	4200	595	9400	975	42000	2490
900	182	4300	604	9600	987	44000	2570
950	191	4400	613	9800	998	46000	2650
1000	199	4500	622	10000	1010		
1050	208	4600	631	10500	1040		
1100	216	4700	638	11000	1070		
1150	224	4800	645	11500	1090		
1200	231	4900	653	12000	1110		

N o t e s : 1. Proof load for intermediate values of the anchor mass is determined by linear interpolation.
2. For high holding power anchors, the proof load is taken depending on the anchor mass increased by 35 %.
3. For super high holding power anchors, the proof load is taken as the doubled anchor mass.

5. In all cases, the proof load is applied to the standard shackle on one side and on the other side, to flukes (for Hall's, Gruson's, super high and high holding power anchors) or to a fluke (for admiralty anchors) at a distance of a third of the fluke length l away from the bill (refer to Figs, 1 and 2).

6. Prior to the tensile test, a punch mark is made on the anchor shank near the shackle, and also on each bill of flukes. Then Hall's, Gruson's, super high and high holding power anchors are subjected

to a 5 min pretension by a load equal to 0,5 F_1.

In what follows, the load is reduced down to 0,1 F_1 and distance between the punch marks are measured. Thereafter the load is increased up to the proof load value and maintained within 5 min. Then the load is reduced down to 0,1 F_1 and the distances between the punch marks are measured again. If the distance between the punch marks increases for more than 1 % of the initial one, the anchor is rejected.

The pretension for admiralty anchors is not needed. The distance between the punch marks is measured before and after the proof load application, and the very load shall be maintained within 5 min. No permanent set is acceptable.

7. Following the proof load test of Hall's, Gruson's super high and high holding power anchors, the free rotation of their flukes through a complete angle shall be checked. If the fluke's rotation is impeded or incomplete, the defects shall be eliminated and the test shall be repeated. The results of the repeat test are considered final.

8. Following the proof load test, all anchors shall be made subject to visual examination to check that they have no defects, and to weighing. The latter may be sampling in amounts of 5 % of each batch, but not less than two anchors. The batch is considered as the anchors of one standard size manufactured according to the same model numbering at least 5 pcs.

APPENDIX 4

TOW HOOK TESTS

1. The specimen of a tow line releasing device shall be tested for the reliability of actuation within the hook loading range from zero to a threefold rated pull at any feasible deviation of the tow line from the ship's centreplane.

With hook loads equal to the rated, twofold and threefold pull, the force on the release lever of the mechanical lock shall not exceed 117 N, 176 N and 392 N respectively.

The strength tests of hooks shall be carried out at the proof load equal to the actual breaking strength of the towline.

The above may be performed in testing pilot specimens, which shall be conducted according to the Register approved program. The hook and their parts tested are not fitted on ships.

2. Production prototypes of tow hooks shall be tested for:

.1 strength by a proof load equal to a twofold rated pull; the time of holding under load shall be at least 10 min;

.2 reliability of the opening of the tow line releasing device under loading; testing is carried out at loads equal to a rated and twofold pull.

The forces on the release lever of the mechanical lock shall not exceed the values recorded in specimens testing.

The hook so tested may be fitted in a ship. If the forces on a lever exceed the values recorded in testing, but less than the limiting ones, the reliability of the tow line releasing device opening is checked at the load equal a threefold pull. In this case, the preproduction hook is not approved for fitting onboard ship;

.3 shock absorber actuation; the limiting load of absorbing effect shall be at least 1,3 the rated pull.

3. Each tow hook prior to its fitting onboard ship shall be tested for strength by the load equal to the twofold rated one, and for the reliability of the tow line releasing device opening under the load equal to the rated one. The force on the release lever of the mechanical lock shall not exceed the value recorded in testing the production prototype and specified in technical documentation.

4. Deformations and failures of any hook components in testing are unacceptable.

APPENDIX 5

TESTING PRODUCTION PROTOTYPES OF SIDE SCUTTLES, SUPERSTRUCTURE AND DECKHOUSE DOORS, COMPANION HATCHES, SKYLIGHTS AND VENTILATING TRUNKS

1. The above products shall be tested under a hydrostatic head to check watertightness and mechanical strength.

2. The tests are carried out as follows:

a product is installed on a test bed and secured in a working position; the test bed chamber is gradually pressurized up to a design and test level using a mechanical or manual pump, and a pressure gauge for control. Water supply regulation and test pressure fixing in the chamber are carried out with a stop valve.

3. Side scuttles are tested under a head determined by the formulae:

for round scuttles

$$P = 1{,}6 \cdot 10^2 t^2 / d^2;$$

for rectangular scuttles (deckhouse windows)

$$P = 1{,}25 \cdot 10^4 t^2 / (k^2 b^2)$$

where d = clear diameter of a round scuttle, mm;
P = hydrostatic head, MPa;
b = the least clear dimension of a rectangular scuttle, mm;
t = thickness of the hardened glass of a scuttle, mm;
a = the largest clear dimension of a rectangular scuttle, mm;
k = factor according to Table:

For intermediate values of a/b, the factor k is determined by linear interpolation.

Round scuttles are tested with the glass and with the deadlight opened, and also without the glass and with the deadlight closed.

4. The specimens of hardened glasses for scuttles shall be tested either by a punch method according to ISO 614 or by a hydrostatic head equal to the two fold head value.

a/b	1,0	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8	1,9	2,0 and above
k	8,45	9,18	9,66	10,4	10,62	11,02	11,35	11,7	11,94	12,16	12,32

5. Outer doors of superstructures and deckhouses are tested under a head by 15 % larger than the design one assumed for a given door (refer to 7.5.2.3, Part III "Equipment, Arrangements and Outfit" of Rules for the Classification and Construction of Sea-Going Ships) in the Register approved technical documentation.

6. Companion hatches, skylights and ventilating trunks are tested under a head by 15 % larger than the design (permissible) one specified in the Register approved technical documentation.

7. The product is considered tight if no leak like jets, runs and drops are detected within 5 min in testing under the design hydrostatic head.

8. The product is considered sound if no residual deformations and failures are detected after test head release.

APPENDIX 6

TESTING NATURAL FIBRE AND SYNTHETIC FIBRE ROPES

1. The specimens for the breaking test of a rope as a whole shall be withdrawn from the batch of ropes having a length of not more than 2000 m and 5000 m for natural fibre and synthetic fibre ropes respectively.

The rope end of at least 2 m long is removed from each batch and the test specimens are cut off.

Prior to testing, the rope specimens are kept unrolled during 24 h under atmospheric conditions.

2. The rope circumference, if 500 mm and over, is measured with a tape measure having the steel tape no more than 5 mm wide, if under 500 mm, it is determined by measuring the cross-section with a caliper.

In order to determine the rope circumference, measurements are made in 10 different locations along the rope length. The arithmetic mean of 10 measurements is taken as the rope circumference.

3. Natural fibre ropes shall be twisted of yarns made of the same material. Exception is admitted for Manila ropes which may include up to 50 % of sisal fibre yarns.

4. Determination of breaking load of a rope as a whole.

4.1 The distance between grips on a breaking machine for natural fibre ropes of up to 65 mm in circumference and synthetic fibre ropes shall be 0,5 m, for ropes of over 65 mm in circumference, 1 m.

The rate of breaking machine grips movement shall not exceed 250 mm/min for synthetic fibre ropes, and 300 mm/min for natural fibre ropes.

Marks shall be applied to the test specimen symmetric about the specimen centre and spaced at least 300 mm apart.

The result obtained in breaking the rope between the marks is assumed as the breaking load.

If the rope specimen fails in the grips of a breaking machine or in splices of an eye (if used), the test shall be repeated.

The breaking load of a rope as a whole shall correspond to the approved technical documentation requirements.

4.2 With the consistent positive test results of determining the breaking load of natural and synthetic fibre ropes as a whole, the Register can waive the test performance and allow determining that load F (in N) from the formula:

$$F = c\left(\sum_{1}^{z} \Delta F\right) n/z$$

where n = total number of yarns in a rope;
z = number of yarns tested for breaking; that number shall be at least $0{,}5n$ for a rope circumference of up to 80 mm, $0{,}3n$ for a rope circumference from 80 mm to 115 mm and $0{,}1n$, over 115 mm; yarns shall be taken from each strand in the same amounts;
ΔF = breaking load of each yarn tested, N;
c = factor determined relying on the results of rope production prototype tests, and periodically confirmed.

In testing, an initial twist in yarns shall be retained. To determine the breaking load, the yarns from rope strands are taken up by untwisting the strand clamped at its ends until the yarns are parallel. The total breaking load of a rope across the yarns making up the rope is determined by testing 50 yarns, taken up from all the strands, for the breaking machine grips shall be equal to 1,0 m.

The rate of breaking machine grips movement shall not exceed 300 mm/min. If the yarns being tested break in the grips or the result is below a mean value specified in technical documentation, the test is considered invalid.

4.3 In testing synthetic fibre ropes, elongation at break is determined at a time.

The rope elongation at break δ_m, % is determined from the formula:

$$\delta_m = \frac{l_{br} - l}{l} \cdot 100$$

where l = initial length of the rope specimen section being tested, cm;
l_{br} = length of the above section loaded with the actual breaking strength of the rope specified in a standard, cm.

4 FIRE PROTECTION MATERIALS, STRUCTURES AND PRODUCTS

4.1 GENERAL

4.1.1 The provisions of this Section apply in technical supervision during manufacture of fire protection materials, structures and products listed in the RS Nomenclature.

4.1.2 This Section defines the extent of and procedure for technical supervision during manufacture of fire protection materials, structures and products, and covers:

.1 materials, structures and products for structural fire protection;

.2 items of fire extinguishing systems and fire fighting outfit, fire extinguishing media.

4.1.3 General provisions on the organization of technical supervision during manufacture of fire protection materials, structures and products are given in Part I "General Regulations for Technical Supervision", and on the technical documentation, in Part II "Technical Documentation".

4.1.4 Technical supervision during manufacture of fire protection materials, structures and products is carried out at the manufacturer's given an application according to Section 4, Part I "General Regulations for Technical Supervision" or an agreement between the Register and manufacturer.

4.1.5 Terms, definitions and abbreviations are given in Part I "General Regulations for Technical Supervision" of the Rules and in Part VI "Fire Protection" of the Rules for the Classification and Construction of Sea-Going Ships.

4.1.6 The Register issues Type Approval Certificates (СТО) for fire protection materials and products, and Type Approval Certificates for Fire-Proof Division (СТПК) according to Section 6, Part I "General Regulations for Technical Supervision".

4.1.7 The IMO Guidelines on Alternative Design and Arrangements for Fire Safety (refer to 1.7, Part VI "Fire Protection" of the Rules for the Classification and Construction of Sea-Going Ships) may be used in technical supervision during manufacture of fire protection materials, structures and products.

4.2 FIRE PROTECTION MATERIALS, STRUCTURES AND PRODUCTS

4.2.1 Technical supervision during manufacture of structural fire protection materials and products is carried out to confirm their compliance with the applicable requirements of 1.6 and 2.1, Part VI "Fire Protection" of the Rules for the Classification and Construction of Sea-Going Ships and the Fire Test Procedures Code with supplements (refer to 1.2, Part VI "Fire Protection" of the Rules for the Classification and Construction of Sea-Going Ships).

4.2.2 In addition to fire tests, structural fire protection products (like doors, fire dampers of ventilation systems, automatic closing devices of fire doors) are checked for operability according to the Register-approved program.

4.2.3 In approval of materials, structures and products for structural fire protection, the Register, as a minimum, shall consider the following:

.1 technical documentation including the material description/structure or product drawings;

.2 instructions on use of the material/fabrication of the structure/installation of the product;

.3 test reports of fire tests carried out at Register-recognized laboratories. The contents of test reports shall be like that specified in the relevant test procedures. The test report usually belongs to the customer of test performance.

4.2.4 The RS approval becomes invalid after any essential material/structure/product modification. To get the new approval, the material/structure/product shall be retested.

4.2.5 Manufacturers of materials/structures/products for structural fire protection shall have a quality control system audited by competent bodies to ensure permanent conformity to type approval conditions. As an alternative, the Register may use procedures for the final verification of the material/structure/product for conformity to the type approval prior to their installation onboard a ship.

4.2.6 In certain cases, the RS may approve the material/structure/product for one-time use only without issuing СТО/СТПК. Such one-time approval is valid only for a particular ship.

4.2.7 СТО/СТПК associated with materials, structures and products for structural fire protection shall include, as a minimum, the following:

.1 name or trade name of the material/structure/product;

.2 detailed description of the material/structure/product;

.3 classification of the material/structure/product and any restrictions on its use;

.4 test procedure (-s) used in accordance with the Fire Test Procedures Code;

.5 test report number and date of its issue, name and address of the test laboratory.

4.3 ITEMS OF FIRE EXTINGUISHING SYSTEMS AND FIRE FIGHTING OUTFIT, FIRE EXTINGUISHING MEDIA

4.3.1 Technical supervision during manufacture of items of fire extinguishing systems and fire fighting outfit, fire extinguishing media is carried out to confirm their compliance with the requirements of Sections 3 and 5, Part VI "Fire Protection" of the Rules for the Classification and Construction of Sea-Going Ships.

4.3.2 Technical supervision during manufacture of items of fire extinguishing systems and fire fighting outfit, fire extinguishing media is carried out in accordance with the Register-approved technical documentation developed by the manufacturer with use of applicable international and/or national standards in the fire safety area.

4.3.3 Technical supervision during manufacture of fire extinguishing system and fire fighting outfit components like pumps, fittings, flexible connections, cylinders, electrical equipment, control systems, etc. is carried out in accordance with applicable Sections of this Part. To be verified are also items characteristics confirming their operability onboard a ship (resistance to sea water effect, explosion-proof enclosure, etc.).

4.3.4 Items/fire extinguishing media are tested according to the Register-approved program or IMO methods (refer to Table 4.3.6) to confirm their conformity to the characteristics specified in the approved technical documentation.

4.3.5 In approval of items/ fire extinguishing media, the availability of documents issued by the organizations competent in the fire safety area or the results of tests witnessed by these organizations, which confirm a possibility to use the items/ fire extinguishing media for fire fighting, may be taken into account.

4.3.6 Technical supervision during manufacture of items/ fire extinguishing media for which the IMO has developed documents is carried out in accordance with these documents as per Table 4.3.6,as the case requires.

4.3.7 Tests with use of methods according to the IMO Guidelines are usually carried out by Register-recognized laboratories.

4.3.8 The fire-extinguishing systems are tested at the test pressure according to Table 3.12.1, Part VI "Fire Protection" of the Rules for the Classification and Construction of Sea-Going Ships.

4.3.9 The prototypes of monitors are tested for a distance of projecting a jet of water, foam or powder at different elevations. The jet length shall be consistent with the technical documentation requirements. During tests, a pressure before the monitor and a flow rate of water, foam concentrate solution or powder are measured.

4.3.10 In the survey of sprinkler heads, their operating temperature is checked for about 3 % of the batch, but for at least three pieces.

4.3.11 In the survey of protective diaphragms of cylinder valves for high pressure carbon dioxide systems,

Table 4.3.6

Nos.	Item/fire extinguishing medium	IMO documents
1	Any	International Code for Fire Safety Systems (IMO Resolution MSC.98(73))
2	Gas fire-extinguishing systems, but carbon dioxide systems	Revised Guidelines for the Approval of Equivalent Fixed Gas Fire-Extinguishing Systems, as referred to in SOLAS 74 for Machinery Spaces and Cargo Pump Rooms (MSC/Circ. 848)
3	Pressure water-spraying system	Recommendation on Fixed Fire-Extinguishing Systems for Special Cargo Spaces (IMO Resolution A.123(V)), Revised Test Method for Equivalent Water-Based Fire-Extinguishing Systems for Machinery Spaces of Category A and Cargo Pump Rooms (MSC/Circ. 728), Alternative Arrangements for Halon Fire-Extinguishing Systems in Machinery Spaces and Pump Rooms (MSC/Circ.668), Guidelines When Approving Alternative Fixed Water-Based Fire-Fighting Systems for Use in Special Category Spaces (MSC/Circ. 914)
4	Sprinkler systems	Revised Guidelines for the Approval of Sprinkler Systems Equivalent as refered to in II-2/12, SOLAS 74 (IMO Resolution A.800(19)
5	Fixed local application fire-fighting systems	Guidelines for the Approval of Fixed Water-Based Local Application Fire-Fighting Systems for Use in Category "A" Machinery Spaces (MSC/Circ. 913)
6	Aerosol fire-extinguishing systems	Guidelines for the Approval of Fixed Aerosol Fire-Extinguishing Systems Equivalent to Fixed Gas Fire-Extinguishing Systems, as referred to in SOLAS 74, for Machinery Spaces (MSC/Circ. 1007)
7	Portable fire extinguishers	Improved Guidelines for Marine Portable Fire Extinguishers (IMO Resolution A.951(23))
8	Foam concentrates	Guidelines for Performance and Testing Criteria, and Surveys of Low Expansion Foam Concentrates for Fire-Extinguishing Systems (MSC/Circ. 582 and MSC/Circ. 582/Corr. 1), Guidelines for Performance and Testing Criteria, and Surveys of Medium Expansion Foam Concentrates for Fixed Fire-Extinguishing Systems (MSC/Circ. 798), Guidelines for Performance and Testing Criteria, and Surveys of High Expansion Foam Concentrates for Fire-Extinguishing Systems (MSC/Circ. 670), Guidelines for Performance and Testing Criteria, and Surveys of Expansion Foam Concentrates for Fixed Fire-Extinguishing Systems of Chemical Tankers (MSC/Circ. 799)

in accordance with the requirements of 3.8.2.6.1, Part VI "Fire Protection" of the Rules for the Classification and Construction of Sea-Going Ships, 3 % to 6 % of diaphragms per batch are subject to a breaking test.

4.3.12 In tests of prototypes of high expansion foam generators, the solution pressure at the generator inlet, foam expansion ratio and generator capacity in operation by the recommended foam concentrate, as well as the automatic and manual control of the device closing the discharge orifice of the generator shall be checked.

4.3.13 In tests of prototypes of fire extinguishers, the duration of fire-extinguishing substance discharge, jet length and fire-extinguishing properties in fighting the model fire seat of an appropriate class are checked.

4.3.14 In tests of prototypes of portable foam generators, the flow rate of foam concentrate solution, pressure at the generator inlet, foam expansion ratio, distance and height of foam projecting, full coverage with foam of the generator net shall be checked.

Each generator shall be tested for strength at a hydraulic pressure of 0,9 MPa to 1,0 MPa within at least 2 min.

4.3.15 In tests of prototypes of portable foam applicators, the foam discharge and foam expansion ratio at a pressure of about 0,3 MPa at the ejecting device, as well as the distance of foam projecting at the maximum pressure shall be checked.

APPENDIX

GUIDELINES ON DRY POWDER TESTS

1. Purpose.

As a rule, powders may be accepted for use when a conclusion of a competent state body is available.

Where approval of the powders is necessary, tests shall de carried out in accordance with these guidelines.

The tests shall be carried out according to program approved by the Register with the aim to verify specifications of the powders presented by the manufacturer of the latter.

2. Main parameters.

2.1 Acceptability of the powders shall be evaluated against the following main parameters and their values determined at the temperature 20 ± 2 °C:

.1 moisture fraction by mass, % . . . . . $\leqslant 0{,}5$;

.2 hygroscopicity, %. . . . . $\leqslant 4$;

.3 apparent density (mass to occupied volume ratio at free filling during 2 min), g/cm^3 . . $\geqslant 0{,}7$;

.4 fluidity (looseness), % . . $\leqslant 15$ (fraction by mass of the remainder of powder);

.5 thermal stability (change of fluidity after exposure to maximum and minimum service temperatures), % . . . . . $\leqslant 20$;

.6 vibration resistance (change of fluidity after vibration effect on the fire extinguisher charged by powder), % . . $\leqslant 20$;

.7 external condition. . . . fine, without lumps, readily friable.

2.2 Functional indicators of the powders are determined by the indicators of the fire extinguishing capability in fighting the model fire seats presented by the manufacturer but not regulated by the Register.

Applications depend on the powder types:

ABCDE type (ammonium phosphate-based) is intended to extinguish fire on solid substances (class A fires), liquids (class B fires), gases (class C fires), magnesium and aluminium alloys (class D fires), electrical installations up to 100 kV (class E fires);

BCE type (sodium bicarbonate-based).

2.3 The powder shall not give rise to abrasion wear of rotating parts.

3. Testing.

3.1 Powders are generally subjected to laboratory and field tests.

3.2 During laboratory tests, parameters listed in 2.1.1 to 2.1.6 are verified.

3.3 Field tests include fire tests for verifying parameters set out in 2.2 and specified in technical documentation submitted by the manufacturer.

3.4 Fire tests shall be carried out to fight fires of all classes which are stated in connection with the powder types and shall be specified in the Register documents.

4. Presentation of results.

4.1 Upon completion of the tests, a record shall be drawn up, which contains the following data:

manufacturer's (company's) name;

powder type (as well as its description, brand);

purpose of tests;

test date;

standards on the basis of which tests have been carried out;

equipment on which tests have been carried out;

main parameters of powder;

parameter values obtained during laboratory and field tests;

conclusions and guidelines on the use of powders.

5 MACHINERY

5.1 GENERAL

5.1.1 The provisions of this Section apply in technical supervision during development and manufacture of machinery listed in the RS Nomenclature.

5.1.2 The Section establishes the procedure of technical supervision during manufacture of the above mentioned items of technical supervision at the manufacturer's.

5.1.3 General provisions for the organization of technical supervision during manufacture of the cited items are set out in Part I "General Regulations for Technical Supervision", and those concerning technical documentation – in Part II "Technical Documentation".

5.1.4 The following definitions and abbreviations are used for the purposes of this Section:

External examination means examination of a component, material, equipment; verification of accompanying documents issued in accordance with the accepted form of supervision during manufacture, and other documentation defining the compliance of the items of supervision with the approved technical documentation, e.g. measurement results, presence of brands (if envisaged), flaw detection results, etc.

Based on the results of external examination, the possibility of continuing manufacturing (machining), installation, hydraulic testing, etc. process shall be explored.

ICE – internal combustion engine;
MGTI – main geared turbine installation;
GTI – gas turbine installation;
GT – gas turbine;
QCV – quick closing valve;
RAC – remote automatic control;
RC – remote control;
HPC – high-pressure compressor;
LPC – low-pressure compressor;
HPT – high-pressure turbine;
LPT – low-pressure turbine;
AT – astern turbine;
FSAH – full speed ahead;
FSAS – full speed astern;
MTB – main thrust bearing;
MODU – mobile offshore drilling unit.

5.1.5 All the materials including forgings and castings, component parts and articles intended for manufacturing machinery and components thereof as well as completing units shall have documents showing compliance of the material and manufacturing technique with the approved technical documentation. These documents shall be drawn up in accordance with the RS Nomenclature.

5.1.6 The results of component measurement and fixing measurements submitted in the process of manufacturing the components and during installation thereof, shall encompass all measuring points specified by the working documentation and instructions on installation and operation of the machinery.

The control of the measurement results shall be exercised at random with the aim to determine the compliance of the design of the supervised item, its dimensions and inspection methods with the requirements of the working drawings.

The requirements of this Section shall be taken into account during external examination of completely finished components.

5.1.7 As regards the materials (blanks) incoming for finishing as well as the related equipment and/or components, prior to installation, the documents stated in 5.1.5 shall be presented.

5.1.8 Where it is necessary to correct defects on treated and untreated surfaces of castings, forgings and welded structures, the requirements of Parts XIII "Materials" and Part XIV" Welding" of Rules for the Classification and Construction of Sea-Going Ships shall be taken as a guidance.

5.1.9 When conducting hydraulic tests, the test pressure shall be taken in accordance with 1.3, Part IX "Machinery" of Rules for the Classification and Construction of Sea-Going Ships, and the testing conditions shall meet the standards in force and the following requirements:

.1 the ambient air temperature shall be not lower than +5 °C;

.2 the difference between the ambient air temperature and the temperature of medium used for the hydraulic test shall not exceed 10 °C; to avoid sweating, a medium with a temperature in excess of the ambient air temperature shall be used;

.3 any work on parts subjected to hydraulic test shall be forbidden.

5.1.10 Scope and procedure of the surveys and tests of the supervised items during the manufacture and installation at the manufacturer's are indicated in the List (refer to 12.2, Part I "General Regulations for Technical Supervision") elaborated by the manufacturer and approved by the RS Regional Branch office on the basis of the RS Nomenclature as well as the requirements of this Section. When compiling the List, account shall be taken of the salient features of the production process adopted at the manufacturer's.

5.1.11 Forms of the manufacturer's documents including measuring results tables, test tables, presentation certificates shall be elaborated with regard to the requirements of the List agreed with the Surveyor.

5.1.12 Test performance and scope, where no special requirements of the rules are available, shall be defined by the standards in force approved by the Register.

5.1.13 The Surveyor, if need be, may perform periodic checks and surveys not stated in the List but stipulated by the Contract on Supervision or Agreement on Supervision, for example:

.1 check of the control operation effectiveness;

.2 check of the adherence to the production process;

.3 check of the assemblies, parts not included in the List, but whose quality of manufacture affects the proper operation of the machinery as a whole, and the check thereof at the final stage of manufacture shall be dispensed with.

In all cases, when an impermissible defect or trouble is detected at any stage of the supervised item presentation, the surveyor, should the need arise, may require a second check of any preceding operation within the scope necessary to discover the causes and prevent re-occurrence of defects.

5.1.14 Methods of check, tools and arrangements for its performance during manufacture and installation shall be established by the manufacturer to the satisfaction of the Register and indicated in the documentation on the production process.

5.1.15 The manufacturing and installation tolerance standards not represented in the approved manufacturing documentation shall be indicated in the production process documentation approved by the Register.

5.2 MAIN AND AUXILIARY INTERNAL COMBUSTION ENGINES OF POWER OUTPUT 55 KW AND OVER

5.2.1 Technical supervision during manufacture of the internal combustion engines, their assemblies and parts shall be performed in accordance with the requirements of Table 5.2.1, list of items and the RS Nomenclature.

5.2.2 Bed plates.

5.2.2.1 The bed plates of cast, welded and combined cast-and-welded construction, upon completion of preliminary treatment and all welding operations (including correction of defects by welding) shall be subjected to heat treatment in accordance with the approved procedure.

Table 5.2.1

Item of technical supervision	Examination of material, blanks, assemblies, parts	Verification of accompanying documents, brands	Flaw detection	Hydraulic tests	Special tests	Bench tests
Main and auxiliary internal combustion engines of power output 55 kW and over		+				+
Bed plates	+	+	+	+		
Crankcases	+	+	+	+		
Frames, columns	+	+	+			
Cylinder blocks	+	+	+	+		
Cylinder covers	+	+	+	+		
Cylinder liners	+	+	+	+		
Inlet and outlet valve housings	+	+	+	+		
Tie rods	+	+	+			
Pistons (crowns and trunks)	+	+	+	+		
Gudgeon pins	+	+	+			
Piston rods	+	+	+			
Connecting rods	+	+	+			
Crossheads	+	+	+			
Crankshafts	+	+	+			
Crankshaft detachable couplings	+	+	+			
Main, connecting rod, top-end, crosshead and built-in thrust bearings	+	+	+		+	
Bolts and studs of crosshead, connecting rod and main bearings, attachment of couterweights to crank webs, cylinder covers and connections of crankshaft sections	+	+	+			
Gearing and chain gears	+	+	+			
Links and levers of synchronizing mechanisms	+	+				
Valve plates	+	+				
Exhaust scrolls and gas collectors	+	+		+		
Speed governors	+	+				+
Overspeed device	+	+				+
Camshafts	+	+	+			+
Safety valves		+		+		
Insulation	+					
High pressure oil fuel injection pipes and their protection	+	+		+		+
High-pressure fuel-oil pumps	+	+				
Injectors	+	+				

Minor defects the correction of which does not give rise to deformation of the bed plate, on agreement with the surveyor, may be rectified without subsequent heat treatment.

5.2.2.2 During external examination of the finished bed plate it is necessary to be guided by the provisions of 5.1.6 and the documents of the technical supervision body. A random check makes it possible to make sure that the bed plate meets the requirements of the technical documentation with respect to:

.1 its construction and dimensions;

.2 performance of welded joints;

.3 performance of joints and joining of the bed plate parts together;

.4 execution of the treated surfaces so that they can be conjugated with the following parts:

wedges,

frames,

crankcase columns,

main bearing liners,

other parts;

.5 performance of the required checks:

inspection of steel cast, forged parts and welds for likely flaws;

alignment of recesses for the main bearings;

position of bearing surfaces;

position of mated surfaces;

parallelism, perpendicularity and concentricity of surfaces;

presence of defects and their nature;

surface roughness.

5.2.3 Crankcases.

5.2.3.1 When surveying a crankcase or its individual parts, the applicable requirements of 5.2.2 shall be taken as guidance.

5.2.3.2 Crankcase explosion relief valves:

.1 crankcase explosion relief valves shall have Type Approval Certificate to confirm their conformity to the requirements of 2.3.5 to 2.3.7 of Section 2 "Internal Combustion Engines", Part IX "Machinery" of the Rules for the Classification and Construction of Sea-Going Ships. The requirements for the extent of relief valve tests are given in Appendix 2 to this Section;

.2 the engine control panel or, more practicable, each detachable cover of the crankcase on both sides of the engine shall have a placard warning that the covers shall not be opened for a certain period of time sufficient for cooling needed after the engine shutdown irrespective of the degree of overheating inside the crankcase.

.3 the set of crankcase explosion relief valves delivered shall include a copy of the manufacturer's installation and maintenance manual that is pertinent to the size and type of the valve supplied for installation on a particular engine. The manual shall contain the following information:

the description of the valve with details of function and design limits;

a copy of Type Test Certificate;

installation instructions;

maintenance inservice instructions including checking/testing and renewal of any sealing arrangements;

actions required after a crankcase explosion.

5.2.3.3 Oil mist detection and alarm equipment

Internal combustion engines shall be fitted according to engine designer's instructions and those of the manufacturer of these devices which shall include the following:

.1 Schematic layout of engine oil mist detection/monitoring and alarm system showing location of engine crancase sample points and piping arrangements together with pipe dimensions to detector/monitor;

.2 evidence of study to justify the selected location of sample points and sample extraction rate (if applicable) in consideration of the crancase arrangements and geaometry and the predicted crancase atmosphere where oil mist can accumulate;

.3 a manual on maintenance and checks (tests) of which a copy shall be onboard a ship;

.4 data on type tests or operational tests as part of the engine protection system.

The requirements for the extent of type tests for devices for detection and control of oil mist concentration in crankcases of internal combustion engines are given in Appendix 3 to this Section. To demonstrate the operation of detectors and the alarm system, the devices in combination with the detectors shall be tested both on a test bench and onboard a ship.

5.2.4 Frames and columns.

When surveying frames and columns or their individual parts, the applicable requirements of 5.2.2 shall be taken as guidance.

5.2.5 Cylinder blocks.

5.2.5.1 When surveying cylinder blocks or individual parts thereof, the applicable requirements of 5.2.2 shall be taken as guidance.

5.2.5.2 The cylinder block or its sections, upon finishing, shall be tested on the cooling space side by a hydraulic test pressure in accordance with the requirements of 5.1.9, with particular attention being given to the tightness of temporary seals.

5.2.6 Cylinder liners.

5.2.6.1 When surveying cylinder liners, the applicable requirements of 5.2.2 shall be taken as guidance.

5.2.6.2 After finishing, the cylinder liner shall be subjected to test by a test hydraulic pressure in accordance with the requirements of 5.1.9.

5.2.6.3 In case of liners with cooling nave collars, particular attention shall be given to the tightness of temporary seals of bores or sockets forming cooling space of the nave collar.

5.2.7 Cylinder covers.

5.2.7.1 When surveying cylinder covers or individual parts thereof, the applicable requirements of 5.2.2 shall be taken as guidance.

Particular emphasis shall be also placed on the tightness of temporary seals of bores and welds of the welded-on shells forming cooling space of the cylinder cover as well as the inserts for mounting valves.

5.2.7.2 After finishing, the cylinder cover (in assembly, in case of built-up cover) shall be subjected to test on the cooling space side by a test hydraulic pressure in accordance with the requirements of 5.1.9.

5.2.8 Inlet and outlet valve housings.

After finishing, the inlet and outlet valve housings shall be subjected to test on the cooling space side by a test hydraulic pressure in accordance with the requirements of 5.1.9.

The results of flaw detection shall be verified.

5.2.9 Tie rods.

In addition to the compliance of their dimensions, particular attention shall be given to thread condition. During external examination of the tie rods, the results of flaw detection shall be verified as well.

5.2.10 Pistons.

During external examination of the finished pistons, the following shall be checked:

parallelism of the ring groove surfaces each other;

perpendicular position of the ring groove to the piston axis;

perpendicular position of the axis of bore for the gudgeon pin to the piston axis and location of these axes in the same plane;

concentricity of the surfaces the centre of which is situated on the piston axis;

results of flaw detection.

Upon finishing, the piston shall be subjected to test by a test hydraulic pressure in accordance with the requirements of 5.1.9.

5.2.11 Gudgeon pins.

During external examination of the gudgeon pins, in addition to the check for compliance of their dimensions, roughness and material, the results of flaw detection and heat treatment shall be also verified.

5.2.12 Piston rods.

During external examination of a finished piston rod, the following shall be checked:

parallelism or alignment of the mated surfaces each other;

perpendicular position or alignment of the mated surfaces with the rod axis;

results of flaw detection.

5.2.13 Connecting rods.

During external examination of a finished connecting rod, the following shall be checked:

parallelism of the mated surfaces each other;

perpendicular position of the mated surfaces to the connecting rod axis;

results of flaw detection.

5.2.14 Crossheads.

During external examination of a finished crosshead, the following shall be checked:

alignment of journals;

parallelism and misalignment of the surface generatrices of one journal in relation to another;

results of flaw detection and heat treatment.

5.2.15 Crankshafts.

5.2.15.1 During external examination of a finished crankshaft, the following shall be checked:

parallelism of the generatrices of journals and crank pins to the crankshaft axis;

lack of cylindrical shape of the journals and crank pins;

crank throw setting angles, crank throw radii;

perpendicular position of the generatrices of journals and crank pins to the surfaces of webs;

run-out of journals and crank pins, flanges and seats for gear or sprocket to drive the camshaft;

observance of the radii and roughness rates of journal, crank pin and flange fillets as well as oil channels;

results of the flaw detection and heat treatment;

roughness of surfaces of the journals and crank pins;

results of the crankshaft balancing.

5.2.15.2 In case of built and semi-built crankshafts, in addition to checks mentioned above, the following shall also be checked:

roughness of the treated surfaces for press-fit;

lack of cylindrical shape of the mounting surfaces;

perpendicular position of the axes of holes for press-fit of journals and crank pins to the side surfaces of webs;

alignment of the oil channels in journals and crank pins and the webs;

value of the accepted interference fit of the journals and crank pins in the webs.

5.2.16 Detachable crankshaft couplings.

During external examination of the finished detachable crankshaft couplings, the following shall be checked:

perpendicular position of the end faces to the bore axis;

concentricity of sections one to another;

availability of a stock for finishing after fitting on the shaft;

results of flaw detection.

5.2.17 Main, connecting rod, top-end, crosshead and built-in thrust bearings.

During external examination of the finished bearing shells for lining or the bearings completely manufactured of antifriction material or after lining, the following shall be checked:

concentricity of sections;

perpendicular position of the end faces to the bore axis;

concentricity of lining;

contact between the bearings and their seats;

interference fit (bushes-bearings);

results of inspection of the lining for flaw;

tight fit and interference value (thin-walled bearings).

For the built-in thrust bearings, see also Section 7.

5.2.18 Bolts and studs of crosshead, connecting rod and main bearings, cylinder covers, attachment of couterweights to crankshaft webs and connections of crankshaft sections.

During external examination of the finished bolts and studs, the following shall be checked:

concentricity of sections;

perpendicular position of the generatrices to the end faces;

bolt length recorded on the bolt body;

results of flaw detection.

5.2.19 Gearing and chain gears.

5.2.19.1 During external examination of the finished gear-wheels and sprockets, the following shall be checked:

perpendicular position of the axis of the hole for mounting to the end faces of the gear or sprocket hub;

tooth shape and contact in engagement;

results of flaw detection and heat treatment.

5.2.19.2 During external examination of the finished components of driving chains and chains in assembly, the requirements of 5.1.6 shall be taken as guidance; and the following shall be checked:

concentricity of the sections of bushings and pins;

centre-to-centre distance in sides;

condition of the internal surfaces of the bushings before fitting sides;

caulking of pins in the chain sides;

chain pitch under measuring load;

length difference of a set of single-row chains in these drives with two and more single-row chains running on two and more row sprockets;

results of heat treatment of components before assembling the chain.

5.2.20 Links and levers of synchronizing mechanisms.

Refer to 5.1.6.

5.2.21 Valve plates.

Refer to 5.1.6

5.2.22 Exhaust passages and gas collectors.

Refer to 5.1.6.

5.2.23 Speed governors and overspeed devices.

The finally assembled speed governors and overspeed devices shall be tested on bench or in conjunction with the machinery to be tested on bench.

5.2.24 Camshafts and their bearings.

During external examination of a finished camshaft and its bearings, the following shall be checked:

.1 parallelism of the generatrices of the working journals to the camshaft axis;

.2 lack of cylindrical shape of the working journals;

.3 setting angles of the cam plates;

.4 parallelism of the working surface of the cam or cam plate profile to the camshaft axis;

.5 run-out of journals, flanges and seats for fitting driving gear or sprocket;

.6 deviation of geometry of the key slots for fitting bushings for cam plates in the perpendicular position and parallelism in relation to the camshaft projections;

.7 roughness of the machined journals and cams (cam plates);

.8 results of flaw detection and heat treatment;

.9 camshaft bearings (refer to 5.2.17).

5.2.25 Upon completion of survey of the ICE assemblies and components, technical supervision during installation of the engine on bench shall be performed.

Assembly of the engine begins with installation of the bed plate on the bench beams. In the process of installation, the following shall be controlled:

.1 installation of the bed plate in horizontal position with fasteners being not tightened down snugly and with wedges adjusted;

.2 matching, fixing and attachment of individual parts of the frame one to another; in case of bed plated of the ICE with long detachable welded oil pans, attention shall be given to the attachment of the oil pan and its parts;

.3 tightening of bolts and stops with subsequent check for the horizontal position of the top frame plane;

.4 removal of the datum lines;

.5 check for the alignment of the main bearing seats;

.6 matching of the main bearing shells to seats and fitting of the radial-and-axial bearing;

.7 check of the oil pan for tightness;

.8 placement of the crankshaft with check of the journals for fit to the bearings, check of the shaft for horizontal position and proper orientation as well as for the run-out of journals, measurement of crank web clearances;

.9 establishment of clearances of the main, radial-and-axial and thrust bearings;

.10 installation of the crankcase columns, frames and their parts, alignment of the guides;

.11 installation and alignment of the cylinder block or individual blocks, check of the surfaces of the individual cylinder block parts for fit to one another, their fixing and securing;

.12 tightening of tie rods and bearings with specified tightening (to be carried out according to the manufacturer's instruction);

.13 control check of the crank web clearances after the tie rods have been tightened and the turning gear (flywheel) mounted;

.14 installation and alignment of the valve timing gear and camshaft;

.15 mounting of the cylinder liners;

.16 mounting of the running gear components;

.17 alignment of the running gear with establishment of mounting bearing clearances;

.18 mounting of the cylinder covers with fittings and gear having undergone tests and adjustment;

.19 mounting of the engine serving systems;

.20 mounting and alignment of the power driven and/or gas turbine air chargers;

.21 check of component locking.

5.2.26 When carrying out bench tests, it is necessary to be guided by the requirements of 5.11 and by the following:

.1 before the ICE is put to an operating mode, the control, regulation, alarm and protection systems shall be checked, namely:

interlocking of the starting control system with the turning gear,

number of starts with determination of the air consumption at various pressures,

operation of the governors,

operation of the overspeed device,

operation of the alarm and protection systems,

operation of the RAC and RC according to special program, reversal on various modes with measuring of time, operation at the minimum stable rotational speed, operation of the emergency shut-down device;

.2 operation of the ICE is checked on modes stipulated by the program, including reversal and meanwhile the following parameters shall be recorded:

temperature and pressure at the inlet and outlet (for the lubrication system);

water temperature and pressure in the external and closed circuits at the inlet and outlet, including air coolers (for the cooling system);

parameters associated with the working process: ambient air pressure, temperature and humidity, supercharging air pressure, compression pressure, combustion pressure, mean effective pressure, gas temperature by cylinders, gas temperature at the turbocharger inlet and outlet, exhaust backpressure;

other: engine power output, speed, turbocharger speed;

.3 upon completion of the bench tests, random inspection of the ICE components shall be performed within the scope stipulated by the bench test program, and the inspection shall cover:

cylinder covers,

pistons and piston rods,

cylinder liners,

connecting rods,

crankshaft,

connecting rod, main and top-end bearings, guides,

crossheads, gudgeon pins,

valve timing gear and camshaft;

.4 the ICE shall be assembled with random verification of the results of the component measurement, except for the ICE supplied in knock-down form, if the inspection results do not call for a test check;

.5 check tests shall be performed with verification of necessary parameters.

5.3 AUXILIARY INTERNAL COMBUSTION ENGINES OF POWER OUTPUT BELOW 55 KW

5.3.1 Technical supervision during the manufacture of the auxiliary ICE, their assemblies and components shall be performed within the scope given in Table 5.3.1 and in compliance with the applicable requirements of 5.2 and the requirements of 5.11.

Table 5.3.1

Item of technical supervision	Examination of materials, blanks, assemblies and components	Verification of accompanying documentation, brands	Flaw detection	Hydraulic tests	Special tests	Bench tests
Auxiliary internal combustion engines of power output below 55 kW						+
Bed plates	+	+	+			
Cylinder blocks	+	+	+	+		
Crankcases	+	+	+			
Cylinder covers	+	+	+	+		
Pistons	+	+	+	+		
Connecting rods	+	+	+			
Crankshafts	+	+	+			
Speed governors, overspeed devices						+
Camshafts	+	+	+			+

5.4 MAIN STEAM TURBINES AND ELECTRIC GENERATOR TURBINES

5.4.1 Technical supervision during the manufacture of main steam turbines, electric generator turbines, their assemblies and components shall be performed within the scope given in Table 5.4.1 and in compliance with the requirements of this Chapter.

5.4.2 Turbine casings.

5.4.2.1 Turbine casings of cast, welded and combined cast-and-welded construction, after preliminary treatment (including all welding operations), shall be made subject to heat treatment according to the approved procedure.

5.4.2.2 During external examination of a finished turbine casing, it is necessary to make sure that:

weld joints, treated surfaces for wedges, for joining individual parts of casing, for bearing shells, gland seals, diaphragms, nozzles and guide apparatus comply with the requirements of the technical documentation;

inspection of welds and basic material for flaw, check of bored seats for gland seals, bearings, nozzles and guide apparatus for alignment have been carried out using approved methods;

Table 5.4.1

Item of technical supervision	Examination of materials, blanks, assemblies, components	Verification of accompanying documents, brands	Flaw detection	Hydraulic tests	Special tests	Bench tests
Main steam turbines and electric generator turbines						+
Turbine casings	+	+	+	+		
Nozzle boxes and manoeuvring gear casings	+	+		+		
Nozzles	+	+				
Diaphragms	+	+			+	
Disks	+	+	+		+	
Blades	+	+	+		+	
Gland seals	+	+				
Rotors and shafts	+	+	+		+	
Bearings	+	+	+		+	
Couplings	+	+			+	
Shrouds and lashing wire	+	+				
Bolts for joining split casings	+	+	+			

welds have required leg and have no defects;

surfaces of individual casing parts joint have been matched to one another and their relative position has been fixed;

holes for bolted joints are aligned and their generatrices are perpendicular to the surfaces for nuts (heads);

surfaces for bearings, gland seals and guide apparatus are concentric and have no conicity and ellipticity and their axis is situated in the horizontal split plane and is perpendicular to end faces of bores.

5.4.2.3 The finished turbine casing shall be made subject to hydraulic test in accordance with 5.1.9.

5.4.3 Nozzle boxes and manoeuvring gear casings.

5.4.3.1 During external examination of the finished nozzle boxes and manoeuvring gear casings, the requirements of 5.4.2 shall be taken as guidance, particular attention being given to pressing-in of the valve seats and treatment of the attachments.

5.4.3.2 The finished box nozzles and manoeuvring gear casings shall be made subject to hydraulic test in accordance with the requirements of 5.1.9.

5.4.4 Nozzles.

During external examination of the finished nozzles, it is necessary to make sure that the profiles comply with the requirements of the technical documentation and the surface are free of undercuts, cracks and other defects.

5.4.5 Diaphragms.

5.4.5.1 All the appropriate requirements of 5.4.2 for the inspection of cast and combined cast-and-welded also cover the diaphragms.

5.4.5.2 The diaphragms (cast iron and steel) with blades cast therein, after thorough cleaning shall be presented to the surveyor to check the blade casting quality.

Where there are poorly cast blades or blades with clear indication of burning, the diaphragms shall be rejected.

5.4.5.3 The channel walls shall be plane; particular attention shall be given to places where the blades emerge from the diaphragm metal.

5.4.5.4 The Surveyor shall verify that the diaphragm channel measurement data sheet has been correctly filled in.

5.4.5.5 In the presence of the surveyor, the diaphragms shall tested for deflection; and after unloading the diaphragms shall be free of residual stresses.

5.4.6 Disks.

5.4.6.1 The finished disks shall be presented to the surveyor to assess the quality of the treated surfaces which shall be free of cracks, cavities and other defects.

The ends of bosses (hubs), crowns, the relieving openings, boss openings, fillet positions shall be thoroughly polished.

Disks shall be measured and the results entered in the data sheets.

5.4.6.2 Each disk shall be inspected for flaw by a method approved by the Register and subjected to static balancing before being fitted on shaft.

If bladed disks are fitted on shaft, the first balancing (without blading) need not be presented to the Surveyor.

5.4.7 Blades.

5.4.7.1 When examining the finished blades, it is necessary to make sure that:

profiles and root parts for fitting comply with the technical documentation;

blade edges are rounded off and have no scratches or scores;

polished blades have no machining traces.

Particular attention shall be given to the blade root thread which shall be made clean, without scores and provide for proper fitting of the blades without float and excessive interference.

5.4.7.2 Each blade shall be inspected for flaw by a method approved by the Register; blades having cracks, cavities and similar defects shall not be admitted for use.

5.4.7.3 In case of the finished blades which are put together in packs, the natural frequency shall be checked.

5.4.8 Gland seals.

When examining gland seals, it is necessary to make sure that their working elements are concentric, the bore axis is perpendicular to end faces, springs have necessary rigidity.

5.4.9 Rotors and shafts.

5.4.9.1 During external examination of the finished rotors or shafts, it is necessary to make sure that:

flaw detection has been performed by an approved method;

sections of journals and their surfaces, radii of all fillets, thrust collar as well as treated surfaces for fitting disks, blades, gland seal cages and coupling parts comply

with the technical documentation;

all treated surfaces have been measured and the results entered in data sheet;

roughness of treated surfaces has been measured and the results entered in data sheet;

bolted joints of built-up drums have been securely locked.

5.4.9.2 Particular attention shall be given to proper position and treatment of entry slots for locking blades and check of key fitting.

5.4.9.3 The bladed rotor shall be presented to the surveyor for external examination during which it is necessary to make sure that:

fitting of disks, gland seal cages, thrust collar and other fitted-on parts has been made with interference stipulated by the technical documentation;

blades have been fitted without float and excessive interference;

shrouding tape, after clinching tenons, has no tears and been securely fastened;

lashing wire has been fastened by the stipulated method with the use of a proper alloy.

5.4.9.4 The completely assembled rotor with all components fitted thereon shall be subjected to indicating and dynamic balancing the results of which shall be entered in the rotor data sheet and presented to the Surveyor.

5.4.10 Bearings.

During external examination of the finished bearings, it is necessary to make sure that:

bearing surfaces of shells machined for seats and journals comply with the requirements of the working drawings;

flaw detection and special tests (bonding, metallography) have been performed by approved methods.

5.4.11 Couplings.

5.4.11.1 During external examination of the finished couplings, it is necessary to make sure that the surfaces machined for fitting on shafts (rotor), key slots, gear rings, holes for pressing in bushings, bushings and pins, heat treatment of teeth comply with the technical documentation.

5.4.11.2 Dynamic balancing and, if need be, finishing of the couplings shall be carried out together with the rotor (shaft).

5.4.12 Shrouds and lashing wire.

In addition to the requirements of 5.4.9.3, inspection of the shrouds and lashing wire shall be carried out also in respect of the materials used and compliance of their technical documentation.

5.4.13 Bolts and studs for joining the split casings shall be checked in accordance with the requirements of 5.2.18.

5.4.14 On completing the survey of assemblies and components of steam turbines during the manufacture thereof, the technical supervision during the turbine mounting shall be performed and whilst so doing, it is necessary to make sure that:

turbine assemblies and components which came for the mounting have no transport damages;

rotor has been placed in accordance with the requirements of the technical documentation for mounting;

also, the check shall cover:

fitting of bearings to seats;

fitting of bearings to rotor journals;

fitting of the thrust bearing pads;

establishment of bearing clearances;

establishment of sliding support clearances;

attachment of resilient supports;

mounting of diaphragms, gland seals;

axial and radial clearances of blading and gland seals;

fixing and joining of split casings;

fit of bolt heads and nuts to the turbine casing flanges;

alignment of turbine rotor with the torsion shaft or with the shaft of the first reduction gear stage pinion with the required contacts on the contact surfaces of half-couplings ensured;

presented results of the fixing measurements made by the technical inspection body using an approved method.

5.4.15 When carrying out bench tests of the steam turbines, it is necessary to be guided by the requirements of 5.11 and the requirements specified below.

5.4.15.1 Before the turbine is put to an operating mode, it is necessary to check operation of the regulation, control, alarm and protection systems. The check shall cover:

thrust and main bearing clearances with the use of organic means;

interlocking of turning gear with controls (quick-closing valve – QCV);

axial displacement of rotor which results in QCV closing;

opening and closing of the quick-closing valve, including use of a manual drive, and closing of the QCV by the emergency shut-down device;

closing of the QCV when the turbine speed exceeds the maximum allowable one, actuated by the speed meter or overspeed trip;

closing of the QCV when the pressure in the condenser rises;

operation of the bleeder valves.

5.4.15.2 When the turbine is checked on modes stipulated by the program, including emergency modes and reversal, the following parameters shall be recorded:

steam pressure before the nozzles of each casing;

pressure in the condenser;

bleed steam pressure;

steam temperature before the nozzles;

condensate temperature;
steam pressure at all ejector stages;
oil pressure in the lubrication system;
oil pressure in the regulation and protection system;
oil temperature in the lubrication system;
reduction gear output shaft speed;
time of reversal from FSAH to FSAS and back;
time of the turbine run-out.

5.4.15.3 Bench tests and inspection of the reduction gear, couplings, thrust bearing and attached machinery shall be performed in accordance with the requirements of the relevant Chapters of this Section.

5.4.15.4 Upon completion of the bench tests, the turbines shall be inspected with random verification of the measurement results of components, and the following items shall be generally examined:
rotor and its components,
main and thrust bearings,
gland seals,
casing and its components.

5.4.15.5 After inspection and rectification of defects, the turbine shall be assembled and check tests performed with the verification of necessary parameters.

5.5 AUXILIARY STEAM TURBINES

5.5.1 Technical supervision during the manufacture of auxiliary steam turbines, their assemblies and components shall be performed within the scope given in Table 5.5.1 and in accordance with the applicable requirements of 5.4 and the requirements of 5.11.

Table 5.5.1

Item of technical supervision	Examination of materials, blanks, assemblies, components	Verification of accompanying documents	Flaw detection	Hydraulic tests	Special tests	Bench tests
Auxiliary steam turbines						+
Turbine casings	+	+	+	+		
Nozzle boxes	+	+		+		
Nozzles	+	+				
Disks	+	+	+			
Blades	+	+	+		+	
Rotors and shafts	+	+	+		+	
Bearings	+	+	+		+	

5.6 MAIN GAS TURBINES AND ELECTRIC GENERATOR GAS TURBINES

5.6.1 Technical supervision during the manufacture of main gas turbines, electric generator gas turbines, their assemblies and components shall be performed in accordance with the requirements of this Chapter within the scope given in Table 5.6.1.

Table 5.6.1

Item of technical supervision	Examination of materials, blanks, assemblies, components	Verification of accompanying documents, brands	Flaw detection	Hydraulic tests	Special tests	Bench tests
Gas turbine frame and its supports	+	+	+			
Air suction inlets	+	+		+		
Turbine casings and compressor housings	+	+	+	+		
Nozzle cascades	+	+	+			
Diaphragms	+	+			+	
Compressor disks and journals and turbine disks	+	+			+	
Turbine and compressor blades	+	+	+		+	
Turbine and compressor rotors and shafts	+	+	+		+	
Shafts (springs) to connect turbines to compressors	+	+	+		+	
Torsion shafts to connect turbines to gearing	+	+	+		+	
Straightening vanes of compressors and turning vanes of reversing devices	+	+	+			
Flame tubes of combustion chambers, regenerators	+	+	+			
Reversing cylinders	+	+		+		
Gas and air lead tapes	+	+	+			
Gland seals	+	+				
Bearings	+	+				
Shrouds, lashing wire	+	+				
Couplings	+	+			+	
Bolts for turbine and compressors split casing joints	+	+	+			

5.6.2 During external examination of the finished gas turbine bed plate, it is necessary to be guided by the requirements of 5.2.2.

5.6.3 During external examination of the finished air suction inlet, the quality of welds and surface quality of detachable joints shall be assessed by visual examination and measuring. If the internal space of the inlet is used for cooling and condensing the oil vapour, the inlet shall be subjected to test for tightness of the internal space, upon completion of welding and machining.

5.6.4 During external examination of the finished turbine and compressor casings, it is necessary to be guided by the provisions of 5.4.2 as applied to their construction. Particular attention shall be given to the quality of the mated surfaces of the casings over the

perimeter of their splits joined by bolts without use of gaskets to ensure gas and air tightness in operation. Such surfaces shall be checked for the lack of warpage. The check may be performed by placing the component on a surface plate. A feeler of 0,05 mm shall not pass between the surface plate and the surface of the freely lying component to be checked. The quality of the mated surfaces shall not be lower than that required by the drawing.

During examination of the assembled compressor housings, particular attention shall be given to the quality of mounting of the metal-ceramic inserts of labyrinth glands, lack of mobility, surface quality. The quality of mounting of the straightening vanes and compliance of the flow areas with the requirements of the drawing shall be checked.

5.6.5 When examining the supporting rims of gas turbines, particular emphasis shall be placed on the quality of welds, treatment of surfaces matched with other assemblies, treatment of seats for rolling bearing races, quality of rivet joints. Loosening of rivets, incomplete rivet heads and their skewness shall not be admitted. Installation of jets to supply oil to bearing and their capacity shall be checked. Tightness of oil supply and drainage pipes shall be checked by connections and that of the pipes to supply air to labyrinth glands shall be also checked.

5.6.6 When examining the finished nozzle cascades, attention shall be given to the quality of weld and rivet joints and quality of mated surfaces. If there are cast components, attention shall be given to the quality of castings. The castings shall meet the requirements of the approved documentation. Particular emphasis shall be placed on the compliance of the nozzle cascade flow area with the requirements of the drawing and the compliance of the nozzle profile and surface roughness. The quality of welds by which the nozzles are welded on shall be checked by non-destructive inspection. No cracks and poor penetration shall be admitted.

The nozzle cascades with nozzles cast therein after thorough cleaning shall be presented to the surveyor to check the quality of casting. Where there are poorly cast nozzles or nozzles with clear indications of burning, the nozzle cascades shall be rejected. Check for the absence of defects shall be performed by non-destructive inspection methods.

When examining the nozzle cascades, the quality of metal-ceramic and honeycomb parts of the gland seals as well as the absence of warpage shall be checked.

No chipping of the metal ceramic components, dents on the honeycombs shall be admitted.

5.6.7 During external examination of diaphragms and straightening vanes, it is necessary to be guided by the provisions of 5.4.5.

5.6.8 During external examination of the finished compressor disks and journals and turbine disks, the quality of surfaces, blade rooting-in slots, compliance of component dimensions with the requirements of the drawing, results of special inspection types, heat treatment, dynamic balancing results shall be checked if so required by the drawing, prior to be mounted on the rotor. Besides, it is necessary to be guided by the provisions of 5.4.6.

5.6.9 When examining the finished moving blades of compressors and turbines, check shall be performed to cover roughness of the blade plate and root profile surfaces, leading and trailing edges, absence of dents and design of the blade locks.

The cast cooled turbine blades provided with cooling channels shall be checked for compliance of the wall thicknesses over all sections indicated in the drawing; along with that, the results of flow test of the channel shall be verified to determine its capacity. Particular attention shall be given to treatment of the leading and trailing edges. Blades having cracks, dents, thinned walls over the cooled channels, leading and cooled edges cannot be permitted for mounting in the rotor.

Cast and stamped moving blades of compressors and turbines shall be manufactured in accordance with the specifications approved by the Register. These specifications shall stipulate requirements imposed upon:

materials,
mechanical properties,
surface condition,
micro- and macro- inspection,
special types of inspection and tests,
special types of treatment,
charge materials,
casting inspection,
allowable defect rates.

See also provisions of 5.4.7.

5.6.10 During external examination of the finished and bladed rotors of the turbines and compressors, it is necessary to be guided by the requirements of 5.4.9 as related to their construction.

It is necessary to give attention to the absence of visible defects (such as hollows and dents on blade edges, labyrinth gland strips, thread surfaces and splines) as well as cracks and corrosion.

Along with that, it is necessary to check:

.1 moving blade float, protrusion of blade ends out of the disk slots which, as against the adjacent blades, shall not exceed that allowed by the drawing;

.2 data sheets on moving blades, disks and shafts; attention shall be given to the results of dynamic balancing of rotors and inspection of components for likely flaw (fluorescent inspection of moving blades, dye penetrant inspection of disks and ultrasonic inspection of shafts);

.3 results of frequency inspection and annealing in inert gas environment as well as mounting of blade locking pieces and fastening of balancing weights.

In case of drum-and-disk construction of rotors, documents confirming the observance of the temperature conditions of disk heating and their press fit pressures shall be verified and the mounting of fixing pins in attachment of adjacent disks and journals to disks attachment shall be checked.

5.6.11 During external examination of the finished compressor and turbine shafts, attention shall be given to the quality of welding if the shafts are made of individual blanks welded together. Specifications for the manufacture thereof approved by the Register, which shall specify the welding method, heat treatment type, weld inspection methods, mechanical properties of shaft blank material after heat treatment and conditions of inspection of the shaft mechanical properties and weld joint.

No defects of the shaft welds shall be admitted.

The finished shafts shall be checked for compliance with the requirements of drawing as related to dimensions, surface roughness; along with that, the results of the dynamic shaft balancing shall be verified.

5.6.12 During external examination of the finished shafts (springs) to connect turbines to compressors and torsion shafts to gearing, the results of inspection of the shaft material for flaws, compliance of surface roughness, splines, seats for rolling bearings, etc. with the requirements of the drawing shall be checked.

5.6.13 During external examination of the finished straightening vanes of the compressors and pivoted reversing gear, their compliance with the requirements of approved drawings as related to dimensions, profile and surface roughness shall be checked.

5.6.14 The quality of weld joints of the finished combustion chambers and flame tubes shall be checked by visual examination and measurement; butt welds shall be subjected to radiographic inspection.

Swirlers of flame tubes shall be checked for the suitability of their flow area for the air discharge capacity. Air supply openings shall not be sealed with enamel by fusion. Free section of these openings shall be not less than that indicated in the flame tube drawing.

Moreover, as regards combustion chambers, flame tubes and regenerators, see also Section 9 of this Part and Section 5 of Part V "Technical Supervision during Construction of Ships".

5.6.15 During external examination of the gas turbine reversing cylinders, the quality of internal working surface treatment, results of hydraulic tests shall be checked and all components of reverse control components examined.

5.6.16 During external examination of the finished air and gas lead tapes, the results of tape heat treatment and inspection for flaw, quality of weld (rivet) joints shall be checked; the tape plate shall be checked for the absence of warpage.

5.6.17 During external examination of the turbine gland seal components, it shall be verified that their working elements have been treated in accordance with the requirements of the approved documentation as related to clearance value and surface roughness and that the metal-ceramic inserts have no defects and mounted without play. Ceramic chipping and evaporated layer flaking shall not be admitted.

Sealing strip condition shall comply with the requirements of the drawing.

5.6.18 During external examination of the rolling bearings in is necessary to be sure that their types and dimensions comply with the requirements of the drawing of the assembly in which they are mounted. If heat resistant bearings shall be used, conventional bearings may not be mounted instead of them.

Bearing surfaces of races (outer and inner) of cages, ball and rollers shall not have cracks, corrosion, dents, spalling and other defects affecting reliable operation of the bearings.

If a loading device is used in the bearing assembly, calibration of the load produced shall be checked.

5.6.19 When examining the couplings and elastic couplings, it is necessary to be sure that the surfaces for fitting on shaft, rotor, flange joints, gear rings, key slots, openings, sleeves, pins, splines, elastic couplings have been treated in compliance with the requirements of the drawing. When the elastic coupling components are manufactured of titanium alloys, blanks shall comply with the specifications approved by the Register. When examining the finished components of titanium alloys, attention shall be given to roughness of treated surfaces, results of the special inspection types, heat treatment.

Upon completion of final assembly, the couplings and elastic couplings shall be subjected to dynamic balancing before being mounted in the subassembly (rotor, shaft, gear, etc) of the article.

5.6.20 External examination of the gas turbine piping shall be carried out during examination of the finished turbine mounted on the bedplate. While this is being done, it is necessary to be sure that all piping (lubricating oil, fuel oil, compressed air, CO_2 smothering, pipes for relieving inter-labyrinth spaces and others) have been mounted on the turbine in full compliance with the requirements of the approved documentation, flexible inserts of the fuel oil and lubricating oil pipes have been fitted without impermissible interference, bends, angularity and the like, which can result in the damage thereof; the quality of pipe welding, pipe joints comply with the requirements of the drawings; access is provided to the joints, burners and other assemblies which require maintenance in service.

5.6.21 When carrying out bench tests of GT and GTI, it is necessary to be guided by 5.11 and the following requirements:

.1 prior to GTI starting the following shall be checked:

thrust and main bearing clearances, using organic means;

interlocking of turning gear with starters;

axial displacement of rotors with the alarm being actuated and with subsequent interruption of fuel supply;

limit speed alarm and protection of propeller or electric generator drive applied to all sections and turbines;

alarm indicating subsequent interruption of fuel supply in case of cooling water pressure drop, cooling water temperature rise, lubrication system pressure drop and working medium temperature rise;

operation of fire protection arrangement;

fuel supply alarm and control based on air supply to HPC;

operation of GT under emergency mode scheme;

time of reversal from FSAH to FSAS and back;

time of turbine run-out;

run-away test;

readiness of GTI for starting;

.2 check shall be performed to cover false starting and motoring, time of operation of the starters, HPC speed, run-outs and GTI lubrication oil pressure;

.3 starting of the turbine shall be checked with measurement of starter current, time of starter operation and other basic parameters defining operation of the GTI during starting.

To be checked with the turbine running:

failure to switch on electric motors to drive the LPC and HPC up to speed;

failure to disconnect electric oil pumps of: turbine, reduction gear, driving compressor, automation system;

failure to provide reverse and "crush stop" condition when the turbine is in operation mode in excess of that permissible to execute manoeuvres (e.g. when the load exceeds 0,5 rated power);

failure to operate manually the air lead tape control push-button;

failure to actuate the ignition system;

.4 when the GTI is idling, check shall cover all parameters as well as the alarm:

"GTI oil pump in operation";

"Oil pump in automatic operation";

"Reduction gear oil pump in operation";

"Thermal limitation system put into operation";

"Air lead tape open";

.5 checks of the GTI protection and the following checks shall be performed:

oil pressure protection for the turbine;

oil pressure protection for the GTI driven machinery (reduction gear, electric generator, compressor);

fuel pressure protection;

starting thermal protection activation;

activation of thermal limitation system before the GTI is put to operational mode;

activation of thermal limitation system in the GTI operational modes;

agreement between the temperature gauges, exhaust gases with the set-point device of temperature regulator;

GTI pick-up;

activation of run-away protection;

starting fuel system tightness;

polarity in connection of thermocouples on temperature regulator;

inter-labyrinth space blow-off to determine that there is no oil blow-out;

operation of fuel pressure rise limiter;

turning on and off reserve fuel pump;

conservatism of the reversing system for air pressure drop;

absence of surging;

"crush stop" mode;

oil pressure protection for automation system;

run-away protection for propeller turbine.

.6 operation of the GTI shall be checked in the modes stipulated by the program, including reversing. During operation of the GTI in all modes, gas- and air-tightness of the GT casing joints along vertical and horizontal splits;

.7 GTI stoppage: normal, urgent and emergency shall be checked;

.8 bench tests of machinery driven by GT and inspection thereof shall be carried out in compliance with the provisions of 5.11;

.9 upon completion of the bench tests, the gas turbine shall be inspected with examination and test of all assemblies and components for flaws. During the inspection, moving blades of all turbine and compressor stages shall be subjected to fluorescent test and the nozzle cascades and HPC stages – to dye penetrant test.

Depending on the structural features of GT, a list of other assemblies and components to be subjected to additional types of inspection shall be agreed with the RS Regional Branch office;

.10 upon completion of the inspection, the GT shall be assembled and subjected to check test on bench;

.11 check tests shall be carried out in accordance with the program approved be the Regional Branch office and whilst so doing, all parameters stipulated by the program shall be checked;

.12 where the results of the check tests are positive, the surveyor shall permit the turbine to be dismounted and completely built-up with assemblies and components which shall not undergo tests (e.g. warmth-insulating cases, fire extinguishing pipes, identification plates, etc);

.13 upon completion of building-up and painting, the turbine shall be presented to the surveyor for external examination. The Surveyor shall put the final Register brand on the manufacturer's plate and issue the Register certificate.

5.7 GEARS AND DISENGAGING COUPLINGS OF MAIN AND AUXILIARY MACHINERY

5.7.1 Technical supervision during the manufacture of gears and disengaging couplings of main and auxiliary machinery, their assemblies and components shall be performed within the scope given in Table 5.7.1 and in accordance with the requirements of this Chapter and 5.11.

Table 5.7.1

Item of technical supervision	Examination of materials, blanks, assemblies, components	Verification of accompanying documents, brands	Flaw detection	Hydraulic tests	Special tests	Bench tests
Gears, disengaging couplings of main machinery:						+
coupling and reduction gear casings	+	+	+	+		
gears and pinions	+	+	+		+	
reduction gears and coupling shafts	+	+	+		+	
detachable shaft half-couplings	+	+			+	
connecting bolts	+	+				
driving and driven parts	+	+			+	
elastic components of couplings	+	+				
bearings	+	+	+		+	
Gears of auxiliary machinery:						+
coupling and reduction gear casings	+	+	+	+		
gears and pinions	+	+	+		+	
reduction gear and coupling shafts	+	+	+		+	
Bearings	+	+			+	

5.7.2 Reduction gear and coupling casings.

5.7.2.1 During external examination of the finished components of reduction gear casings to be performed upon completion of welding operations and heat treatment, it is necessary to be sure that:

welded joints, treated surfaces for foundation wedges, flange joints of individual casing parts and for bearing shells comply with the technical documentation;

inspection of welds for flaws, check for the alignment of seat bores for bearings of one shaft, check for the parallelism and misalignment of axes of shafts in engagement have been carried out by approved methods;

welds have been made with the required leg and have no defects;

individual parts of reduction gear casing have been joined together by the required number of calibrated bolts (pins) fixing the position of individual parts relative to each other;

reduction gear casing have been subjected to test for oil-tightness.

5.7.2.2 During external examination of the finished (upon completion of welding operations and heat treatment) coupling casing components, it is necessary to be sure that:

welded joints, treated surfaces of flange joints of individual casing parts, bores for bearing shells and seals, surfaces for foundation wedges comply with the requirements of the technical documentation;

inspection of welds for flaws, check for alignment of seat bores for bearings have been performed by approved methods;

constituent parts of coupling casing joined together by the required number of calibrated bolts (pins) fixing position of individual parts relative to each other;

casing of hydraulic coupling have been subjected to hydraulic test for tightness.

5.7.3 Gears and pinions.

5.7.3.1 During external examination of the finished gears, pinions and their components, it is necessary to be sure that:

treated surfaces for fitting, interferences provided, journals, key slots and heat treatment of gear rings comply with the requirements of the technical documentation;

teeth cutting parameters, perpendicular position of shaft axis to end faces, radial run-out have been checked and inspection of teeth for flaws have been performed by approved methods;

attachment of the ring to rim, rim to ribs, ribs to hub and hub to shaft complies to the requirements of the technical documentation.

5.7.3.2 The completely assembled and finished gear or pinion shall be subjected to the dynamic or only static balancing.

5.7.4 Reduction gear and coupling shafts.

5.7.4.1 During external examination of the finished reduction gear and coupling shafts, it is necessary to be sure that:

treated surfaces for fitting, journals and key slots comply with the requirements of the technical documentation;

radial run-out, parallelism of shaft axis to the generatrices of concentric surfaces have been checked and inspection for likely flaws has been performed by approved methods.

5.7.4.2 The finished shafts in association with half-couplings shall be subjected to the dynamic or only to static balancing.

5.7.5 Detachable shaft half-couplings.

During external examination of the finished detachable shaft half-couplings, it is necessary to be sure that:

treated surfaces, key slots, gear rings, holes for pressing in sleeves, sleeves and pins, holes for bolts and fitting on shaft comply with the technical documentation;

dynamic or only static balancing and finishing have been carried out in association with shaft, the need for balancing having been dictated by the need for the shaft balancing and the need for the finishing – by the results of check in assembly with the shaft.

5.7.6 Connecting bolts.

During external examination of the finished connecting bolts, it is necessary to be sure that:

treated surfaces for fitting, threaded joints comply with the technical documentation;

perpendicular position of the end faces snugged against the bolt axis, thread have been checked by an approved method.

5.7.7 Driving and driven parts of couplings.

5.7.7.1 During external examination of the finished parts of couplings, it is necessary to be sure that:

treated surfaces for the connection with the driving and driven shafts, interferences, surfaces for seals and for joining the coupling parts comply with the technical documentation;

concentricity of treated surfaces, heat treatment of the contact surfaces have been checked by an approved method.

5.7.7.2 The completely assembled driving and driven parts of the coupling shall be subjected to the dynamic or only static balancing.

5.7.7.3 The need for finishing shall be dictated by the results of checking the couplings in assembly with shafts.

5.7.8 Elastic coupling components.

During external examination of the elastic components of the couplings, check shall be performed to determine whether their construction, material and characteristics defining their operation comply with the working documentation.

5.7.9 Bearings of gears and disengaging couplings.

5.7.9.1 To be checked:

.1 sliding bearings (refer to 5.2.1.7);

.2 during external examination of rolling bearings, it is necessary to be sure that their dimensions and types comply with the requirements of the technical documentation. Bearing surfaces of the races, cages, balls and rollers shall have no cracks, corrosion, dents, spalling and other defects affecting reliable operation of the bearings.

5.7.10 On completing the survey of assemblies and components of the gears of the main engines, technical supervision during the mounting of the gear shall be performed; while this is being done, the following mounting operations shall be monitored:

installation of the gear (reduction gear) casing on wedges on the bench foundation with fixing of the position;

matching of the bearings to the seats;

matching of the bearings to the journals of regular or dummy shafts;

check of the centre-to-centre distances;

check for the lack of parallelism of the shaft axes;

check of the gear clearances;

establishment of the radial and axial bearing clearances;

check of the engagement by teeth contact (final check after bench tests);

mounting of the torsion shafts and their couplings;

alignment of the reduction gear with the regular driving power unit or bench power unit;

mounting of the systems serving the reduction gear;

alignment of the reduction gear with the loading device or through a coupling.

Check shall also cover the supply of lubricating oil to the toothing and bearings in accordance with the requirements of 4.2.4, Part IX "Machinery" of Rules for the Classification and Construction of Sea-Going Ships.

Note. Check of the centre-to-centre distances, lack of parallelism of the shaft axes, misalignment of the axes and gear clearances shall be carried out on shafts related in pairs by engagement.

5.7.11 On completing survey of assemblies and components of the disengaging couplings of main machinery, it is necessary to perform technical supervision of mounting, the following operations being monitored:

installation of the stationary part of coupling (case, housing) on wedges, on the bench foundation;

mounting of the driving part of the coupling;

mounting of the driven part of the coupling;

matching of the radial-axial bearings to seats;

matching of the radial-axial bearings to journals of the driving and driven shafts with check for their alignment or by dummy shaft;

alignment of the driving and driven shafts;

alignment of the driving part of the coupling (shaft) with the regular power unit (reduction gear or power unit), bench reduction gear and driven part of the coupling (shaft), loading device;

mounting of the systems serving coupling.

5.7.12 When conducting bench tests of the main machinery gears, it is necessary to be guided by the requirements of 5.11 as well as the requirements specified below.

5.7.12.1 Testing of the gears shall be generally conducted with the regular driving power unit and/or coupling.

5.7.12.2 When conducting testing of a gear with the bench driving power unit, its operating modes shall meet the operating conditions when using the regular power unit; whilst so doing, the following shall be checked:

reversing by the driving power unit;

reversing provided for by the gear (reverse-reduction gear) construction;

reversing by the reverse-couplings;

change in the driving power unit speed;

change in the driving shaft speed provided for by the gear construction;

change in the speed through the use of the hydrodynamic torque converter;

disengaging of the gear from the driving power unit or load.

5.7.12.3 Operation of the attached machinery and mounting thereof shall be effected in compliance with the requirements of these Rules depending of the principle of operation and purpose of the machinery.

5.7.12.4 Time and load conditions of the gear tests are dictated by the requirements imposed on the regular driving power unit.

5.7.12.5 Upon completion of tests, the gear shall be subjected to inspection with examination of the following:

shafts,

pinions and gear wheels, built-in couplings, bearings,

to be checked shall be the gear contact the pattern of which shall be at least 90 % along the length and 60 % along the height of teeth, and in case of the gears of auxiliary machinery – at least 70 % along the length and 50 % along the height.

5.7.12.6 The gear shall be assembled, and the results of the component measurements and fixing measurements shall be verified at random.

5.7.12.7 Check tests shall be carried out with the necessary parameters being verified.

5.7.13 When conducting bench tests of the disengaging couplings of the main machinery, it is necessary to be guided by the requirements of 5.11 as well as the requirements specified below.

5.7.13.1 Test of the disengaging couplings shall be generally carried out with the regular driving power unit and/or reduction gear.

5.7.13.2 When the disengaging couplings are subjected to bench tests with the bench driving power unit, "power unit – reduction gear" set or reduction gear, operating modes shall meet the conditions of operation depending on the regular scheme which shall provide for;

reversing by the driving power unit or reverse-reduction gear;

change in the speed.

5.7.13.3 Depending on the coupling construction, the following shall be checked:

.1 spline, claw, tooth and friction couplings –

engagement and disengagement of the coupling with fixed and rotating driving shaft: ahead, astern, at different modes and speeds, if this is provided for by the construction and required by the service conditions;

operation of the coupling engagement mechanism;

whilst so doing, the following shall be recorded:

coupling temperature;

working medium pressure when the engagement mechanism is hydraulically driven;

limiting torque slipping, if envisaged;

.2 hydrodynamic torque converters, hydraulic couplings, electromagnetic couplings –

engagement and disengagement of the coupling with the fixed and rotating driving shaft: ahead, astern, at different modes and speeds, if this is provided for by the construction and required by the service conditions;

filling and emptying of the hydraulic couplings and hydrodynamic torque converters;

change in the driven shaft speed by the hydrodynamic torque converter at different loads and, should the need arise, change to the hydraulic coupling mode;

coupling slipping.

5.7.13.4 The electrical part of the electromagnetic couplings shall be tested in accordance with the requirements of Section 10.

5.7.13.5 During the tests, the following parameters shall be recorded:

oil temperature at the inlet and outlet;

time of the coupling filling and emptying;

discharge (delivery) of pumps serving the coupling during filling and replenishing leaks;

slipping.

5.7.13.6 Upon completion of tests, the couplings shall be subjected to inspection with the following being examined:

shafts;

contact surfaces;

seals;

bearings;

pumps;

engagement mechanisms.

5.7.13.7 The coupling shall be assembled with the results of component measurements and fixing measurements being verified at random.

5.7.13.8 Check tests shall be carried out with the necessary parameters being verified.

5.7.14 Technical supervision during the manufacture of the auxiliary machinery gears, their assemblies and components shall be performed within the scope given in Table 5.7.1 and in accordance with the applicable requirements of this Chapter and 5.11.

5.8 AUXILIARY MACHINERY

5.8.1 Technical supervision during the manufacture of the auxiliary machinery listed in Table 5.8.1 shall be performed in accordance with the requirements of 5.9 and of this Chapter.

5.8.2 Steam-jet ejectors of condensers.

5.8.2.1 During external examination of the finished components of the steam-jet ejectors, it is necessary to be sure that:

design of the nozzles and casings complies with the working drawings;

Table 5.8.1

Item of technical supervision	Examination of materials, blanks, assemblies, components	Verification of accompanying documents, brands	Flaw detection	Hydraulic tests	Special tests	Bench tests
Starting air compressors						+
Turbochargers						+
Main boiler blowers						+
Pumps:						
circulating pumps of main condensers						+
lubricating oil pumps of main engines and turbines						+
boiler feed water pumps						+
condensate pumps						+
boiler burner pumps						+
fuel oil transfer pumps						+
bilge pumps						+
fire pumps						+
ballast pumps						+
cargo oil pumps						+
main engine cooling pumps						+
Steam-jet ejectors of condensers						+
Circulating pumps of waste-heat boilers						+
Oil fuel and lubricating oil separators						+
Bilge ejectors						+
Submersible make-up sea water pumps of MODU						+
Jacking mechanism of MODU						+
Arrangement for lifting and lowering pipers and make-up pumps of MODU						+

nozzle throats have been checked by an approved method;

during the mounting of the ejector, position of the nozzle in casing in relation to the vacuum chamber have been checked.

5.8.2.2 The final adjustment shall be made during the bench tests at specified parameters; the following parameters being recorded:

steam pressure before the nozzles of all stages;

pressure of the steam and air mixture in heat exchanges of all stages;

amount of the dry air drawn off.

5.8.2.3 Technical supervision of the heat exchangers serving the steam-jet ejectors shall be performed in accordance with the requirements of Section 9, Part V "Technical Supervision during Construction of Ships".

5.8.3 Bilge ejectors.

The requirements of 5.8.2 shall be taken as guidance, the following paragraphs being recorded:

working medium pressure;

pressure in the vacuum chamber;

pressure at the outlet;

working medium consumption;

supply of the liquid to be drawn off.

5.8.4 Arrangements for lifting and lowering the columns of submersible sea water pumps of MODU.

Technical supervision of the arrangements for lifting and lowering the columns of submersible sea water pumps of MODU shall be performed in accordance with the applicable requirements of Rules for the Cargo Handling Gear of Sea-Going Ships.

5.8.5 Fans of machinery spaces, enclosed spaces and holds intended for carriage of vehicles, refrigerated spaces, fire extinguishing stations, cargo pump rooms, helicopter sheds, holds fitted for carriage of dangerous goods, storage battery rooms and boxes.

5.8.5.1 During external examination of the finished fan components, it is necessary to make sure that:

materials used comply with the technical documentation;

impeller has been subjected to the dynamic or only static balancing.

5.8.5.2 When checking the fan mounting for compliance with the requirements of the drawings, it is necessary to make sure that:

sliding bearings have been mated to the seats and journals and the required clearance provided;

required fixing radial and axial clearances between the impeller and casing have been established;

shaft has been aligned with the prime mover;

results of the component measurements and fixing measurements have been submitted by the technical supervision body for the mounting carried out;

checks have been carried out by approved methods.

5.8.5.3 When conducting the bench tests of the fans, the requirements of 5.9.5.7 and 5.11 shall be taken as guidance.

5.8.6 Motors and pumps of hydraulic systems.

5.8.6.1 Shafts and rotors.

5.8.6.2 Rods.

5.8.6.3 Pistons and plungers.

5.8.6.4 Casings.

5.8.6.5 Cylinders.

5.8.6.6 Technical supervision regarding 5.10.9.1 to 5.10.9.5 shall be performed in accordance with the requirements of 5.9, depending on the principle of operation of the pump.

5.8.6.7 Final check of the mounting of the variable delivery pumps and hydraulic motors shall be carried out during the check in operation.

5.8.6.8 When conducting bench tests of the variable delivery pumps and motors of the hydraulic systems, the requirements of 5.11 and the following requirements shall be taken as guidance:

.1 the following parameters shall be recorded:

power consumed;

capacity over the range from zero to maximum delivery or flow rate;

working fluid pressure;

working fluid temperature;

pressure in supporting systems;

.2 tests shall be conducted under the conditions where the delivery of the working fluid is changed from the maximum delivery in one direction to the maximum delivery in another direction;

.3 upon completion of the tests, the pump (motor) shall be inspected with examination of:

bearing surfaces for plungers,

plungers;

cylinder block;

gland seals;

pump serving the auxiliary systems;

.4 pump shall be assembled with the results of component measurements and fixing measurements being verified;

.5 check tests shall be conducted with verification of the necessary parameters.

5.9 COMPONENTS OF THE MACHINERY LISTED IN TABLE 5.8.1

5.9.1 Piston type pumps and compressors.

5.9.1.1 Cylinder blocks.

During external examination of the finished cylinder blocks, it is necessary to make certain that:

treated surfaces for fitting the cylinder liners and the surfaces mated with the crankcase, cover and one with another comply with the technical documentation;

concentricity of the bore axes, perpendicular position of the bore axis to the end faces have been checked by an approved method;

cylinder block is subjected to the hydraulic test in accordance with the requirements of 5.1.9.

5.9.1.2 Cylinder liners.

During external examination of the finished cylinder liners, it is necessary to make certain that:

treated surfaces for mounting liners in the block and mating with the cover comply with the technical documentation;

concentricity of the surfaces and perpendicular position of the bore axis to the collar plane have been checked by an approved method;

cylinder liners have been subjected to the hydraulic test in accordance with the requirements of 5.1.9.

5.9.1.3 Pistons.

During external examination of the finished pistons, it is necessary to make sure, that the concentricity of the surfaces, perpendicular position and intersection of the piston axis with the pin bore axis have been checked by an approved method.

5.9.1.4 Piston rods.

During external examination of the finished piston rods, it is necessary to make sure that:

mounting surfaces comply with the working drawings;

concentricity of the surfaces, perpendicular position or alignment of the rod axis with the surfaces of mating with the piston and crosshead have been checked by an approved method.

5.9.1.5 Connecting rods.

During external examination of the finished connecting rods, it is necessary to make sure that:

treated surfaces for the top-end and bottom-end bearings comply with the technical documentation;

parallelism of the axes of bores for the bearings or of the planes for mounting thereof and the parallelism of the bearing axes have been checked by an approved method.

5.9.1.6 Crankshafts.

During external examination of the finished crankshafts or their components in the built-up crankshafts, it is necessary to make sure that:

treated surfaces of journals and crank pins and the surfaces for mounting, interferences comply with the technical documentation;

crankshaft journals are aligned, the generatrices of the crank pins are parallel to those of the main journals, the setting angle of the crank throws, parallelism of the axes of holes for the press-fit of the crank webs and their perpendicular position to the end faces have been checked by approved methods.

5.9.1.7 Mounting of piston-type pumps and compressors.

During mounting of the piston-type pumps and compressor, in order to verify whether the mounting has been properly made and complies with the requirements of the documentation, it is necessary to make sure that:

cylinders in case of direct-acting pump are aligned;

crankshaft is placed in mated bearings; and whilst so doing, the axes of the cylinders are perpendicular to those of the crank throws when in DC and are parallel to the guides (parallels);

pistons when moving down from TDC to BDC retain constant circular clearance along their edge;

bearings of the running gear have been matched and mounted with a required clearances;

crankshaft has been aligned with the driving shaft;

measurement results for the mounting made shall be submitted by the technical supervision body;

checks have been carried out by an approved method.

5.9.1.8 When conducting bench tests of the starting air compressors, the requirements of 5.11 shall be taken as guidance and it is necessary also to:

check the starting characteristics of the prime mover;

measure the power consumption over the range from idling running until the limiting pressure is reached;

check the operation of the automatic facilities for starting and shutting down the compressor at specified pressures, blowing off the moisture and oil separators;

check operation of the safety valves of all stages.

5.9.1.8.1 The following parameters shall be recorded during the tests:

capacity;

air temperature at the compressor inlet;

cooling water temperature at the inlet and outlet;

air pressure after each compressor stage.

5.9.1.8.2 Upon completion of the tests, the compressor shall be inspected; while this is being done, the cylinder liners, pistons, crankshaft, main and connecting rod bearings, inlet and outlet valves shall be examined.

5.9.1.8.3 Upon completion of the inspection and correction of all the defects detected, the compressor shall be assembled with random verification of the component measurement and fixing measurement results, whereupon check tests shall be conducted with the necessary parameters being verified.

5.9.1.9 When conducting bench tests of the power-driven and direct-acting steam pumps, the requirements of 5.11 and those specofied below shall be taken as guidance.

5.9.1.9.1 Safety valves shall be checked.

5.9.1.9.2 The following parameters shall be recorded:

capacity;

suction pressure;

discharge pressure;

pumped medium temperature;

number of double strokes;

steam conditions and rate;

consumed power and characteristics of the prime mover for power-driven pumps.

5.9.1.9.3 Upon completion of the tests, the pump shall be inspected, while this is being done, the following components have to be checked: cylinder liners, piston, suction and discharge valves and rods as well as:

for power-driven pumps:

crankshaft;

main bearings;

connecting rod bearings;

guides, parallels;

gears, reduction gears;

for direct-acting pumps:

steam cylinder liners;

steam cylinder pistons;

steam cylinder rods;

slide valve and slide valve boxes.

5.9.1.9.4 The pumps shall be assembled with the component measurement and fixing measurement results being verified at random, whereupon the check tests shall be conducted with verification of the necessary parameters.

5.9.2 Centrifugal and rotary pumps and compressors.

5.9.2.1 Shafts.

During external examination of the finished shafts, it is necessary to make certain that:

treated surfaces for mounting the working elements of the pumps, half-couplings and linings, interference fits and working journals comply with the technical documentation;

concentricity of the surfaces, run-out of the half-coupling end face have been checked by an approved method.

5.9.2.2 Impellers and rotors.

During external examination of the finished impellers and rotors, it is necessary to make certain that:

treated surfaces for mounting and glands comply with the technical documentation;

mating of the mounting surface, run-out of the faces, concentricity

of the surfaces have been checked by an approved method;

impellers and rotors have been subjected to the dynamic or static balancing.

5.9.2.3 Casings.

During external examination of the finished pump casings, it is necessary to make certain that:

treated surfaces of the glands and joints have been made and checked in accordance with the technical documentation;

concentricity of the bores, perpendicular position of the bore axis to the end joining face have been checked by an approved methods;

casing is subjected to the hydraulic test in accordance with 5.1.9.

5.9.2.4 When mounting the centrifugal and rotary pumps and compressors, for the purpose of checking the mounting that meets the requirements of the documentation, it is necessary to make sure that:

required radial and axial clearances in the sliding bearings, glands, between the casing and impeller (rotor) have been established;

shaft has been aligned with the prime mover;

measurement results have been presented for the mounting done;

checks have been carried out by an approved method.

5.9.2.5 When conducting the bench tests of the centrifugal and rotary pumps, the requirements of 5.11 shall be taken as guidance, also, it is necessary to:

.1 check the starting characteristics of the prime mover;

.2 record the power consumption for the compressors in the range from the idling running until the limiting pressure is achieved;

.3 check the automatic devices for starting and shutting down the pumps at the specified pressures;

.4 check operation of the safety valves;

.5 record the following parameters:

capacity (for the compressors – medium at the normal conditions);

suction and discharge pressure;

medium temperature (for the compressors – at the inlet and outlet);

.6 in case of the self-priming pumps, operation under dry suction condition shall be checked with the time of air draw-off being determined;

.7 upon completion of the tests, the machinery shall be inspected with the examination, as a rule, of:

shafts;

impellers and rotors;

casings;

shaft journals (in case of sliding bearings);

.8 upon completion of the inspection and correction of the defects, the machinery shall be assembled and subjected to the check tests with the necessary parameters being verified.

5.9.3 Screw and gear pumps and compressors.

5.9.3.1 Shafts and screws.

During external examination of the finished shafts and screws, it is necessary to make sure that:

treated surfaces for mounting, heat treatment comply with the technical documentation;

concentricity of the surfaces, screw surface and teeth profiles, heat treatment of the working surfaces have been checked by approved methods.

5.9.3.2 Casings.

5.9.3.2.1 During external examination of the finished casings, it is necessary to make sure that:

treated surfaces for mounting the screw housings, bearings, pinions and joining surfaces comply with the technical documentation;

concentricity of the bores for bearings with the bores for the operator bodies, centre-to-centre distances of the bores for the operator bodies and bearings, parallelism of the bore axes and their perpendicular position to the end faces have been checked by approved methods.

5.9.3.2.2 The casing shall be subjected to the hydraulic test in accordance with the requirements of 5.1.9.

5.9.3.3 Screw housings.

5.9.3.3.1 During external examination of the finished screw housings, it is necessary to make sure that:

treated surfaces for mountings, centre-to-centre distances of the bores for the screws comply with the technical documentation;

concentricity of the bores, perpendicular position of their generatrices to the end faces, parallelism of the bore axes one to another and to the common axis and the centre-to-centre distances of the bores have been checked by approved methods.

5.9.3.3.2 The screw housings shall be subjected to the hydraulic test in accordance with 5.1.9.

5.9.3.4 Pinions.

During external examination of the finished pinions, it is necessary to make sure that:

treated surfaces for mounting and heat treatment comply with the technical documentation;

tooth shape, toothing contact and heat treatment have been checked by approved methods.

5.9.3.5 When mounting the screw and gear pumps and compressors, in order to determine whether the mounting has been properly carried out and complies with the working documentation, it is necessary to make sure that:

required radial and axial clearances between the casing (housing) and operator body (pinions, screws) have been established;

required centre-to-centre distances and toothing contacts have been maintained;

driving shaft has been aligned with the prime mover;

measurement results for the mounting carried out have been submitted by the technical supervision body;

checks have been carried out by approved methods.

5.9.3.6 When conducting the bench tests of the screw and gear pumps and compressors, the requirements of 5.11 and the following requirements shall be taken as guidance:

.1 to check operation of the safety valves;

.2 to record the following parameters:

capacity (for compressors – medium at normal conditions),

suction and discharge pressure;

medium temperature (for compressors – at the inlet and outlet);

.3 in case of the wide range control of the screw pump and compressor capacity, the power in the range from the idling running up to the limiting pressure shall be recorded and when the capacity is constant – the speci-fied operational power;

.4 upon completion of the tests, the machinery shall be inspected; whilst so doing, the following components shall be generally examined:

shafts and screws,

screw pump housings,

working spaces of the gear pumps,

gear pump casing covers,

pinions;

.5 upon completion of the inspection and correction of the defects detected, the machinery shall be assembled with the results of component measurements and fixing measurements being verified, whereupon the check tests shall be conducted with verification of the necessary parameters.

5.9.4 Oil fuel and lubricating oil separators.

5.9.4.1 Bowls and their shafts.

5.9.4.1.1 During external examination of the finished bowls and their shafts, it is necessary to make sure that:

treated surfaces for mounting and joints, including threaded ones, comply with the technical documentation;

concentricity of the treated surfaces, mating of the bearing surfaces including threaded ones, and flaw detection have been checked by approved methods.

5.9.4.1.2 The bowl in assembly and the shaft with the driven pinion shall be subjected jointly to the dynamic balancing.

5.9.4.2 Casings.

During external examination of the finished casings, it is necessary to make certain that:

treated surfaces for mountings and glands comply with the technical documentation;

alignment of the bores for the bearings of each one shaft, centre-to-centre distance of the bores and the angle at which the axes cross have been checked by approved methods.

5.9.4.3 Pinions.

During external examination of the finished pinions, it is necessary to make sure that:

treated surfaces including mounting ones and heat treatment comply with the technical documentation;

tooth shape, toothing contact, mounting surfaces and mating thereof, heat treatment have been checked by approved methods.

5.9.4.4 When mounting the fuel oil and lubricating oil separators, in order to determine whether the mounting has been properly carried out and complies with the requirements of the technical documentation, it is necessary to make sure that:

required centre-to-centre distances and toothing contact have been maintained;

assembled separator is readily turned by hand;

driving shaft has been aligned with the prime mover;

results of the mounting measurements have been submitted by the technical supervision body;

checks have been carried out by approved methods.

5.9.4.5 When conducting the bench tests of the fuel oil and lubricating oil separators, the requirements of 5.11 and 5.9.4.5.1 to 5.9.4.5.5 shall be taken as guidance.

5.9.4.5.1 During the tests the following shall be checked:

starting characteristics of the separator;

separation quality;

operation of the friction coupling;

operation of the brake lock;

manual and automatic discharge systems of the self-cleaning separators;

separator operation in the automatic mode according to a special program approved by the Register;

separator operation in the clarification and purification modes;

water consumption.

5.9.4.5.2 The following parameters shall be recorded during the tests:

pump capacity;

separator capacity;

temperature of the medium handled;

temperature of the washing water;

vibration and noise levels.

5.9.4.5.3 Tests shall be conducted on the fuel oil and lubricating oil at various viscosities to obtain the capacity recommended for the accepted viscosity.

5.9.4.5.4 Upon completion of the tests, the separator shall be inspected with examination of the following components:

bowl and its parts including verification of the results of the bowl inspection for likely flaws;

bowl shaft;

pinions;

friction coupling.

5.9.4.5.5 Upon completion of the inspection and correction of the detected defects, the separator shall be assembled with the results of the component measurements and fixing measurements being verified, whereupon the check tests shall be carried out with verification of the necessary parameters.

5.9.5 Gas turbochargers and air blowers.

5.9.5.1 Shafts and rotors.

During external examination of the finished shafts, rotors and their components (impellers, disks), it is necessary to make sure that:

treated surfaces for mounting, interference fits comply with the technical documentation;

concentricity of the surfaces and absence of the defects have been checked by an approved method;

completely assembled rotor has been subjected to the dynamic balancing.

5.9.5.2 Gland seals.

During external examination of the finished gland seals, it is necessary to make sure that:

surfaces for mounting and working surface comply with the technical documentation;

concentricity of the surfaces and radial clearance have been checked by an approved method.

5.9.5.3 Casings.

During external examination of the finished casings of the turbochargers, it is necessary to make sure that:

treated surfaces for mounting, joint planes comply with the technical documentation;

alignment of the bores, perpendicular position of the bore axis to the end faces and the axial and radial clearances have been checked by an approved method.

5.9.5.4 Bearings.

During external examination of the finished sliding bearings, it is necessary to make sure that:

treated surfaces for the seat and journals comply with the technical documentation;

concentricity of the treated surfaces, perpendicular position of their axis to the end faces have been checked and the metallography has been made by an approved method.

5.9.5.5 When mounting the turbochargers, for the purpose of meeting the requirements of the working documentation, it is necessary to make sure that:

.1 rotor has been placed in accordance with the technical documentation in respect to:

mating of the bearings to the seats;

mating of the bearings to the journals and the establishment of clearances;

check of the radial and axial clearances in the blading and gland seals;

checks have been carried out by an approved method;

.2 results of measurements for the mounting carried out have been sub-mitted by the technical control body.

5.9.5.6 When conducting the bench tests of the turbochargers, the requirements of 5.11 and 5.9.5.6.1 to 5.9.5.6.3 shall be taken as guidance.

5.9.5.6.1 The following parameters shall be recorded:

for the working medium:

flow rate, temperature and pressure at the inlet and outlet;

time of speed-up when changing from one mode to another (acceleration);

in case of simulation – the power consumed;

for the air:

delivery;

temperature and pressure at the inlet and outlet.

5.9.5.6.2 Upon completion of the tests, the turbochargers shall be inspected with the following components being examined:

shaft and rotors,

gland seals,

casings,

bearings.

5.9.5.6.3 Upon completion of the inspection and correction of the defects detected, the check tests shall be conducted with the parameters obtained being verified.

5.9.5.7 In case of the large-scale (serial) production of the turbochargers, the requirements of 5.11 and 5.9.5.7.1 to 5.9.5.7.2 shall be taken as guidance.

5.9.5.7.1 Tests of the prototypes of the turbochargers for the purpose of issuing Type Approval Certificate shall be conducted on an especially equipped bench during 1 h at the maximum allowable service temperature.

In well-grounded cases, these tests may be conducted on the engine for which the turbochargers are intended, when operating with an overload not less than 10 % of the rated output during 1 h.

5.9.5.7.2 Each turbocharger shall be subjected to tests at the maximum operational speed within 20 min.

In the well-founded cases, where there is a positive supervision experience over a long period of time, the duration of tests may be reduced to 10 min.

Tests may be conducted on the engine, if the turbocharger is a regular unit or will be such for similar engines. The duration of tests with the engine overload not less than 10 % of its rated output shall be at least 20 min.

Where a quality system meeting the approved standards is in prolonged and effective use in the turbocharger production, in deciding the number of specimens to be tested in a batch of similar turbochargers the statistical sampling principle may be used at the Surveyor's discretion.

5.9.5.8 When conducting the bench tests, the requirements for the air parameters as set out in 5.11 and 5.9.5 shall be taken as guidance and whilst so doing, the consumed power and engine characteristics shall be taken into account.

5.10 DECK MACHINERY

5.10.1 Supervision during the manufacture of the deck machinery shall be performed within the scope given in Table 5.10.1 and in accordance with the requirements of this Chapter.

Table 5.10.1

Nos	Item of technical supervision	Examination of materials, blanks, assemblies, components	Verification of accompanying documents, brands	Flaw detection	Hydraulic tests	Special tests	Bench tests
1	Deck machinery:						
	steering gear (engine)						+
	tillers of main and standby gear	+	+	+			
	steering segments	+	+				
	rudder stock yoke	+	+				
	cylinders	+	+		+		
	pinions, gear wheels and tooth rims	+	+	+			
	pistons with rods	+	+				
	fittings and piping	+	+		+		
	drive shafts	+	+				
	connecting pins of tiller drive	+	+	+			
2	Windlasses and anchor capstans:						+
	driving and intermediate shafts, spindles	+	+				
	chain sprockets	+	+				
	pinions, gear wheels of power drives	+	+	+			
	disengaging and safety clutches	+	+				
	band and disk brakes	+	+				
3	Mooring capstans and winches:						+
	spindles, output shafts	+	+				
	pinions, gear wheels of power drives	+	+				
	safety clutches	+	+				
	band and disk brakes	+	+				
4	Towing winches:						+
	output and intermediate shafts	+	+				
	pinions and gear wheels of power drives	+	+	+			
	towline tension governing devices and fairleads	+	+				
	brakes	+	+				
5	Boat winches:						+
	output and intermediate shafts	+	+				

Table 5.10.1 — continued

Nos	Item of technical supervision	Examination of materials, blanks, assemblies, components	Verification of accompanying documents, brands	Flaw detection	Hydraulic tests	Special tests	Bench tests
	pinions, gear wheels of power drives	+	+				
	automatic and hand brakes	+	+				
	stoppers	+	+				
6	Engine order telegraphs						+
7	Fans of machinery spaces, enclosed spaces and holds intended for carriage of vehicles, refrigerated spaces, fire extinguishing stations, cargo pump rooms, helicopter sheds, holds fitted for carriage of dangerous goods, storage battery rooms and containers	+	+				+
8	Motors and pumps of hydraulic systems:						+
	shafts, rotors	+	+				
	rods	+	+				
	pistons, plungers	+	+				
	casings	+	+		+		
	cylinders	+	+		+		
	fittings and piping	+	+		+		

5.10.2 Steering gear (engine).

5.10.2.1 Tillers of the main and standby gear.

During external examination of the finished tillers, it is necessary to make sure that:

treated surfaces for mounting on the rudder stock, interference fits and key ways comply with the technical documentation;

perpendicular position of the axis of bore for mounting to the end face, parallelism of the key way axes one to another and to the mounting bore axis, and for the hydraulic steering gear – perpendicular position of the tiller axis to the mounting bore axis have been checked by approved methods.

5.10.2.2 Steering segments.

During external examination of the finished steering segments, it is necessary to make sure that:

treated surfaces for mounting on the rudder stock, key ways, surfaces for fastening tooth rims, guides, where tiller rope is used, comply with the technical documentation;

perpendicular position of the mounting bore axis to the end face of the hub, parallelism of the key way axes one to another and to the mounting bore axis, parallelism of the generatrices of the surfaces for tooth rim to the rudder stock axis have been checked by approved methods.

5.10.2.3 Slides, yoke.

During external examination of the finished slides, it is necessary to make sure that:

treated sliding surfaces, surfaces for connection with the plungers, bores for mounting the hinge pivot bushes and tiller bushes comply with the technical documentation;

alignment of the bores for the hinge pivot bushes, perpendicular position of the pivot axes to the axis of the bore for the tiller bush, parallelism of the surfaces for connection with the plungers one to another and their perpendicular position to the sliding surface of the slide have been checked by approved methods.

5.10.2.4 Cylinders.

5.10.2.4.1 During external examination of the finished cylinders, it is necessary to make sure that:

treated surfaces for the gland seals and fastening comply with the technical documentation;

alignment of the bores, perpendicular position of the bore axis to the end faces have been checked by approved methods.

5.10.2.4.2 The cylinders shall be subjected to hydraulic test in accordance with the requirements of 5.1.9.

5.10.2.5 Pinions, gear wheels and tooth rims.

During external examination of the finished pinions, gear wheels and tooth rims, it is necessary to make sure that:

treated surfaces for mounting, interference fits and heat treatment comply with the technical documentation;

tooth shape, toothing contact, perpendicular position of the mounting bore axis to the end faces, heat treatment have been checked by approved methods;

stipulated flaw detection has been carried out by an approved method.

5.10.2.6 Pistons with rods.

During external examination of the finished pistons with rods, it is necessary to make sure that:

treated surfaces for mounting and gland seals comply with the technical documentation;

concentricity of the surfaces, mating of the mounting surfaces, alignment or perpendicular position of the mounting surfaces to the axis have been checked by an approved method.

5.10.2.7 When mounting the steering gear, in order to meet the requirements of the working documentation, it is necessary to make sure that:

hydraulic cylinders have been installed coaxially in pairs and their axis is parallel to the bearing surface of the slide and to the datum plane;

bearing surface of the slide is parallel to the bearing surface of the frame;

tiller axis is parallel, while the axis of bore for the rudder head is perpendicular to the datum plane;

mounting and tests of the hydraulic system comply with the technical documentation;

safety valves have been checked and adjusted;

input shaft of the reduction gear has been aligned with the prime mover;

required contact in the engagement of the output reduction gear shaft pinion with the tooth rim of the steering segment and their centre-to-centre distance have been provided;

for reduction gears, see 5.7.9;

results of the mounting measurements and checks have been submitted by the technical control body;

checks have been carried out by approved methods.

5.10.2.8 When conducting bench tests of the steering gear the requirements of 5.11 and 5.10.2.8.1 to 5.10.2.8.11 shall be taken as guidance.

5.10.2.8.1 Power supply units shall be tested under no-load conditions.

5.10.2.8.2 The electrical equipment of the steering gear shall be tested and subjected to inspection in accordance with the requirements of Section 10, Part V "Technical Supervision during Construction of Ships".

5.10.2.8.3 No-load test of the steering gear with the tiller (segment) being put over on both sides to positions which differ from one another by 5° up to the hard-over angle and from the hard-over angle to zero angle by each unit in turn and by joint action of the units, where envisaged, from each steering position.

5.10.2.8.4 Test of the steering gear at 50 % load with the tiller (segment) being put over to hard-over angles on each side by each unit in turn from the main steering position, 120 cycles each time.

5.10.2.8.5 Test of the steering gear at 100 % load with the tiller (segment) being put over to hard-over angles on both sides by each unit in turn from the main steering position, 10 cycles each time.

5.10.2.8.6 Pump unit supplied as a spare unit shall be tested together with the steering gear under the following conditions:

under no-load conditions with the inoperative steering gear;

under no-load conditions with the steering gear operating at hard-over angles during 5 cycles;

under full pressure load conditions.

5.10.2.8.7 When testing the steering gear, the following parameters shall be recorded:

power consumed;

oil pressure in the power and auxiliary systems;

oil and air temperature;

tiller deflection angles and time required to put the tiller over.

5.10.2.8.8 In case of four-cylinder steering gears, operation on two cylinders following the proposed scheme shall be checked.

5.10.2.8.9 When testing the steering gear, it is necessary to check:

oil temperature, oil level and electric motor overloading alarm;

operation of the safety valves;

zero position of the control.

5.10.2.8.10 Upon completion of the test, the steering gear shall be inspected with the following components being generally examined:

hydraulic steering gear:

tiller, slides with yoke, cylinders, pumps;

electric steering gear:

segment rack rims, pinions, reduction gear, switching clutches (devices).

5.10.2.8.11 Upon completion of the inspection and correction of the defects, the steering gear shall be assembled with random verification of the results of components measurements and fixing measurements and the check tests shall be conducted with the necessary parameters being verified.

5.10.3 Windlasses and anchor capstans.

5.10.3.1 Drive and intermediate shafts, spindles.

During external examination of the finished drive, intermediate shafts and spindles, it is necessary to make sure that:

treated surfaces for mounting, journals comply with the technical documentation;

concentricity of the mounting surfaces, journals and the mating of the mounting surfaces have been checked by approved methods.

5.10.3.2 Chain sprockets.

During external examination of the finished chain sprockets, it is necessary to make sure that:

treated surfaces for mounting, contact surfaces comply with the technical documentation;

concentricity of the surfaces, perpendicular position of the bore axis to the end faces, mating of the mounting surfaces and contact surfaces of the clutches have been checked by approved methods.

5.10.3.3 Pinions, gear wheels of power drives.

During external examination of the finished pinions, gear wheels of power drives, it is necessary to make sure that:

treated surfaces for mounting, interference fits, heat treatment comply with the technical documentation;

tooth shape, toothing contact, mating of the mounting surfaces, perpendicular position of the bore axis to the end faces, concentricity and heat treatment have been checked by approved methods;

stipulated flaw detection has been carried out by an approved method.

5.10.3.4 Disengaging and safety couplings.

During external examination of the finished driving and driven parts of the disengaging and safety couplings, it is necessary to make sure that:

treated mounting surfaces, contact surfaces of the driving and driven parts of the couplings comply with the technical documentation;

mating of the contact surfaces and seats, concentricity of the bores and perpendicular position of their axes to the end faces have been checked by approved methods.

5.10.3.5 Band and disk brakes.

During external examination of the finished brake components, it is necessary to make sure that:

friction band (lining) material, construction, tension components, contact surfaces comply with the technical documentation;

contact surfaces, mating and adjustment thereof have been checked by approved methods;

brake band drive rotates readily by the effort of one man and is provided with a device to adjust fit of the brake band to the drum.

All surveys and tests of the sensors and actuators depending on their principle of operation have been dealt with in the relevant parts of these Rules.

5.10.3.6 When mounting the windlasses and anchor capstans, it is necessary to make sure that:

shafts have been placed in the bearings mated to the seats and journals;

axes of the shafts related in pairs by toothing are parallel and provide the required centre-to-centre distance, including the driving shaft of the reduction gear with drive pinion;

required toothing contact has been provided;

driving shaft of the reduction gear is aligned with the prime mover;

anchor chain links have been properly placed in the sprocket pockets;

safety coupling has been adjusted for the allowable torque;

in the disengaging couplings the required contact has been provided, "engaged" and "disengaged" positions fixed;

generatrices of the enveloping or end surfaces of the stationary brake part are parallel to those of the enveloped or end surfaces of the rotating brake parts;

results of the fixing measurements and those of the checks have been submitted by the technical supervision body;

checks have been carried out by an approved method.

5.10.3.7 When conducting bench tests of the windlasses and anchor capstans, the requirements of 5.11 shall be taken as guidance, and also it is necessary to:

.1 check their operation under no-load conditions with the sense of rotation being changed during 30 min in each direction;

.2 test the brake for holding the sprockets under the maximum permissible static load during 10 min;

.3 check the operation of the safety coupling and switching coupling;

.4 test them at the maximum operating pull load and heaving-in speed during 60 min (30 min per sprocket);

.5 upon completion of the tests, the anchor machinery shall be inspected with the shafts and spindles, bearings, pinions and gear wheels of the reduction gear, disengaging and safety couplings and brakes being examined;

.6 upon completion of the inspection and correction of the defects detected, with the component measurement results being verified at random, carry out assembling and check tests with verification of the parameters relating to the pull, heaving-in speed and consumed power.

5.10.4 Mooring capstans and winches.

5.10.4.1 Spindles, output shafts.

5.10.4.2 Pinions, gear wheels.

5.10.4.3 Safety couplings.

5.10.4.4 Band and disk brakes.

5.10.4.5 Technical supervision regarding 5.10.4.1 to 5.10.4.4 shall be performed in accordance with the requirements of 5.10.3, as far as the similar components, mounting and bench tests are concerned.

5.10.5 Tow winches.

5.10.5.1 Output and intermediate shafts.

5.10.5.2 Pinions, gear wheels.

5.10.5.3 Brakes.

5.10.5.4 Technical supervision regarding 5.10.5.1 to 5.10.5.3 shall be performed in accordance with the requirements of 5.10.3, as far as the similar components, mounting and bench tests are concerned.

5.10.5.5 Towline tension governing devices, fairleads.

During external supervision of the finished towline tension governing devices and fairleads, it is necessary to make sure that:

contact surfaces and heat treatment thereof comply with the technical documentation;

all surveys of the sensors and actuators of the towline tension governing devices have been dealt with, depending on the principle of operation, in the relevant parts of the Rules;

final check of the machinery in operation has been carried out during the tests.

5.10.6 Boat winches.

5.10.6.1 Output and intermediate shafts.

5.10.6.2 Pinions, gear wheels of power drives.

5.10.6.3 Automatic and hand brakes.

5.10.6.4 Technical supervision regarding 5.10.6.1 to 5.10.6.3 shall be performed in accordance with 5.10.3, as far as the similar components, mounting and bench tests are concerned.

5.10.6.5 Stoppers.

Final check in operation shall be carried out during the bench test of the machinery.

The winches shall be tested by application of a static load that is 1,5 times greater than the maximum working load which shall be held by the brakes.

5.10.7 Engine order telegraphs.

During external examination of the engine order telegraph components and the telegraphs in assembly, it

is necessary to make sure that their construction and dimensions comply with the technical documentation with the fixed positions of the handles and indicators being provided.

5.11 ENGINE-ROOM MECHANICAL TELEGRAPHS

5.11.1 During external examination of the engine-room mechanical telegraph components and the telegraphs in assembly, it is necessary to make sure that their construction and dimensions comply with the technical documentation with the fixed position of the handles and indicators. During the survey the telegraphs are subject to bench tests.

5.12 BENCH TESTS

5.12.1 Bench tests shall be carried out according to a program approved by the Register. Prior to the bench tests commencement, the following documents shall be submitted to the Surveyor:

.1 document of the technical control body on readiness of the bench for test of the machinery and on calibration of the loading device;

.2 bench equipment layout agreed with the surveyors (systems, machinery, devices, instruments serving the bench);

.3 document of the technical control body on performance of the manufacturer's tests with presentation of the results for the controlled parameters;

.4 documents on the verification of the bench instrumentation or regular instruments;

.5 technical documentation for the manufacture and delivery of the product;

.6 test program;

.7 test procedure;

.8 description and operating instruction, the results of the component and fixing measurements, justification of the departures from the working drawings;

.9 machinery certificate;

.10 documentation on the related equipment when installed on the bench together with the machinery to be tested.

5.12.2 As a rule, interruption of the bench tests for more than 15 min due to faults will entail, depending on the cause, repetition of the interrupted operation, and in case of the renewal of the components, which are the items of the supervision, tests shall be repeated.

Based on the analysis of the causes of the test interruption, a conclusion shall be made about the arrangements to preclude the recurrence of the faults if they are not of sporadic nature.

If necessary, duration of the bench tests may be extended.

5.12.3 The test procedure shall be agreed upon with the Surveyor with due account of the operating instructions and bench equipment. All mounting and dismounting works shall be also performed according to instructions.

5.11.4 The inspection scope stipulated by the program may be changed by the Surveyor, depending on the test results and nature of the defects detected during the inspection.

5.12.5 Check tests after the inspection shall be conducted under the rated load conditions if the rated conditions and parameters are the basic ones in the operation of the machinery.

5.12.6 As a rule, the check test with the issuance of the documents in accordance with the RS Nomenclature is the closing stage of the survey for an item subject to technical supervision.

Exclusion of the check tests is subject to special consideration by the Register in each case.

5.12.7 The duration of the check tests stipulated by the program may be changed by the Surveyor, depending on the results of the bench tests and inspection.

5.12.8 The related equipment and its operational parameters shall be checked to the extent required for the bench tests of the supervised item, unless the related equipment itself is the subject of the bench tests. Check shall be carried out in compliance with the requirements of the Rules.

5.12.9 All the data necessary to issue the Register documents (manufacturer's documents for the material, components, related equipment, measurement results, etc.) shall be submitted for each supervised item.

5.12.10 If the technical supervision item has been presented to the Surveyor for conducting bench tests, all works on the machinery and on the bench shall be performed on agreement with the Surveyor.

5.12.11 The tests of a finished item shall be carried out in the following order:

.1 bench tests and inspection;

.2 check tests.

Satisfactory test results are a ground for issuance of the Register documents.

5.12.12 When conducting bench tests of the internal combustion engines and turbines, depending on the purpose thereof, the following peculiarities shall be taken into consideration:

.1 main internal combustion engines intended for driving the fixed pitch propellers (FPP) shall be tested according to the propeller curve under the ship free running conditions.

The methods of putting to the propeller curve and changing from mode to mode are subject to agreement with the Surveyor;

.2 main machinery (turbines) intended for driving the fixed pitch propellers and Voith-Schneider propellers

(VSP) may be tested according to the propeller curve and at constant governor setting with putting to the rated power at constant revolutions;

.3 where the system CPP – engine (reduction gear, disengaging coupling, etc.) has structural features affecting the test performance, the order of the tests shall be subject to special consideration by the Register;

.4 prime movers (turbines) intended for driving generators, compressors, pumps and similar machinery shall be tested at constant governor setting with putting to the rated power at constant speed;

.5 when checking the operation of the speed governors, consideration shall be given to stable maintenance of the speed at steady state as well as to the speed deviations and time of speed stabilisation during throwing on and off the loads which shall not fall outside the standards established by Rules for the Classification and Construction of the Sea-Going Ships;

.6 when checking the operation of the overspeed device or trip, consideration shall be given to the speed at which the device or trip is activated.

5.12.13 The bench tests shall be conducted under conditions close to operational ones, that is at the normal pressure of the working medium before the turbines, normal ignition and combustion pressure for the internal combustion engines, at various loads of the unit, for which purpose the bench shall be fitted with devices that provide acquisition of the required characteristics of the unit tested.

To be tested simultaneously with the turbines and internal combustion engines are all their regular supporting auxiliaries: pumps, coolers, filters, etc.

Serial turbines and ICE may be tested without the regular auxiliaries and equipment, except when these auxiliaries and equipment are attached to the turbine or ICE or are an integral part of the turbine or ICE systems within the machinery. The bench auxiliaries and equipment shall in such case have characteristics similar to those of the regular auxiliaries and equipment.

5.12.14 In the process of the tests, the surveyor shall make sure that all parts of the turbines and internal combustion engines operate without abnormal heating, knocking, vibration; all connections and joints are tight and sound.

5.12.15 The duration of the bench tests shall be assigned in compliance with Table 5.12.15, and along with that:

.1 in view of the conditions of using the ICE in service the scope of the tests may be extended;

.2 measurements of the parameters at the rated power shall be made two times at 30 min interval;

.3 duration of the test modes has been indicated at steady parameters;

.4 after the bench tests, the fuel supply systems of the main engines driving the propellers shall be adjusted so that the overload capacity cannot be reached in service;

.5 after the bench tests, the fuel supply systems of the ICE driving the main and auxiliary diesel-generators shall be adjusted so that operation at 110 % of rated power is possible in service, and that the governor characteristics including operation of the protection mechanism are ensured at any time.

5.12.16 During the check tests, the duration of operation at the rated power shall be equal to at least 25 % of the time indicated in Table 5.12.15, but in all cases not less than 30 min.

5.12.17 During the bench tests of the machinery jointly with the RC and RAC systems, it is necessary to be guided by the directions of Section 12, while conducting tests according to the program for the RC or RAC.

Table 5.12.15

Operation mode characteristics	Main ICE driving propellers		ICE driving main and auxiliary diesel-generators	Duration of tests of turbines, h, at rated power, kW					
Power in % of rated one	Speed in % of rated one	Duration of tests, h, not less than	Duration of tests, h, not less than	over 10000	below 10000	below 5000	below 1000	below 500	less than 200
110	103,2	0,5 — 0,75	0,5	1,0	1,0	1,0	0,5	0,5	0,5
100	100	1,0	1,0	16,0	12,0	8,0	6,0	4,0	2,0
90	Along propeller	0,5	—	—	—	—	—	—	—
75	curve	0,5	0,5	3,0	3,0	3,0	1,0	1,0	1,0
50		0,5	0,5	2,0	2,0	2,0	1,0	1,0	1,0
25		0,5	0,5	2,0	2,0	2,0	1,0	1,0	1,0
Idling		—	0,5	1,0	1,0	1,0	0,5	0,5	0,5
Astern		—	—	1,0	1,0	1,0	1,0	1,0	1,0
Starts		+	+	—	—	—	—	—	—
Reversals		+	—	—	—	—	—	—	—
Tests of governor and independent runaway protection		+	+	+	+	+	+	+	+
Tests of "shut-down device"		+	+	+	+	+	+	+	+

5.12.18 The test scope given in this Chapter pertains to the tests of the machinery in case of a stable production.

The prototypes of the machinery shall be tested on the bench according to a special program approved by the Register.

The scope and duration of the tests shall be assigned in each particular case, depending on the degree of the machinery refinement.

The scope and duration of the type tests of the ICE for issuance of Type Approval Certificate are considered in the Appendix to this Section.

5.12.19 The prototypes of the engines intended for the use on the life-boats, during the bench tests, in addition to the requirements imposed on the bench tests by 5.11, shall be checked for compliance with the re-quirements of 6.13.6 and 6.15.4, Part II "Life-Saving Appliances" of Rules for the Equipment of Sea-Going Ships.

5.13 REGISTER DOCUMENTS

5.13.1 When the results of surveying the product on the manufacturer's bench are positive, the Register documents shall be issued in accordance with the RS Nomenclature.

5.13.2 The results of testing the prototype or pilot sample shall be presented in the Report to be drawn up by the Surveyor. The Report shall contain a conclusion as to the possibility of permitting the product to be used on board ship and, if necessary, the conditions for permitting the products concerned to be used on board ships, when manufactured subsequently in accordance with the provisions of Section 1.

APPENDIX 1

PROGRAM OF TYPE TESTS OF THE IC ENGINES FOR ISSUANCE OF TYPE APPROVAL CERTIFICATE

1. General.

The present program has been drawn up on the basis of the IACS Unified Requirements M50.

Upon finalization of the development and approval of the technical documentation for a marine engine, one engine after the tests carried out at the manufacturer's shall be subjected to tests for the issuance of Type Approval Certificate within an appropriate scope indicated below.

The suitability for an engine to operate on heavy fuel oil shall be proved by the results of the appropriate tests on the manufacturer's bench, and as a last resort, on the first engine installed on board.

2. Tests carried out at the manufacturer's.

2.1 Normal conditions.

2.1.1 Tests at 25 %, 50 %, 75 %, 100 % and 110 % of the rated power:

along the nominal propeller curve and operation with constant governor setting (at constant speed) for propulsion engines;

at constant speed for engines intended for generating sets.

2.1.2 Tests at the limit points of the permissible operating range (these points shall be defined by the engine manufacturer).

2.2 Emergency operation conditions.

For turbocharged engines the achievable continuous output shall be determined in the case of turbocharger damage:

engines with one turbocharger, when rotor is blocked or removed;

engines with two or more turbochargers, when damaged turbochargers are shut off.

2.3 The main measured characteristics and parameters obtained during the manufacturer's tests including test hours at various load points shall be presented to the surveyor to the Register prior to type testing.

3. Tests for issuance of Type Approval Certificate.

3.1 The type tests shall be carried out according to a program approved by the Register in the presence of the surveyor. The results achieved shall be recorded in an appropriate Register Report (Form 6.3.18). Deviations from this program for the award of Type Approval certificate shall be agreed with the Register.

3.1.1 Load points.

Load points at which the engine shall be tested are shown in the power/speed diagram for the crankshaft (refer to Fig. 3.1.1).

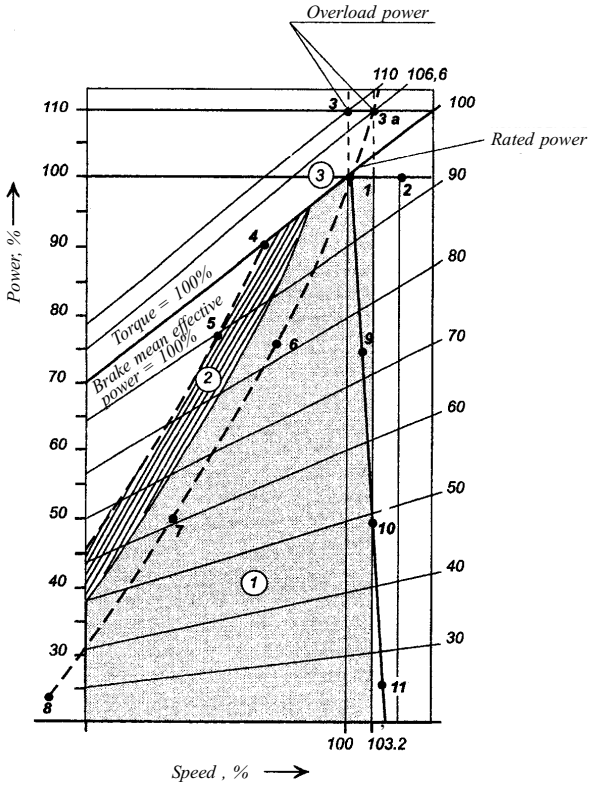


Fig. 3.1.1 Power/Speed Diagram:
1 – range of continuos operation;
2 – range of intermitted operation;
3 – range of short-time overload operation

The data to be measured and recorded when testing the engine at various load points shall include all necessary parameters for engine operation.

The operating time per load point depends on the engine size (achievement of steady-state condition) and on time for collection of the operating values, which, normally, can be assumed to be 0,5 h per load point.

At the rated power as per 3.1.1.1 the operating time of two hours is required. Two sets of readings shall be taken at a minimum interval of one hour.

3.1.1.1 Rated power, i.e. 100 % output at 100 % torque and 100 % speed corresponding to point *1*.

3.1.1.2 100 % power at maximum permissible speed corresponding to point *2*.

3.1.1.3 Maximum permissible torque (normally 110 %) at 100 % speed corresponding to point *3* or maximum permissible power and speed according to nominal propeller curve corresponding to point *3a*.

3.1.1.4 Minimum permissible speed at 100 % torque corresponding to point *4*.

3.1.1.5 Minimum permissible speed at 90 % torque corresponding to point *5*.

3.1.1.6 Part loads, e.g. 75 %, 50 %, 25 % of rated power and speed according to nominal propeller curve corresponding to points *6*, *7* and *8* and at rated speed with constant governor setting corresponding to points *9*, *10* and *11*.

3.1.2 Emergency operation.

Maximum achievable power when operating along the nominal propeller curve and when operating with constant governor setting for rated speed as per 2.2.

3.1.3 Functional tests.

3.1.3.1 Lowest steady engine speed according to nominal propeller curve.

3.1.3.2 Starting tests, for non-reversible engines and/or starting and reversing tests for reversible engines.

3.3.3 Governor test.

3.3.4 Testing the safety system, particularly for overspeed and low lubricating oil pressure.

N o t e. For engines intended to be used for emergency services, supplementary tests may be required by the Surveyor to the Register.

4. Component inspection upon completion of the tests.

Immediately after the test run, the following components of one cylinder for in-line engines and two cylinders for V-engines shall be presented for inspections:

piston removed and dismantled;

crosshead bearing, dismantled;

crank bearing and main bearing, dismantled;

cylinder liner;

cylinder head, valves disassembled;

control gear, camshaft and crankcase with opened covers.

N o t e. If deemed necessary by the surveyor to the Register, further dismantling of the engine for inspection of the components may be required.

5. Definition of IC engine type.

5.1 General requirements.

Engines are of the same type if they do not vary in any detail included in the definition in 5.2. When two engines are to be considered of the same type it is assumed that they do not substantially differ in design and their design details, crankshaft, etc., and the materials used meet the RS rules and are approved by the Register.

5.2 Definition

The type of internal combustion engine expressed by the Engine Builder's designation is defined by:

the bore,

the stroke,

the method of injection (direct or indirect injection),

the kind of fuel (liquid, dual-fuel, gaseous),

the working cycle (4-stroke, 2-stroke),

the gas exchange (naturally aspirated or supercharged),

the maximum continuous power per cylinder at maximum continuous speed and/or maximum continuous brake mean effective pressure,

the method of pressure charging (pulsating system, constant pressure system),

the charging air cooling system (with or without intercooler, number of stages),

cylinder arrangement (in-line, vee).

N o t e s: 1. After a large number of engines has been proved successfully by service experience, an increase in power up to maximum 10 % may be permitted, without any further type test, provided approval for such power is given.

2. One type test suffices for the whole range of engines having different numbers of cylinders.

APPENDIX 2

TYPE TESTING PROCEDURE FOR CRANKCASE EXPLOSION RELIEF VALVES

1. SCOPE

1.1 The Procedure specifies standard conditions for the type testing of crankcase explosion relief valves of internal combustion engines and reduction gears with use of methane gas and air mixture to confirm the Register's requirements.

1.2 The Procedure is only applicable to explosion relief valves fitted with flame arresters.

N o t e. Where internal oil wetting of a flame arrester is a design feature of an explosion relief valve, alternative testing arrangements developed by the valves manufacturer to confirm this procedure requirements may be used by agreement with the Register.

2. RECOGNISED STANDARDS AND NORMATIVE REFERENCES

The procedure has been developed on the basis of IACS Unified Requirements M66 (Jan 2005) (Corr.1 Nov 2005) (Rev. 2 Sept 2007) "Type testing procedure for crankcase explosion relief valaves". Where appropriate, the following normative documents may be used:

2.1 EN 12874:2001: Flame arresters – Performance requirements, test methods and limits for use.

2.2 ISO/IEC EN 17025:2005: General requirements for the competence of testing and calibration laboratories.

2.3 EN 1070:1998: Safety of Machinery – Terminology.

2.4 VDI 3673: Part 1: Pressure Venting of Dust Explosions.

2.5 IMO MSC/Circ. 677: Revised Standards for the Design, Testing and Locating of Devices to Prevent the Passage of Flame into Cargo Tanks in Tankers.

3. EXTENT OF VERIFICATIONS

3.1 Type testing of crankcase explosion relief valves provides for four main kinds of verifications according to 3.1.1 to 3.1.4.

3.1.1 Verification of flame arrester effectiveness.

3.1.2 Verification of valve closing after an explosion.

3.1.3 Verification of valve airtightness/gastightness after an explosion.

3.1.4 Determination of the level of overpressure protection provided by the valve.

4. EQUIPMENT OF TESTING LABORATORY

4.1 The testing laboratory carrying out type testing of crankcase explosion relief valves shall meet the requirements in 4.1.1 to 4.1.11.

4.1.1 The laboratory where testing is carried out shall be recognized by the Register and also to comply with the requirements of applicable national and international standards.

4.1.2 The laboratory shall be equipped so that it can perform and record explosion testing in accordance with this procedure.

4.1.3 The equipment for controlling and measuring a methane gas in air concentration within a test vessel shall ensure an accuracy of $\pm 0{,}1\%$.

4.1.4 The equipment shall be capable of effective point-located ignition of a methane gas in air mixture.

4.1.5 The pressure measuring equipment shall be capable of measuring the pressure in the test vessel in at least two positions, one at the valve and the other at the test vessel centre. The measuring arrangements shall be capable of measuring and recording the pressure changes throughout an explosion test at a frequency recognizing the speed of events during the explosion. The result of each test shall be documented by video recording and, if necessary, by recording with a heat sensitive camera.

4.1.6 The test vessel for explosion testing shall have documented dimensions. The dimensions shall be such that the vessel is not "pipe like" with the distance between dished ends being not more than 2,5 times its diameter. The internal volume of the test vessel shall include any standpipe arrangements.

4.1.7 The test vessel shall be provided with a flange, located centrally at one end perpendicular to the vessel longitudal axis for mounting the explosion relief valve. The test vessel shall be arranged in an orientation cosistent with how the valve will be installed in service, i.e. in the vertical plane or the horizontal plane.

4.1.8 A circular plate shall be provided for fitting between the pressure vessel flange and valve to be tested with the following dimensions:

.1 Outside diameter of 2 times the outer diameter of the valve top cover;

.2 Internal bore having the same internal diameter as the valve to be tested.

4.1.9 The test vessel shall have connections for measuring the methane in air mixture at the top and bottom.

4.1.10 The test vessel shall be provided with a means of fitting an ignition source at the position specified in 5.3.

4.1.11 The test vessel volume shall be as far as practicable related to the size and capability of the relief valve to be tested. In general, the volume shall correspond to the requirements in 2.3.5.5, Part IX "Machinery" of the Rules for the Classification and Construction of Sea-Going Ships, for the free area of the explosion relief valve to be not less than 115 cm^2/m^3 of the crankcase gross volume, i.e. the testing of a valve having 1150 cm^2 of free area would require a test vessel with a volume of 10 m^3. Where the free area of relief valves is greater than 115 cm^2/m^3 of the crankcase gross volume, the volume of the test vessel shall be consistent with the design ratio. In no case is the volume of the test vessel to vary by more than +15% to 10% from the design 115 cm^2/m^3 volume ratio.

5. EXPLOSION TEST PROCESS

5.1 All explosion tests to verify the functionality of crankcase explosion relief valves shall be carried out using an air and methane mixture with a volumetic methane concentration of 9,5% ± 0,5%. The pressure in the test vessel shall be not less than atmospheric and shall not exceed the opening pressure of the relief valve.

5.2 The concentration of methane in the test vessel shall be measured at the top and bottom of the vessel and these concentrations shall not vary by more than 0,5%.

5.3 The ignition of the methane and air mixture shall be made at the centreline of the test vessel at a position approximately one third of the height or length of the test vessel opposite to where the valve is mounted.

5.4 The ignition shall be made using a maximum 100 J explosive charge.

6. VALVES TO BE TESTED

6.1 The valves used for type testing (including testing specified in 6.3) shall be selected from the

manufacturer's normal production line for such valves by the Classification Society's representative witnessing the tests.

6.2 For type approval of a specific valve size, three valves shall be tested in accordance with 6.3 and 7. For a series of valves, in accordance with 9.

6.3 The valves selected for type testing shall have been previously tested at the manufacturer's works to demonstrate that the opening pressure is 0,05 bar ± 20 % and that the valve is airtight at a pressure below the opening pressure for at least 30 seconds. This test shall verify that the valve is airtight following assembly at the manufacturer's works and that the valve begins to open at the required pressure demonstrating that the correct spring has been fitted.

6.4 The type testing of valves shall recognize the orientation in which they are intended to be installed on the engine or gear case. Three valves of each size shall be tested for each intended installation orientation, i.e. in the vertical and/or horizontal positions.

7. TEST METHOD

7.1 The requirements of 7.1.1 to 7.1.5 shall be satisfied at explosion testing.

7.1.1 The explosion testing shall be witnessed by the Classification Society's Surveyor.

7.1.2 Where valves shall be installed on an engine or gear case with shielding arrangements to deflect the emission of explosion combustion products, the valves shall be tested with the shielding arrangements fitted.

7.1.3 Successive explosion testing to establish valve functionality shall be carried out as quickly as possible during stable weather conditions.

7.1.4 The pressure rise and decay during all explosion testing shall be recorded.

7.1.5 The external condition of the valves shall be monitored during each test for indication of any flame release by video and heat sensitive camera.

7.2 The explosion testing shall be in three stages for each valve that is required to be approved as being type tested.

7.2.1 Stage 1

7.2.1.1 Two explosion tests shall be carried out in the test vessel with the circular plate described in 4.1.8 fitted and the opening in the plate covered by a 0,05 mm thick polythene film. These tests establish a reference pressure level for determination of the capability of a relief valve in terms of pressure rise in the test vessel, see 8.1.6.

7.2.2 Stage 2

7.2.2.1 Two explosion tests shall be carried out on three different valves of the same size. Each valve shall be mounted in the orientation for which approval is sought, i.e. in the vertical or horizontal position with the circular plate described in 4.1.8 located between the valve and pressure vessel mounting flange.

7.2.2.2 The first of the two tests on each valve shall be carried out with a 0,05 mm thick polythene bag, having a minimum diameter of three times the diameter of the circular plate and volume not less than 30% of the test vessel, enclosing the valve and circular plate. Before carrying out the explosion test the polythene bag shall be empty of air. The polythene bag is required to provide a readily visible means of assessing whether there is flame transmission through the relief valve following an explosion.

Note. During the test, the explosion pressure will open the valve and some unburned methane/air mixture will be collected in the polythene bag. When the flame reaches the flame arrester and if there is flame transmission through the flame arrester, the methane/air mixture in the bag will be ignited and this will be visible.

7.2.2.3 Provided that the first explosion test successfully demonstrated that there was no indication of combustion outside the flame arrester and there are no visible signs of damage to the flame arrester or valve, the second explosion test without the polythene bag arrangement shall be carried out as quickly as possible after the first test. During the second explosion test, the valve shall be visually monitored for any indication of combustion outside the flame arrester and video records shall be kept for subsequent analysis. The second test is required to demonstrate that the valve can still function in the event of a secondary crankcase explosion.

7.2.2.4 After each explosion, the test vessel shall be maintained in the closed condition for at least 10 seconds to enable the tightness of the valve to be ascertained. The tightness of the valve can be verified during the test from the pressure/time records or by a separate test after completing the second explosion test.

7.2.3 Stage 3

7.2.3.1 Two more explosion tests are carried out as described in Stage 1. These further tests are required to provide an average baseline value for assessment of pressure rise, recognizing that the test vessel ambient conditions may have changed during the testing of the explosion relief valves in Stage 2.

8. ASSESSMENTS AND RECORDS

8.1 To confirm compliance of the valves used for explosion testing with the requirements of this procedure, the valves shall be assessed in accordance with 8.1.1 to 8.1.9 with the data documented.

8.1.1 Technical documentation for the valves to be tested shall be approved by the Register.

8.1.2 The designation, dimensions and characteristics of the valves to be tested shall be specified in the technical documentation and test reports. The data shall include the free area of the valve and of the flame arrester and the amount of valve lift at a pressure of 0,2 bar.

8.1.3 The test vessel volume shall be determined and recorded.

8.1.4 For acceptance of the functioning of the flame arrester, there shall not be any indication of flame or combustion outside the valve during an explosion test. This should be confirmed by the testing laboratory taking into account measurements from the heat sensitive camera.

8.1.5 The pressure rise and decay during an explosion shall be recorded, with indication of the pressure variation showing the maximum overpressure and steady underpressure in the test vessel during testing. The pressure variation shall be recorded at two points in the pressure vessel.

8.1.6 The effect of an explosion relief valve in terms of pressure rise following an explosion is ascertained from maximum pressures recorded at the centre of the test vessel during the three stages. The pressure rise within the test vessel due to the installation of a relief valve is the difference between the average pressure of the four explosions from Stages 1 and 3 and the average of the first tests on the three valves in Stage 2. The pressure rise shall not exceed the limit specified by the manufacturer.

8.1.7 The valve tightness shall be ascertained by verifying from the records at the time of testing that an underpressure of at least 0,3 bar is held by the test vessel for at least 10 seconds following an explosion. This test shall verify that the valve has effectively closed and is reasonably gas-tight following dynamic operation during an explosion.

8.1.8 After each explosion in Stage 2, the external condition of the flame arrester shall be examined for signs of serious damage and/or deformation that may affect the operation of the valve.

8.1.9 After completing the explosion tests, the valves shall be dismantled and the condition of all components ascertained and documented. In particular, any indication of valve sticking or uneven opening that may affect operation of the valve shall be noted. Photographic records of the valve condition shall be taken and included in the report.

9. DESIGN SERIES QUALIFICATION

9.1 The qualification of quenching devices to prevent the passage of flame can be evaluated for other similar devices of the identical type where one device has been tested and found satisfactory.

9.2 The quenching ability of a flame arrester depends on the total mass of quenching lamellas/mesh. Provided the materials, thickness of materials, depth of lamellas/thickness of mesh layer and the quenching gaps are the same, then the same quenching ability can be qualified for different sizes of flame arresters subject to (*a*) and (*b*) being satisfied.

$$(a)\ n_1/n_2 = S_1/S_2$$

$$(b)\ A_1/A_2 = S_1/S_2$$

where: n_1= total depth of flame arrester corresponding to the number of lamellas of size 1 quenching device for a valve with a relief area equal to S_1;

n_2 = total depth of flame arrester corresponding to the number of lamellas of size 2 quenching device for a valve with a relief area equal to S_2;

A_1 = free area of quenching device for a valve with a relief area equal to S_1;

A_2 = free area of quenching device for a valve with a relief area equal to S_2.

9.3 The qualification of explosion relief valves of larger sizes than that which has been previously satisfactorily tested in accordance with Sections 7 and 8 can be evaluated where valves are of the identical type and have identical features of construction subject to the conditions set forth in 9.3.1 to 9.3.3.

9.3.1 The free area of a larger valve does not exceed three times +5 % that of the valve that has been satisfactorily tested.

9.3.2 One valve of the largest size, subject to 9.3.1, requiring qualification is subject to satisfactory testing required by 6.3 and 7.2.2 except that a single valve will be accepted in 7.2.2.1 and the volume of the test vessel is not to be less than one third of the volume required by 4.1.11.

9.3.3 The assessment and records shall be in accordance with Section 8 noting that 8.1.6 will only be applicable to Stage 2 for a single valve.

9.4 The qualification of explosion relief valves of smaller sizes than that which has been previously satisfactorily tested in accordance with Sections 7 and 8 can be evaluated where valves are of the identical type and have identical features of construction subject to the conditions set forth in 9.4.1 to 9.4.3.

9.4.1 The free area of a smaller valve shall not be less than one third of that of the valve that has been satisfactorily tested.

9.4.2 One valve of the smallest size, subject to 9.4.1, requiring qualification is subject to satisfactory testing required by 6.3 and 7.2.2 except that a single valve will be accepted in 7.2.2.1 and the volume of the test vessel is not to be more than one third of the volume required by 4.1.11.

9.4.3 The assessment and records shall be in accordance with Section 8 noting that 8.1.6 will only be applicable to Stage 2 for a single valve.

10. THE REPORT

10.1 The testing laboratory shall submit a detailed report that includes the information and documents according to 10.1.1 to 10.1.8.

10.1.1 Specification or program for test performance.

10.1.2 Details of test pressure vessel and valves tested.

10.1.3 The orientation in which the valve was tested (vertical or horizontal position).

10.1.4 Methane in air concentration for each test.

10.1.5 Ignition source.

10.1.6 Pressure curves for each test.

10.1.7 Video recordings of each valve test.

10.1.8 The assessment and records stated in 8.

11. APPROVAL

11.1 The approval of an explosion relief valve is carried out by the Register based on the approved technical documentation, considering the approved program, assessment of test results and laboratory report on type testing performed.

APPENDIX 3

TYPE TESTING PROCEDURE FOR CRANKCASE OIL MIST DETECTION AND ALARM EQUIPMENT

1. SCOPE

1.1 The Procedure specifies the extent of tests to confirm that crankcase oil mist detection and alarm equipment fitted to internal combustion engines meets the Register's requirements.

Note: This Test Procedure is also applicable to oil mist detection and alarm equipment intended for gear cases.

2. RECOGNISED STANDARDS AND NORMATIVE REFERENCES

2.1 The Procedure has been developed on the basis of IACS Unified Requirement M67 (Jan 2005), (Corr. 1 Nov 2005), (Rev. 1 Oct 2006) "Type Testing Procedure for Crankcase Oil Mist Detection and Alarm Equipment".

Where appropriate, the following normative documents may be used:

IACS Unified Requirement E10 "Type Test Specification";

RS ND No. 2-040301-004 "Procedure for Testing and Drawing up Type Approval Certificates
for Electrical and Electronic Automation Equipment, Computers and Peripheral Facilities";

"Standards and Methods of Testing Automation Equipment" – Appendix to 12.4, Section 12,
Part IV "Technical Supervision during Manufacture of Products"".

3. EXTENT OF VERIFICATIONS

3.1 The procedure for type testing of crankcase oil mist detection and alarm equipment provides for the verification of:

3.1.1 Functionality of the system.

3.1.2 Effectiveness of oil mist detectors.

3.1.3 Accuracy of oil mist detectors.

3.1.4 Alarm set points.

3.1.5 Time delays between oil mist leaving the source and alarm activation.

3.1.6 Functional failure detection.

3.1.7 Influence of optical obscuration on detection.

4. TEST FACILITIES

4.1 The testing laboratory carrying out type testing of crankcase oil mist detection and alarm equipment shall meet the requirements of 4.1.1 to 4.1.2.

4.1.1 All the equipment for carrying out functional and other tests required by this Procedure shall be available for examination by the Register's Surveyor.

4.1.2 The testing laboratory that verifies crankcase oil mist detection and alarm equipment shall be equipped so that it can control, measure and record oil mist concentration levels in terms of mg/l to an accuracy of ± 10% in accordance with this Procedure.

5. TESTING OF CRANKCASE OIL MIST DETECTION AND ALARM EQUIPMENT

5.1 The range of tests shall include the following:

5.1.1 For the alarm/monitoring panel:

.1 functional tests according to Section 6;

.2 electrical power supply failure test;

.3 power supply variation test;

.4 dry heat test;

.5 damp heat test;

.6 vibration test;

.7 EMC test;

.8 insulation resistance test;

.9 high voltage test;
.10 static and dynamic inclinations.
5.1.2 For the detectors:
.1 functional tests according to Section 6;
.2 electrical power supply failure test;
.3 power supply variation test;
.4 dry heat test;
.5 damp heat test;
.6 vibration test;
.7 insulation resistance test;
.8 high voltage test;
.9 static and dynamic inclinations.

Note: See also 12.4 with Appendix to Section 12, Part IV "Technical Supervision during Manufacture of Products" of these Rules.

6. FUNCTIONAL TESTS

6.1 All the tests to verify the functionality of crankcase oil mist detection and alarm equipment shall be carried out in accordance with 6.2 to 6.6 with an oil mist concentration in air known in terms of mg/l to an accuracy of $\pm$ 10 %.

6.2 The concentration of oil mist in the test chamber shall be measured in the top and bottom of the chamber and these concentrations shall not differ by more than 10 % (also refer to 8.1.1.1).

6.3 The oil mist monitoring arrangements (devices) shall be capable of detecting oil mist in air concentrations of between 0 and 10 % of the lower explosive limit (LEL) or between 0 and a percentage corresponding to a level not less than twice the maximum oil mist concentration alarm set point.

Note: The LEL corresponds to an oil mist concentration of approximately 50 mg/l (~4,1% weight of oil in air mixture).

6.4 The alarm set point for oil mist concentration in air shall provide an alarm at the maximum level corresponding to not more than 5% of the LEL or approximately 2,5 mg/l.

6.5 Where alarm set points can be altered, the means of adjustment and indication of set points shall be verified against the equipment manufacturer's instructions.

6.6 Where oil mist is drawn into a detector via piping arrangements, the time delay between the sample leaving the crankcase and operation of the alarm shall be determined for the longest and shortest lengths of pipes recommended by the manufacturer. The pipe arrangements shall be in accordance with the manufacturer's instructions/recommendations.

6.7 Detector equipment that is in contact with the crankcase atmosphere and may be exposed to oil splash and spray from engine lubricating oil shall be demonstrated as being such, that openings do not occlude or become blocked under continuous oil splash and spray conditions. The manufacturer (laboratory)–developed arrangements for this type of tests shall be agreed with the Register.

6.8 Detector equipment may be exposed to water vapour from the crankcase atmosphere which may affect the sensitivity of the equipment and it shall be demonstrated that exposure to such conditions will not affect the functional operation of the detector equipment. Where exposure to water vapour and/or water condensation has been identified as a possible source of equipment malfunctioning, testing shall demonstrate that any mitigating arrangements such as heating are effective. The manufacturer (laboratory)–developed arrangements for this type of tests shall be agreed with the Register.

Note: This testing is in addition to that required by 5.1.2.5 and is concerned with the effects of condensation caused by the detector equipment being at a lower temperature than the crankcase atmosphere.

7. DETECTORS AND ALARM EQUIPMENT TO BE TESTED

7.1 The detectors and alarm equipment selected for the type testing shall be selected from the manufacturer's normal production line by the Register's Surveyor.

7.2 Two detectors shall be tested. One shall be tested in clean condition and the other in a condition representing the maximum level of lens obscuration specified by the manufacturer.

8. TEST METHOD

8.1 The following requirements shall be satisfied at type testing:

8.1.1 Oil mist generation shall satisfy the requirements of 8.1.1.1 to 8.1.1.5.

8.1.1.1 Oil mist shall be generated with equipment using an oil product of one brand (corresponding to SAE 80 or equivalent) and supplied to a test chamber having a volume of not less than 1 m^3. The oil mist produced shall have the maximum droplet size of 5 μm.

Note: The oil droplet size shall be checked using the sedimentation method.

8.1.1.2 The oil mist concentrations used shall be ascertained by the gravimetric deterministic method or equivalent.

Note: For this test, the gravimetric deterministic method is a process where the difference in weight of a 0,8 μm pore size membrane filter is ascertained from weighing the filter before and after drawing 1 litre of oil mist through the filter from the oil mist test chamber. The oil mist chamber shall be fitted with a recirculating fan.

8.1.1.3 Samples of oil mist shall be taken at regular intervals and the results plotted against the oil mist detector output. The oil mist detector shall be located adjacent to where the oil mist samples are drawn off.

8.1.1.4 The results of a gravimetric analysis are considered invalid and shall be rejected if the resultant calibration curve has an increasing gradient with respect to the oil mist detection reading. This situation occurs when insufficient time has been allowed for the oil mist to become homogeneous. Single results that are more than 10 % below the calibration curve shall be rejected. This situation occurs when the integrity of the filter unit has been compromised and not all of the oil is collected on the filter paper.

8.1.1.5 The filters require to be weighed to a precision of $\pm$ 0,1 mg and the volume of air/oil mist sampled to $\pm$ 10 ml.

8.1.2 The type testing shall be witnessed by the Register's Surveyor.

8.1.3 Oil mist detection equipment shall be tested in the orientation (vertical, horizontal or inclined) in which it is indended to be installed on an engine or gear case as specified by the equipment manufacturer.

8.1.4 Type testing shall be carried out for each type of oil mist detection and alarm equipment for which a manufacturer seeks type approval. Where sensitivity levels can be adjusted, testing shall be carried out at the extreme and mid-point level settings.

9. EQUIPMENT CONDITION ASSESSMENT AND DOCUMENTATION

9.1 Assessment of oil mist detection equipment after testing shall be carried out in accordance with the requirements in 9.1.1 to 9.1.3.

9.1.1 Technical documentation for the equipment (devices) being tested shall be approved by the Register.

9.1.2 The name of a manufacturer, type designation, oil mist concentration assessment capability and alarm settings shall be specified in test reports.

9.1.3 After completing the tests, the oil mist detection equipment shall be examined and the condition of all components noted in the test report which shall have equipment photographs attached.

10. DESIGN SERIES QUALIFICATION

10.1 If agreed by the Register, the approval of one type of detection equipment may be used to qualify other devices having identical design details what shall be confirmed by the manufacturer's relevant documentation.

11. THE REPORT

11.1 The testing laboratory shall submit a full report which includes the information and documents according to 11.1.1 to 11.1.3:

.1 description of the test process and test equipment;

.2 details of equipment tested;

.3 results of tests.

12. ACCEPTANCE

12.1 Crankcase oil mist detection equipment is accepted by the Register on the basis of the approval of technical documentation, reports and test reports of the laboratory with the type testing results.

12.2 To accept oil mist detection and alarm equipment, the documentation as per 12.2.1 to 12.2.4 shall be submitted.

12.2.1 Description of oil mist detection equipment and system including alarms.

12.2.2 Copy of the test report according to the requirements of Section 11.

12.2.3 Schematic layout of engine oil mist detection arrangements showing location of detectors/sensors and piping arrangements and dimensions.

12.2.4 Maintenance and test manual which shall include the following information:

.1 intended use of equipment and its operation;

.2 functionality tests to demonstrate that the equipment is operational and that any faults can be identified and eliminated;

.3 maintenance routines and spare parts recommendations;

.4 limit setting and instructions for safe limit levels;

.5 where necessary, details of configurations in which the equipment is and shall not be used.

6 SHAFTING COMPONENTS

6.1 GENERAL

6.1.1 The provisions of this Section apply during the technical supervision of the shafting components listed in the RS Nomenclature.

6.1.2 The Section lays down the procedure of technical supervision during the manufacture of the above mentioned items at the manufacturer's.

6.1.3 The procedure and scope of the checks, tests and surveys of the articles during the manufacture thereof are determined from Table 6.1.3, the requirements of this Section as well as from a list to be developed by the manufacturer in accordance with 12.2, Part I "General Regulations for Technical Supervision" and agreed with the RS Regional Branch office. When developing the list, the features of the manufacturing process adopted at the manufacturer's shall be taken into consideration.

Table 6.1.3

Items of technical supervision	Verification of technical documentation (see 6.1.8)	External examination	Verification of geometric dimensions	Flaw detection	Hydraulic test and check for tightness	Mating of shafts
Shafting:						+
thrust shafts	+	+	+	+		+
intermediate shaft	+	+	+	+		+
propeller (stern)[1] shaft	+	+	+	+	+[2]	+
propeller (stern)[1] shaft liner	+	+	+	+	+	
shaft couplings	+	+	+			+

[1] From here on, all the requirements for the propeller shafts and propeller shaft liners cover, respectively, the stern shafts and stern shaft liners as far as they are applicable.

[2] For liners consisting of two or more lengths to be welded on the shaft.

6.1.4 The construction of the shafts and their components shall comply with the approved technical documentation and meet the requirements of Part VII "Machinery Installations" of Rules for the Classification and Construction of Sea-Going Ships. The manufacture of the shafting, their components and assemblies and the production operations shall be carried out under the technical supervision of the Register in accordance with the approved technical documentation listed in Part I "Classification" of Rules for the Classification and Construction of Sea-Going Ships, as applied to the shafting.

6.1.5 The forms of the manufacturer's documents (measurement tables, requests for the presentation to surveying, etc.) shall be developed by the manufacturer or shipyard and agreed with the Register.

6.1.6 The inspection methods, tools and devices for measuring, testing and inspecting shall be determined by the manufacturer or shipyard, indicated in the process documentation and, where necessary, agreed with the Register.

6.1.7 The results of measurements made during the manufacture of the components shall encompass all measuring points, specified by the technical documentation, instructions for assembly, installation and operation of the shafting. The measurements shall be checked by the surveyor to the Register at random.

6.1.8 The materials, related equipment and components (blanks) used for the manufacture and completing of the items and products which have to be subjected to the technical supervision shall have marking (brands) and documents confirming the Register technical supervision during the manufacture thereof in accordance with the RS Nomenclature. Transfer of the Register brands and manufacturer's marking from the blanks during the treatment of the components shall be effected in compliance with the Instruction on Branding of Items Supervised by the Register (refer to Appendix 2 to Part I "General Regulations for Technical Supervision").

6.1.9 Prior to treatment, installation or assembling, the materials, components (blanks) and related articles shall be subjected to external examination in order to check their condition and compliance with the accompanying documentation. In specific cases, the examination and check shall be carried out by the Surveyor to the Register. During external examination, material, component or article shall be examined visually, with the accompanying documents as well as the manufacturer's certificates, measurement tables, flaw detection results and availability of the brands and marking being verified and checked.

Based on the external examination results and availability of the documents mentioned in 6.1.8, the possibility for launching production shall be explored.

6.1.10 Where the casting and forging defects must and can be corrected by welding, the requirements stated in the technical documentation shall be taken as a guide. The specifications of drawings shall indicate the method for correction of the defects, their nature, number and size, position of the defects or references to the guidelines and process documentation shall be made.

6.1.11 Machining and other types of treatments shall generally include heating and cold-work hardening. These shall be eliminated by heat treatment.

6.1.12 When conducting the hydraulic tests, it is necessary to be guided by the requirements of the technical documentation, defining the test conditions and by the requirements of 1.3, Part IX "Machinery" and 5.8, Part VII "Machinery Installations" of Rules for the Classification and Construction of Sea-Going Ships.

6.1.13 For the finished articles (components) a document shall be issued, which is defined by the technical supervision form. The need for the issuance of the Register certificate and for the branding of the articles is stipulated by the RS Nomenclature.

6.2 THRUST, INTERMEDIATE AND PROPELLER SHAFTS

6.2.1 The treated shafts shall comply with the requirements of the technical documentation and this Chapter.

6.2.2 During the manufacture of the shafts and upon finalization of their treatment, it is necessary to perform:

.1 check for the compliance of the material quality with the requirements of the technical documentation;

.2 heat treatment and verification of the flaw detection results;

.3 check for the roughness of the working surfaces;

.4 check of the dimensions and shape of the surfaces treated;

.5 check of the radial run-out of the shafts, axial run-out of the flange and collar planes of the thrust shafts, concentricity of the outer and inner surfaces or variable wall difference of the shafts;

.6 check of the section shape and key slot shape as well as check of the position of the axis of symmetry of the key slot in relation to the shaft and cone axis;

.7 check of the assembly and observance of the coaxiality when mating shafts, interferences and clearances in the joints;

.8 external examination of the shafts to detect likely surface defects.

6.2.3 After heat treatment, the propeller shaft forgings shall be generally subjected to ultrasonic inspection. On agreement with the Register, the ultrasonic inspection may be performed at any stage of the shaft manufacture.

The materials on the ultrasonic shaft test shall contain an appraisal of the test results.

6.2.4 The dimensions and cylindrical shaft surface shape errors shall be checked in two mutually perpendicular directions and in several sections along the length of the shaft portion to be checked. The number of sections shall be sufficient for precise determination of the dimensions and the shape of the shaft portion to be checked, but not less than two. Ovality in any section of the journal for bearings and conicity measured over the bearing length shall not exceed 50 % of the tolerance for the shaft journal diameter, unless the working drawings instruct otherwise.

6.2.5 The radial run-out shall be checked with the shafts slowly rotating.

The radial run-out of journals, cones and inoperative portions of the shafts whose journals rotate with peripheral velocity less than 10 m/s shall not exceed the values given in Table 6.2.5.

Where floating prisms capable of moving in a horizontal plane under the action of a bent shaft are used as the supports, the tolerances for the radial run-out are increased by 1,5 times.

The value of the limiting radial run-out shall be obtained by multiplying the values given in Table 6.2.5 by twice the distance, m, to the nearest end extremity of the shaft.

For the propeller shafts hardened by rolling-down, the radial run-out of the cone for the propeller with key shall not exceed the values accepted for the inoperative shaft portions.

Table 6.2.5

Shaft length to diameter ratio	Radial run-out of shafts, mm, with the check applied to		
	journals and cones at centres		inoperative lengths at centres and on supports
	on supports	per 1 m of length	
Above 5 up to 20	0,04	—	—
Above 20 up to 25	0,05	0,06	0,08
Above 25 up to 30	—	0,08	—
Above 30 up to 40	0,06	0,09	—
Above 40 up to 50	0,07	0,12	0,10

6.2.6 The axial run-out of the connecting flange surfaces, half-couplings or working surfaces of the thrust shaft collar shall be checked during rotation of the shaft mounted at the centres and on supports. The permissible axial run-out of the connecting surfaces as well as the thrust shaft collar surfaces shall not exceed: for shafts with the flange (collar) diameter up to 500 mm – 0,03 mm; over 500 and up to 800 mm – 0,04 mm and over 800 mm – 0,05 mm.

6.2.7 Non-plane nature of the connecting flange surfaces or of the working surfaces of the thrust shaft collar shall be checked by the straight-edge. Lack of convexity on the surface checked shall be checked by blue test with the use of the straight-edge. When the straight-edge is positioned in the centre plane or along the largest chord (in case of the collar checking), the non-blued spot may be only in the centre part of the area checked.

6.2.8 The conicity and rectilinearity of the generatrix of the conical shaft surfaces shall be checked by taper measuring rules whose length shall be not less than 0,7 the cone length. The rectilinearity of the generatrix can be checked by the straight-edge, and the total length of the blued surface (in percents of the cone length) for cones of 80-2000 mm in length shall be within 90 – 40 % (the specific values shall be determined by linear interpolation). Taper gauges may be used for blue test. In such case, the blue shall be uniformly distributed over

the entire surface and have the total area (in percents of the conical surface area) within 90 to 40 % for cones of 80 to 2000 mm in length (the specific value shall be determined by linear interpolation). Absence of the blue spots at the cone ends shall not be permitted. Scraping of the conical shaft surfaces shall not be permitted.

6.2.9 The methods of inspecting the key slots shall be established by the manufacturer depending on the adopted manufacturing processes and inspection means. The fit of the key mounted to the side surfaces of the key slot shall be checked by a feeler gauge, and the total clearance shall be within the tolerance for the key slot width.

6.2.10 The propeller shaft portions for fitting liners shall include tolerances for interference fit stipulated by the technical documentation. The portions may be treated for fitting according to the actual dimensions of the liner openings with the nature of such fitting fastening being observed.

6.2.11 Upon the finalization of machining, the propeller shafts are recommended to be subjected to superficial hardening by rolling-down. The hardening shall be carried out in way of the cone for the propeller boss, in way of the after flange including 1/3 of the fillet arc length and under the ends of each liner. The length of the portion to be hardened on the cone shall be half as great as the shaft diameter at the place of hardening, and in the remainder of the shaft portions – one shaft diameter.

6.2.12 Upon the final treatment of the cone opening and key slot, the flange half-couplings shall be fitted on the shaft and finished over the external diameters, connecting ends and centering grooves. The axial run-out in such a case shall not exceed the values given in 6.2.6 and the radial run-out – the values for the flanges given in 6.2.13.

6.2.13 The finally assembled, during mating, ship's shafts shall be aligned. When checking two assembled adjacent shafts at the centres on a bed with supports, the radial run-out of the journals shall meet the requirements of 6.2.6 (for a shaft of the total length) and the radial run-out of the flanges with diameters of 200 to 800 mm and over – 0,03 to 0,05 mm (the specific value shall be determined by linear interpolation).

When mating shafts without working journals, the run-out shall be checked over the external surfaces of the flanges. When mating shafts with the use of centering disks, the shafts shall be mounted relative to each other in such a manner that the axial run-out of the connecting surfaces gives rise to minimum break of the common axis of the shafts connected.

If there is a special instruction in the technical documentation, the flanges of the assembled shafts or half-couplings shall be machined to the same external diameter. Based on the results of coaxiality check, the relative position of the shafts shall be marked suitably on the flanges.

6.2.14 The bolted joints of the shaft flanges shall be such as to ensure the fit stipulated by the technical documentation. The holes for the bolts shall be finished jointly for the both flanges of adjacent shafts. Upon finishing, not more than one annular mark up to 1 mm in width and up to 0,3 mm in depth shall be accepted over the hole surface length of 15 mm.

6.2.15 Connection of the shafts with the use of flanged (key, keyless) and box couplings shall be effected with an assured interference fit by hydropress method. Keyless couplings including couplings with cylindrical connections may be fitted on shafts up to 200 mm in diameter using the heat method. Fitting of the couplings on shafts using hydropress method shall be effected according the design fitting parameters (force of mounting components in initial position, axial displacement, pressure of oil feed to the mated conical surfaces, force of the final press fit) and permissible deviations therefrom. In case of the heat method of fitting, the half-coupling heating temperature and axial displacement shall be assumed as the design parameters.

The reference point for the axial displacement of the half-coupling over the cone shall be determined in such a manner as this is indicated in 7.3.3 for the propellers.

The following deviations of the fitting parameters are permitted: axial displacement – from minus 2 up to plus 8 %; axial force during mounting an enveloping component in the initial position – from minus 5 up to plus 10 %; half-coupling heating temperature – from minus 5 up to plus 20 °C.

6.2.16 The finished shafts shall be subjected to the external examination. No lamination, cracks, black spots, backfins, rags, flowers, slag inclusions, sand marks, crazes, burrs and scratches shall be permitted on the shafts. The results of the shaft checks including the flaw detection results as well as the results of the measurements made shall be entered in the measurement tables (shaftline certificate, reports). Where the results of the checks, flaw detection and measurements are positive, a brand shall be put on the shafts and the Register certificate issued.

6.3 PROPELLER SHAFT LINERS

6.3.1 The finished liners including the water-proof coatings of the propeller shafts shall comply with the requirements of the technical documentation and of this Chapter.

6.3.2 The following checks, verifications and tests shall be performed during and upon the manufacture of the liners:

.1 check for compliance of the material quality with the requirements of the technical documentation;

.2 flaw detection;

.3 external examination of the liner before being shrunk on the shaft and after being finished on the shaft;

.4 verification of the dimensions providing an assured interference fit on the shaft;

.5 test of the liners for tightness before being shrunk on the shaft and of the built-up liners being welded on the shaft;

.6 check of the built-up liner joints;

.7 verification of the dimensions, shape and quality of the treated surfaces of the journals for stern bearings after finishing of the liners shrunk on the shaft;

.8 check for radial run-out of the finished liners on the shaft.

6.3.3 The liners shall be shrunk on the shaft in such a way as to provide interference fit. Attachment of the liners to the shaft by blunt bolts or other means, as well as sealing of the liner ends with the use of soldering, glueing up and similar methods shall not be permitted.

6.3.4 The treated liners or shells for the welded liners, before being shrunk on the propeller shaft, shall be subjected to the hydraulic test for tightness by a pressure of 0,2 MPa. The welds and adjacent zone (40 mm in width) of the liners welded outside the shaft, before the hydraulic tests for tightness, shall be subjected to the external examination, X-ray or gamma-ray inspection. The welds of the liners welded on the shaft shall be subjected to the dye penetrant inspection before being tested for tightness by air or oil at a pressure of 0,2 MPa.

6.3.5 The liner shrunk on the propeller shaft shall be subjected to the finishing, whereupon the roughness of the working surfaces, dimensions and shape errors of the liner cylindrical surfaces (ovality and conicity) as well as the radial run-out by the working journals for the stern bearings and gland seals as specified in 6.2.4 to 6.2.5 shall be checked. The finished external surfaces of the liners shall be checked visually for the absence of defects. In questionable cases, dye penetrant inspection or local etching shall be carried out with subsequent examination of the portion etched with the use of a magnifying glass.

6.3.6 The finished surfaces of the liners and the welds of the joined liners shall be free of defects affecting the proper performance of the stern tube.

Individual portions of fine porosity of not more than 50 mm^2 in area and individual gas cavities which diameter and depth do not exceed 3 mm in the number of not more than three per square decimetre may be permitted on the surfaces of the finished liners provided that the water-tightness is ensured. The total area of the said defects shall not exceed 1 % of the entire external surface of the liner. Fine porosity which does not affect the watertightness may be permitted on the internal surface of the liners or shells after treatment and fitting on the propeller shaft. The total area of such porosity shall not exceed 3 % of the internal surface area.

The following defects may be permitted in the welds of the joined liners: individual blow-holes up to 3 mm in size and slag inclusions up to 5 mm in size and not more than 5 mm^2 in area; chains of blow-holes up to 3 mm in length and non-continuous slag inclusions up to 5 mm in length and extending for not more than 20 % of the weld portion length inspected by radiograph; local accumulations of non-continuous blow-holes up to 3 mm in size and slag inclusions up to 4 mm on the weld portion not more than 20 mm in length. The total extension of all defects shall not exceed 20 % of the weld length inspected by radiograph. Individual cavities of 1 to 1,5 mm in size and up to 1 mm in depth, spaced at 10 to 15 mm may be permitted on the finished surface of the liner weld. The total number of such cavities shall not exceed five. Other defects not mentioned above shall be corrected. The possibility of correcting them is subject to special consideration by the Register in each case.

6.3.7 The shaft portions between the liners shall be protected by waterproof insulation. The waterproof insulation shall be smooth, even, free of sags, bulges, air inclusions. The external surface of the insulation shall be inspected visually. Check of the internal defects in the waterproof insulation and the defects between the shaft surface and insulation shall be carried out by methods approved by the Register. The portions of the waterproof insulation at the distance of 0,4 m but not more than the shaft diameter from the liner ends shall be inspected completely; the remaining portions – at random. The area of the portions to be inspected at random shall be not less than 20 % of the total area of the waterproof insulation.

6.4 CONNECTING BOLTS AND SHAFT COUPLINGS

6.4.1 During and upon completion of the manufacture of the couplings, it is necessary to carry out:

.1 check of the material quality and construction for the compliance with the requirements of the technical documentation;

.2 check of the dimensions providing the required fitting of the coupling on the shaft, and the bolts in flanged joints of the shaftline;

.3 check of the key slot geometry and the position of the key slot in relation to the coupling axis;

.4 check of the radial and axial run-out of the finished couplings;

.5 external examination of the couplings.

6.4.2 The bolts shall be manufactured according to the technical documentation approved by the Register.

6.4.3 The conical surfaces of couplings mated with the shafts shall be clean and rectilinear; ovality of the conical opening section shall not exceed 50 % of the tolerance value adopted for the cone base diameter. Check of the conical surfaces shall be carried out in accordance with the requirements of 6.2.8. Check of the key slots and key fitting shall be carried out in accordance

with the requirements of 6.2.9. Besides, the conical openings of the flange half-couplings shall be checked by fitting thereof on the cone of the mated shaft with the use of blueing. Check with the use of a taper gauge-plug shall be also permitted. During the check, the number of blue spots over the area of 25 × 25 mm shall be from one to five for the cones of 80 to 320 mm in length (the intermediate values shall be de-termined by linear interpolation). Where the cone length exceeds 320 mm, the number of blue spots on the same area shall be not less than 1.

6.4.4 Finishing and check of the flange half-couplings by the external cylindrical and end surfaces shall be performed with the half-couplings fitted on the shaft as required by 6.2.6, 6.2.12 to 6.2.13. The position of the half-couplings on the shafts and relative to each other shall be suitably marked.

6.4.5 The finished couplings shall be subjected to external examination. The results of the checks and measurements made shall be entered in tables (report, certificate).

6.4.6 The technical supervision during the manufacture of flexible, disengaging and sound-proofing couplings is subject to the special consideration by the Register in each case.

6.5 THRUST AND JOURNAL BEARINGS

6.5.1 The finished bearings shall comply with the requirements of the technical documentation approved by the Register.

6.6 STERN TUBE ARRANGEMENT

6.6.1 The finished tubes, bushes and stern bearings including strut bearings shall comply with the requirements of the technical documentation approved by the Register.

6.7 STERN TUBE SEALS AND GLANDS

6.7.1 The finished oil lubricated seals and water lubricated glands of the stern tube shall comply with the requirements of the technical documentation approved by the Register.

7 PROPELLERS

7.1 GENERAL

7.1.1 The provisions of this Section apply during the technical supervision of propellers, their assemblies and components listed in the RS Nomenclature.

7.1.2 The Section sets forth the procedure of the technical supervision during the manufacture of the above-mentioned supervised items at the manufacturer's.

7.1.3 General provisions for the arrangement of the technical supervision during the manufacture of the cited items are given in Part I "General Regulations for Technical Supervision" and those for the technical documentation – in Part II "Technical Documentation".

7.1.4 The procedure and scope of the surveys and tests of the supervised items during their manufacture and installation at the manufacturer's are defined from the list (refer to 11.2, Part I "General Regulations for Technical Supervision") drawn up by the manufacturer and approved by the RS Regional Branch office on the basis of the RS Nomenclature and also the requirements of Table 7.1.4.

When drawing up the list, account shall be taken of the peculiarities of the manufacturing process adopted at the manufacturer's.

7.1.5 Technical supervision during the manufacture of the propellers, their assemblies and components shall be performed in accordance with the requirements of Table 7.1.4, list and the RS Nomenclature.

7.1.6 The manufacture of the propellers, their assemblies and components and the manufacturing operations shall be performed under the technical supervision of the Register according to the technical documentation approved by the Register and listed in Part I "Classification" of Rules for the Classification and Construction of Sea-Going Ships, as applied to the propellers.

The construction of the propellers and components thereof shall comply with the approved technical documentation and meet the requirements of Part VII "Machinery Installations" of Rules for the Classification and Construction of Sea-Going Ships.

7.1.7 Forgings, castings and other blanks used for the manufacture and building-up of the propellers, shall have documents confirming their compliance with the approved technical documentation according to the technical supervision form stipulated by the RS Nomenclature.

Where the forgings, castings and other articles come without the Register documents, the feasibility of using them shall be subject to special consideration by the Register in each particular case.

Table 7.1.4

Nos	Item of technical supervision	Verification of technical documents	External examination	Verification of geometrical dimensions	Flaw detection	Balancing	Hydraulic tests, check for tightness	Bench tests	Inspection
1	Fixed pitch propellers (FPP):	+	+	+	+	+			
1.1	bosses	+	+	+	+				
1.2	blades	+	+	+	+				
2	Controllable pitch propellers (CPP) and supporting systems:	+	+	+		+	+	+	+
2.1	bosses	+	+	+	+				
2.2	blades	+	+	+	+				
2.3	hydraulic cylinders and pitch control unit shafts, servo motors in boss	+	+	+			+		
2.4	CPP components: slider blocks, push-pull rods, washers	+	+	+	+				
2.5	CPP control systems	+	+				+		
3	Voith-Schneider propellers	+	+	+			+	+	+
4	Steerable propellers	+	+	+			+	+	+

7.1.8 When finished components are delivered to an enterprise in conformity with a cooperation agreement, check shall be carried out for availability of the documents and brands according to the RS Nomenclature and technical supervision form. During the external examination of the propellers and their components, the following shall be checked: compliance of the documents and brands with the adopted supervision form, measurement cards, absence of defects.

7.1.9 Forgings, castings and other blanks of propellers shall be subjected to flaw detection by non-destructive methods in accordance with the requirements of the approved technical documentation.

7.1.10 Faulty portions corrected by welding and straightening shall be subjected, as a rule, to mandatory non-destructive inspection.

In particular cases, the inspection method shall be specified at the Register discretion.

7.1.11 After being finished, the propeller components shall have no surface and internal defects: cracks, cavities, slag inclusions, etc. The defects shall be corrected according to the practice adopted by the manufacturer. The ratings of the defects allowed to be corrected as well as the ratings of the defects allowed to be uncorrected, which occur on the finished propellers, bosses and blades are stated in the technical documentation approved by the Register, having regard to the Instruction for Correcting Defects of Propellers Made of Copper Alloys (refer to Appendix).

If the nature of defects and the method for correcting them do not comply with those stated in the approved documents, they shall be subject to special consideration by the Register.

7.1.12 Fastening parts (bolts, studs and pins) shall be manufactured in accordance with the technical documentation approved by the Register.

7.1.13 Fitting of the boss cone opening shall be checked against a gauge or shaft. The fitting quality shall be defined by the number of spots per the unitary area of the boss cone opening (not less than two over an area of 25×25 mm, unless the technical documentation for the propeller instructs otherwise).

7.1.14 After being machined and completely assembled, the FPP and CPP shall be checked for static balancing by a test load in conformity with the guidelines of the drawings, according to the Register standard (refer to 6.4, Part VII "Machinery Installations" of Rules for the Classification and Construction of Sea-Going Ships). In case of the detachable-blade propellers, check shall be carried out of the difference in mass between the regular and spare detachable blades according to the guidelines of the drawings.

7.1.15 Each propeller, except for the FPP, shall be tested on bench in accordance with a program approved by the Register.

7.1.16 Prior to the bench tests, mounting, alignment, clearances, contact in the components matched shall be checked, and the hydraulic tests and other inspection types carried out in accordance with the guidelines of the approved technical documentation.

7.1.17 Propellers undergone running-in according to the manufacturer's program and accepted by the inspection body shall be permitted for the bench tests.

7.1.18 Prior to the bench tests of the propeller, the following documents shall be submitted to the Surveyor to the Register:

.1 propeller record book or certificate filled in by as-built data (measurements of components, clearances, alignment, hydraulic tests, balancing, etc.);

.2 specifications, working drawings and test program approved by the Register;

.3 bench certificate or report of bench acceptance by the inspection bodies of the enterprise with the supporting system diagrams;

.4 certificates on the materials of the main propeller components and related equipment or other documents confirming technical supervision by the Register during the manufacture;

.5 flaw detection report.

7.1.19 Bench tests shall be carried out with regular equipment and shall be as close as possible to the shipboard conditions. Deviations from these requirements shall be subject to special consideration by the Register in each particular case.

7.1.20 Upon completion of the bench tests, the propeller assemblies shall be inspected in knock-down form.

The scope of the inspection shall be determined on the basis of the bench tests and agreed upon with the Surveyor to the Register.

7.1.21 The technical supervision during the manufacture of the hydraulic motors and pumps, piping and fittings, propeller automation equipment shall be performed in accordance with Sections 5, 8 and 12.

7.1.22 When the results of the survey and test are successful, the Register brand shall be put on the propeller and the Register certificate issued.

7.2 FIXED-PITCH PROPELLERS

7.2.1 General provisions concerning the technical supervision during the manufacture of the propellers are set forth in 7.1.

7.2.2 After the machining of the propeller, the documents of the inspection body with measurements of the geometric dimensions as well as measurements of the blade thicknesses at a radius equal to 0,6 the propeller radius and at the blade tip edges shall be submitted to the surveyor to the Register.

7.2.3 When a finished propeller is presented, the Surveyor shall check:

.1 static balancing;

.2 key way position and dimensions;

.3 fitting of the cone opening of the boss (if the propeller shaft or gauge is available).

During the external examination, particular attention shall be given to the roughness of the key way on side planes and cone opening of the boss.

7.2.4 The cone opening of the boss and key way may be machined with an allowance for complete fitting, which shall be stated in the documents issued.

7.2.5 When blades are fitted into the boss with a guaranteed interference ("cold"), the position of the blade in the boss shall be checked by the blade pitch with a tolerance stated in the drawings.

7.2.6 Regular and spare detachable blades shall be checked for interchangeability.

7.2.7 In the process of technical supervision during the manufacture of plastic propellers the following shall be taken as a guide:

.1 the documentation for the manufacture of plastic propellers shall be subject to special consideration by the Register;

.2 the propeller blades shall be selectively subjected to strength tests by a concentrated static load until dead break. The breaking static load Q_{br}, in N, shall be determined from the formula:

$$Q_{br} \geqslant K_f R_b$$

where K_f = safety factor equal to:
- 6 = for passenger and transport ships;
- 7 = for towing and fishing ships;

$R_b = \sqrt{P_b^2 + T_b^2}$ = resultant of hydraulic forces on the blade under operating conditions, N;

$P_b = P/z$ = blade thrust, N;

$T_b = M/(0{,}65Rz)$ = centrifugal force on blade, H;

$M = 9550N/n$ = shaft torque, N·m;

- N = propeller power, kW;
- z = number of blades;
- n = speed, min^{-1};
- R = propeller radius, m.

Notes: 1. The load is applied perpendicularly to the section chord at the radius $r = 0{,}65R$ at the point of intersection thereof with the blade centre line.

2. The formula is applicable for the detachable-blade propellers made of glass reinforced plastic up to 2 m in diameter.

3. The static breaking load Q_{br} for the propellers with a diameter over 2 m shall be subject to consideration in each particular case.

.3 each batch of the moulded material shall have the manufacturer's document with indication of the component composition and mechanical properties: tensile strength, compression strength, static bending strength; impact strength and modulus of elasticity;

.4 during the external examination, the quality of the manufactured propellers and blades shall be checked. There shall not be explicit whitening and blackening (indication of burning), cracks, cavities, laminations, waviness, folds, warping, etc. The allowable defects on the propellers and blades, their number and size shall be stated in the specifications or other approved documentation.

7.3 CONTROLLABLE-PITCH PROPELLERS AND THEIR SUPPORTING SYSTEMS

7.3.1 General provisions concerning technical supervision during the manufacture and tests of the propellers at the manufacturer's are set forth in 7.1.

7.3.2 The manufacture of the pitch control unit, piston, push-pull rod, hydraulic cylinder, pipes to supply oil to the boss, sliding shoes and other essential components of the CPP as well as the systems serving the CPP shall be performed in accordance with the requirements of the technical documentation approved by the Register.

7.3.3 Working spaces of the hydraulic cylinder shall be tested by hydraulic pressure indicated in the working drawings.

7.3.4 When assembling the CPP and its units in accordance with the guidelines of the drawings, the following shall be checked:

.1 clearances in the blade bearings, blade driving mechanisms, oil boxes and oil transfer blocks, actuators, hydraulic boosters, etc.;

.2 tightening and locking torques of the coupling bolts, studs or bolts for fastening thrust washers, blades and pitch control unit to the propeller shaft, nut of the propeller shaft half-coupling, hydraulic cylinder fastening, etc.;

.3 alignment of the piston, rod or the pipes to supply oil to the piston in the boss.

7.3.5 The requirements put forth in 7.2.2, 7.2.3 and 7.2.6 cover also the finished propellers.

7.3.6 Upon finalisation of all welding operations, the CPP shall be subjected to bench tests according to the program approved by the Register.

7.3.6.1 Prior to testing under load, "zero position", agreement in indications of the pointers of the remote pitch indicators and mechanical pitch indictor, actuators and feedback mechanisms shall be checked. The indications shall be read over the entire range of the blade turning-over from "full ahead' to "full astern" positions and back.

The agreement in indications of the pointers of the remote pitch indicator and mechanical pitch indicator shall be also checked at the rated speed.

7.3.6.1.1 During the bench tests of the non-rotating shaftline, the following shall be checked:

tightness of connection between the CPP and pipelines in accordance with the requirements of the technical documentation approved by the Register. During the test, the piston shall be sequentially moved to the fore and aft stops. No oil leaks shall be permitted;

safety devices which preclude the excess of the design pressure in the hydraulic system;

range of the blade turning;

lubricating oil pressure in the boss when the blades are turned over from "full ahead" to "full astern" positions and back;

operation of the local and remote control;

turning-over of the blades from "full ahead" to "full astern" positions and back, for which purpose the blades shall be turned over to both positions four times. Blades shall be turned over without jamming and additional efforts, the value of which shall be monitored by oil pressure in the hydraulic system and time of turning-over;

emergency locking of the blades in the ahead position.

7.3.6.1.2 During the bench tests of the rotating shaftline, the following shall be checked:

oil pressure in the hydraulic system which ensures reliable turning-over of the blades from "full ahead" to "full astern" positions and back, with measurements of time during operation of each pump, for which purpose the blades shall be turned over to both positions four times at the rated speed of the propeller shaft;

agreement in the positions of the control desk levers with those of the remote and local pitch indicators. The indications shall be read from the scale of the manoeuvring lever over the entire range of turning-over from "full ahead" to "full astern" positions and back. For the CPP with pneumatic and pneumo-hydraulic control, air and oil pressures in the control system and actuators and feed-back mechanisms shall be measured;

turning-on of the stand-by power supply unit of the hydraulic system when failure of the main power supply unit is simulated;

minimum oil pressure in the hydraulic system which ensures reliable turning-over of the blades;

blade turning-over to ahead position with simulation of failure of the CPP power hydraulic system or loss of power of the electric oil pumps of the power system as well as when remote control system fails or when there is a possibility of emergency setting and locking the blades in ahead position.

7.3.7 Bench tests of the CPP prototypes of fundamentally new designs shall be conducted with loading devices instead of regular blades. These devices shall provide not less than 110 % of the design load on the main blade turning parts.

The construction and calculations of the loading devices shall be presented to the Register for information.

The CPP with the loading devices, in case of stable production, shall be subject to special consideration by the Register.

7.4 VOITH-SCHNEIDER PROPELLERS

7.4.1 General provisions concerning the technical supervision during the manufacture and tests of the Voith-Schneider propellers (VSP) at the manufacturer's are set forth in 7.1.

7.4.2 When manufacturing and assembling the components and assemblies of the VSP, the following shall be checked:

.1 side clearances and contact patches in the reduction gears, axial and radial clearings in the bearings of the rotor and driving shafts, axial clearances in the support plates, in the vane thrust bearings;

.2 proper assembling and kinematics characteristics of the vane driving mechanisms;

.3 static balancing of the driving shafts in assembly with couplings and assembled rotors.

7.4.3 During the bench tests of the VSP, the following shall be obligatorily checked:

.1 with the non-rotating rotor:

tightness of the rotor and VSP housing seals;

tightness of the space outside rotor by the external hydraulic pressure with disconnected oil affluent system;

operation of the alarm, protection systems and the automatic devices;

.2 with the rotating rotor:

starting properties of the VSP by thrice-repeated starting with putting to the operating mode being checked;

operation of the automatic control by thrice-repeated shifting of the control lever from "full ahead" position to "full astern" position and back and from "starboard" position to "port" position and back;

reset of the control lever from all extreme positions "full ahead", "full astern", "starboard", "port" with the engine shut down;

operation of the remote control system and propeller controls with the vanes being turned over three times from the "full ahead" position to "full astern" position and back as well as from "starboard" position to "port" position and back;

accuracy in setting the eccentricity by thrice-repeated turning-over the vanes from "stop" position to each extreme position "full ahead", "full astern", "starboard", "port" and back.

Under the conditions of rated speed and maximum needle lift the vanes shall be turned over ten times from "full ahead" to "full astern" position and back, from "starboard" to "port" position and back.

7.5 STEERABLE PROPELLERS

7.5.1 General provisions concerning the technical supervision during the manufacture and testing of the steerable propellers at the manufacturer's are set forth in 7.1.

7.5.2 Propellers, pinions of the upper reduction gears (if any) and couplings shall be statically balanced.

7.5.3 When manufacturing the components and assemblies of the steerable propellers, the following shall be checked:

.1 side clearances and contact patches in the reduction gears;

.2 axial and radial clearances in the bearings of the reduction gear shafts;

.3 lifting, turning and blocking mechanisms.

7.5.4 During the bench tests of the steerable propellers, the following shall be obligatorily checked:

.1 with the non-rotating propeller:

tightness of the lower reduction gear at static oil affluent;

operation of the lowering, lifting and turning mechanisms;

.2 with the rotating propeller:

starting properties of the steerable propeller under local and remote control;

lifting, lowering and turning of the steerable propeller;

compliance of all parameters and characteristics with the approved documentation.

7.5.5 The scope of the bench tests of the steerable propellers shall be defined by the Register depending on their design features.

APPENDIX

INSTRUCTION FOR CORRECTING DEFECTS OF PROPELLERS MADE OF COPPER ALLOYS

1. General.

1.1 This Instruction establishes methods to correct defects of the FPP and CPP made of copper alloys.

1.2 The Instruction is intended for rectifying defects of the propellers detected in the process of manufacture, repair and operation thereof.

1.3 When developing technological processes for repairing the propellers, consideration shall be given to:

propeller material, its mechanical characteristics and weldability;

results of survey including non-destructive inspection;

position and mode of the defect or damage;

blade dimensions and safety factors.

2. Methods of exposing defects.

2.1 Defects located in the zone *A* (refer to Fig. 2.1) as well as in areas where porosity can be expected, shall be exposed visually and by the non-destructive inspection approved by the Register.

2.2 Roentgenography shall be used if the blade thickness does not exceed 160 mm.

2.3 Ultrasonic inspection may be used for the propellers made of CU3 and CU4 type copper alloys (refer to Tables 4.2.2.1 and 4.2.3, Part XIII "Materials" of Rules for the Classification and Construction of Sea-Going Ships).

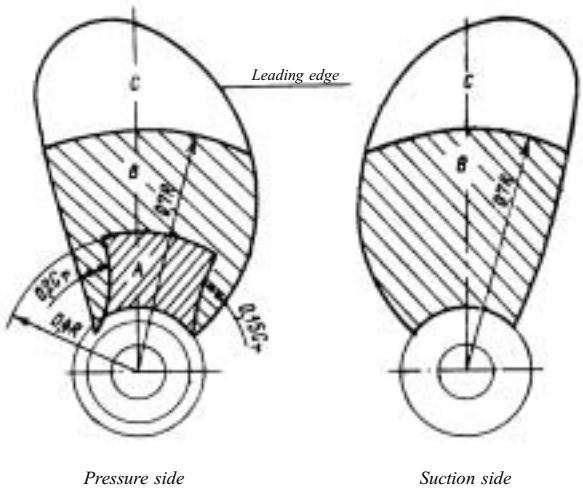


Fig. 2.1
Subdivision of the blade surface into zones:
R – propeller radius; C_r – chord length on radius

3. Correction of defects by mechanical methods.

3.1 Minor defects (porosity, pitting, oxide spots, etc) may be corrected by mechanical method with subsequent grinding. In this case, the transition from the defect correction area to the propeller blade shall be smooth.

3.2 Cold straightening of a bent blade may be performed only in cases where slight deflection of the blade edge up to 20° with the blade thickness at the bent portion not more than 20 mm.

3.3 Cold straightening of the blades with impact loads applied shall not be permitted.

3.4 Upon finalisation of the straightening of the propellers made of CU1, CU2 and CU4 type copper alloys (refer to Tables 4.2.2.1 and 4.2.3, Part XIII "Materials" of Rules for the Classification and Construction of Sea-Going Ships), the propellers shall be annealed at the temperatures indicated in Table 3.4.

Table 3.4

Propeller alloy type	Temperature, °C		
	Preheating	Annealing	Hot straightening
CU1	150 — 250	350 — 550	500 — 800
CU2	150 — 250	350 — 550	500 — 800
CU3	50 — 150	Not recommended	750 — 950
CU4	50 — 250	450 — 600	775 — 875

3.5 As a rule, before the blade straightening operation, the repaired place and surrounding area of 500 mm in width shall be heated. The recommended preheating temperatures are given in Table 3.4.

3.6 Preheating shall be gradual and uniform. No use of an oxyacetylene or oxypropane flame shall be permitted. An electric heating is recommended to be used.

3.7 During the hot straightening, the temperature shall be maintained within the range specified in Table 3.4 and be the same through the entire blade thickness.

The temperature shall be monitored by contact or radiation thermometers and by thermopencil.

3.8 Upon finalisation of the hot straightening of the blades, the propeller shall be allowed to cool down slowly. Whilst so doing, the propeller blades are recommended to be covered by asbestos mats.

3.9 Upon correcting defects, the corrected portions shall be subjected to visual examination as well as dye penetrant or fluorescent inspection.

4. Correction of defects by welding.

4.1 Welding shall be used for correcting such propeller defects which cannot be rectified by mechanical method.

Use of welding for correction of minor surface defects shall be avoided.

4.2 The peculiarities of correcting the propeller defects by welding shall be specified depending on the area (zone) of location thereof and the extent to which the defects affect the strength characteristics of the propeller. The entire propeller surface shall be divided into zones *A*, *B* and *C* (refer to Fig.2.1).

4.3 The defects in zone *A* shall not be corrected by welding. Each case of defect correction shall be subject to special agreement with the Register.

4.4 Correction of the defects in zone *B* by welding may be permitted following a technological process approved by the Register for a particular propeller.

4.5 The defects in zone *C* may be corrected by welding following typical technological processes of the propeller repair approved by the Register and under its technical supervision.

4.6 Weld preparation area shall be of smooth contour without acute and right angles, abrupt projections and hollows and shall be also thoroughly ground and dried.

Before being chipped out, the ends of non-through cracks shall be treated with a drill from 8 to 12 mm in diameter to a depth by 2 – 3 mm more that that to which the crack has propagated. The ends of the through cracks shall be drilled up all the way through.

4.7 During welding, the propeller blade shall be in horizontal position.

4.8 Correction of the defects by welding shall be performed by a welder of certified qualification.

4.9 It is recommended to use electrodes with special coating or to conduct gas-shielded welding operations by a method approved by the Register. Coated electrodes shall be heated before welding to a temperature recommended by the manufacturer thereof.

The defects in zone *C* may be corrected by gas welding.

4.10 When welding with preheating is used, it is recommended not to exceed the preheating temperatures, given in Table 3.4.

4.11 It is recommended to conduct welding operations slowly to avoid welding strains and development of cracks. Before the next weld is made, it is necessary to remove thoroughly the slag and possible contamination from the weld already made.

4.12 Upon correcting the defects by welding, heat treatment shall be carried out in accordance with the requirements of the technical documentation approved by the Register and of Table 3.4.

4.13 After correction of defects and finishing of the weld or deposit surface, the adjacent heat-affected area shall be checked both prior to heat treatment and thereafter. The check shall include visual examination as well as dye penetrant or fluorescent inspection.

Should the need arise, the Surveyor may require balancing of the propeller.

8 SYSTEMS AND PIPING

8.1 GENERAL

8.1.1 Application.

8.1.1.1 The provisions of this Section apply for the technical supervision during the manufacture of the system components listed in the RS Nomenclature at the shipyard and at the manufacturer's.

8.1.1.2 General provisions concerning the organisation of the technical supervision during the manufacture of system components are given in Part I "General Regulations for Technical Supervision" and those concerning the technical documentation – in Part II "Technical Documentation".

8.1.1.3 Pipes intended for the manufacture of the pipelines as well as the materials and related products used in the manufacture of the system components shall have documents stipulated by the RS Nomenclature.

8.1.2 Definitions and explanations.

System components are pipelines and individual portions thereof, flexible joints and expansion pieces, fittings of all types and purposes, detachable joints (nipple unions, slip-on sleeves, flanges, etc), fittings of air pipes, ventilation ducts and venting systems, spark arresters of exhaust gas systems and uptakes.

Pipeline portions are straight and bent pipes with and without welded on components.

8.1.3 Scope and procedure of surveying.

8.1.3.1 In general, the scope and procedure of surveying in the process of technical supervision during the manufacture of system components are specified in Table 8.1.3.1.

8.1.3.2 Irrespective of the survey scope prescribed by this Section, the technical supervision shall provide for periodic control over the technological processes affecting the product characteristics specified by the Register.

8.1.3.3 The scope and procedure of surveying prototypes and pilot samples (batches) of the products shall be established with due regard to Table 8.1.3.1 and the special requirements set out below. The results of surveying the prototype (pilot) sample shall be presented in the Report of surveying the prototype (pilot) sample.

8.1.4 Technical documentation.

8.1.4.1 The technical documentation for the items stated in the RS Nomenclature shall be approved by the Register.

8.1.4.2 The items included into the RS Nomenclature shall be permitted to be used for their intended purpose if the documents prescribed by the RS Nomenclature are available.

8.2 FITTINGS OF CLASSES I AND II PIPELINES AS WELL AS BOTTOM AND SIDE INSTALLED ON FOREPEAK BULKHEAD AND REMOTELY OPERATED FITTINGS

8.2.1 Technical supervision during the manufacture of the fittings of Class I and II pipelines as well as the bottom, side, installed on forepeak bulkhead and remotely operated fittings shall provide for checking:

.1 compliance of the materials used with the requirements of the technical documentation;

Table 8.1.3.1

Item of technical supervision	Inspection of materials used	External examination	Test by proof pressure	Inspection of welding processes	Check in operation
Fittings of classes I and II pipelines (as well as bottom, side, installed on forepeak bulkhead and remotely operated fittings)	+	+	+	—	+
Fittings of venting system, cargo vapour return system and air pipe system	+	+	—	+	+
Flexible joints (including expansion pieces)	+	+	+	+	—

.2 freedom of surface defects (cracks, fractures, blowholes, etc.) as well as defects at the attachments to pipelines);

.3 operation of the local and remote control gear;

.4 strength by hydraulic tests by a test pressure according to Section 21, Part VIII "Systems and Piping" of Rules for the Classification and Construction of Sea-Going Ships;

.5 tightness of closures by hydraulic tests of the fittings in assembly by design pressure.

8.2.2 The control, safety and measuring fittings as well as air pipe automatic closing devices shall be checked in operation to confirm compliance with the requirements of the technical documentation.

8.2.3 When checking the remotely operated fittings, it is necessary to make sure that the valves are capable of taking up position stipulated by the technical documentation, in case of the automatic control failure as well as that the indications "open" and "closed" have been positioned properly.

8.2.4 During the technical supervision of the prototype and pilot samples of the fittings, provision shall be made for supplementary check of the continuous operation thereof under vibration, at limiting temperature and pressure values, as well as their operation under other special conditions which depend on the purpose of the fittings.

8.3 CLASS III PIPELINE FITTINGS

8.3.1 After the manufacture, Class III pipeline fittings shall be delivered together with documents according to the RS Nomenclature.

8.3.2 Where the specifications for the order do not stipulate the purpose of the fittings, the technical supervision during the manufacture thereof shall be performed in accordance with 8.2.

8.4 FITTINGS OF VENTING SYSTEM AND AIR PIPES

8.4.1 Technical supervision during the manufacture of the valves of venting system of all types shall provide for checking:

.1 compliance of the materials used with the requirements of the technical documentation;

.2 freedom of surface defects, quality of the sealing and joining surface treatment, tightness of the fittings casings;

.3 compliance of the fittings construction with the technical documentation approved.

8.4.2 When surveying fittings equipped with flame arresters, attention shall be given to the compliance of the clear area of such fittings with the cross-sectional area of air pipes.

8.4.3 The air pipe automatic closing devices shall be tested in accordance with 21.4, Part VIII "Systems and Fittings" of Rules for the Classification and Construction of sea-Going Ships.

8.4.4 When surveying the pressure/vacuum valves and high-velocity venting devices, it is necessary to check at which pressure and vacuum values they come into operation.

8.4.5 The pressure/vacuum valves and high-velocity venting devices shall undergo type tests according to the requirements of IMO Circular MSC/Circ. No 677.

8.4.6 When surveying the prototypes of the fittings equipped with flame arresting gauze, the non-flammability of combustible mixture vapours at a specified temperature shall be checked.

8.5 MECHANICAL, FLEXIBLE JOINTS AND EXPANSION PIECES

8.5.1 Technical supervision during the manufacture of the mechanical, flexible joints and expansion pieces intended for the pipelines of systems being subject of the Register supervision shall provide for checking:

.1 compliance of the material trade marks with the requirements of the technical documentation;

.2 compliance of the structural features, dimensions and other characteristics of the products with the approved technical documentation;

.3 strength of the joints and expansion pieces subjected to a hydraulic test in accordance with 21.2, Part VIII "Systems and Piping" of Rules for the Classification and Construction of Sea-Going Ships;

.4 compliance of the mechanical joints with the requirements of 2.4.5, Part VIII "Systems and Piping" of Rules for the Classification and Construction of Sea-Going Ships.

8.5.2 When surveying the prototype and pilot samples of non-metallic flexible joints, it shall be necessary to check them for fire-resistance in accordance with 2.1.8, Part VIII "Systems and Piping" of Rules for the Classification and Construction of Sea-Going Ships.

8.5.3 The scope of the tests of the mechanical joints shall comply with the requirements of 2.4.5.12, Part VIII "Systems and Piping" of Rules for the Classification and Construction of Sea-Going Ships and the method of tests – with the requirements of 8.5.4 of this Chapter.

8.5.4 Type tests of mechanical joints.

8.5.4.1 Documentation.

The following documentation shall be submitted by the manufacturer for review and approval:

.1 full description of the product;

.2 cross-sectional drawing indicating dimensions for assessing the joint construction;

.3 full list of materials for all unit components;

.4 data on the product quality system implemented at the enterprise;

.5 draft test program;

.6 initial information:

maximum design pressure and vacuum,
maximum and minimum design temperature,
media conveyed,
purpose,
allowable axial, horizontal and angular deflections,
requirements for installation.

8.5.4.2 Materials.

The materials used shall meet the requirements of 2.4.5.4, Part VIII "Systems and Piping" of Rules for the Classification and Construction of Sea-Going Ships.

The manufacturer shall submit justified proof that all components are sufficiently resistant to the working medium at the design pressure and temperature.

8.5.4.3 Tests, procedures and requirements.

The aim of the tests is confirmation of the proper performance of the pipeline joints under prescribed service conditions. The scope and type of the tests, sequence of checks, number of test samples shall be approved by the Register depending on the joint type, its purpose and with consideration for the present requirements.

Unless otherwise specified, water or machine oil may be used as test medium.

8.5.4.4 Test program.

The requirements for testing the mechanical joints are set out in Table 8.5.4.

8.5.4.5 Sampling.

The test samples of the joints shall be taken from the production line or manufacturer's warehouse.

When a type series is represented by a considerable number of standard sizes, at least three test samples of each standard size shall be subjected to tests listed in Table 8.5.4.

8.5.4.6 Test unit.

The unit of a mechanical joint shall consist of the components taken in accordance with 8.5.2 and pipe lengths of a dimension acceptable for the joint.

If the pipe material can affect the joint characteristics, this shall be taken into account when choosing the pipes.

Unless otherwise specified, the length of the pipe sections intended for testing the joint shall be equal to at least five pipe diameters. Prior to assembly, the compliance of the joint components with the requirements of the technical documentation shall be confirmed. The test sample shall be installed in full compliance with the manufacturer's instruction. Additional adjustment of the joint not stipulated by the manufacturer shall not be permitted during the tests.

8.5.4.7 Criteria for assessment of the test results.

If the joint has not undergone all or part of tests mentioned in Table 8.5.4, the same tests shall be repeated on two identical units. Where the results of the repeated tests are unsatisfactory, the standard size concerned shall be considered as not withstanding the test.

8.5.4.8 Test methods.

Table 8.5.4

Test types	Joint types			References and notes
	Compression, screwed nipple and nipple unions	Sleeve		
		Fixed	Slip	
Tightness	+	+	+	8.5.4.8.1
Vibration (fatigue)	+	+	+	8.5.4.8.2
By fluctuating pressure[1]	+	+	—	8.5.4.8.5
By collapsing pressure	+	+	+	8.5.4.8.6
By tensile load	+	+	+	8.5.4.8.7
Fire-resistance	+	+	+	8.5.4.8.8 see 2.4.5.6
By vacuum	+[3]	+	+	8.5.4.8.9[4]
Assembly – disassembly	+[2]	+	—	8.5.4.8.10

Symbols:
+ required;
— not required.

[1] for systems operating under fluctuating pressure conditions.
[2] other than compression joints.
[3] other than joints with metallic sealing elements.
[4] only for suction portions.

8.5.4.8.1 Tightness test.

To verify that the unit has been properly assembled, all joints shall be subjected to the following tightness tests:

.1 test unit assembled with due regard for the manufacturer's recommendations shall be filled with liquid and deaerated.

Units with mechanical joints intended for longitudinal fixing of the pipe ends shall not fails due to axial loads.

In the event where ther is a drop in pressure or there os visual indication of leakage, the tests shall be repeated for two test pieces. If during the repeat test one test piece fails, the testing is reagrded as being failed.

Pneumatic tests may be permitted as an alternative to hydraulic tests;

.2 capability of the compression joints of retaining tightness when exposed to gaseous atmosphere shall be corroborated by pneumatic tests. The pressure shall be equal to the maximum design pressure or 7 MPa, whichever is less;

.3 if the tightness tests have been conducted in compliance with the procedure outlined in 8.5.4.8.1.1 with the use of gaseous atmosphere, repetition thereof with the use of procedure of 8.5.4.8.1.2 is not necessary.

8.5.4.8.2 Vibration (fatigue) tests.

To confirm the proper performance of the mechanical joints under effect of fatigue loads induced by vibration, they shall be subjected to vibration tests.

Upon completion of the tests, there shall be no leaks and other indications of damages.

8.5.4.8.3 Tests of compression and screwed nipple and nipple union joints.

Compression and screwed nipple and nipple union and other similar joints intended for rigid fixing of pipe ends which preclude angular or axial shifting thereof shall be tested in compliance with the procedure given below.

Two pipe lengths shall be assembled with the use of the joint tested. One end of the unit shall be rigidly fixed while the other end shall be connected to vibration set. The schematic assembly diagram of the test unit is given in Fig. 8.5.4.8-1.

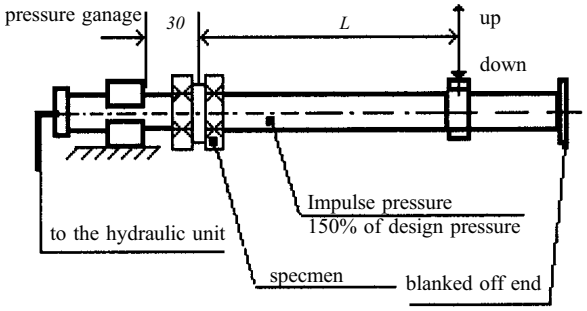


Fig. 8.5.4.8-1

The test unit shall be filled with liquid, dearated and the pressure therein shall be risen up to the design one. This pressure shall be maintained and monitored during the tests. Where pressure drop or leaks are detected, the tests shall be repeated as prescribed in 8.5.4.8.1.

The absence of damages which can at a later time give rise to leakages shall be confirmed by visual examination.

If necessary, after 1000 cycles re-compression of the joints shall be permitted.

The vibration amplitude shall be maintained with a deviation being not more than 5 % of the value determined from the formula:

$$A = \frac{2SL^2}{3ED}$$

where A = amplitude, mm,

L = pipe length, mm,

S = allowable bending stress equal to 0,25 the yield strength, N/mm^2,

E = elastic modulus of the pipe material (for low-carbon steel $E = 210$ kN/mm^2),

D = outside pipe diameter, mm.

The test sample shall withstand not less than 107 cycles with a frequency of 20 to 50 Hz without any leaks and damages.

8.5.4.8.4 Sleeve joints with retaining rings or with set grooves.

Sleeve joints incorporating elastic sealing elements shall be tested in accordance with the method outlined below.

Use may be made of the test bed of cantilever type used for the fatigue tests. The diagram of installation of the test sample on the bed is shown in Fig.8.5.4.8-2.

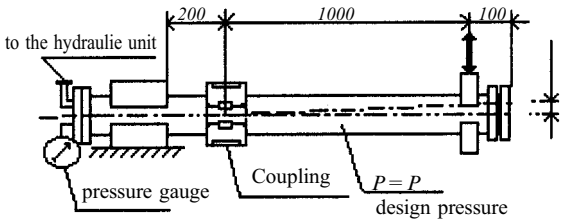


Fig. 8.5.4.8-2

Two pipe lengths shall be joined by means of the test sample. One end of the unit shall be rigidly fixed while the other end shall be connected to the vibration gear. The fixed pipe length shall be as short as possible and on no account shall exceed 200 mm.

Joints intended for rigid fixing of the pipe ends shall not be relieved from the axial loads.

The unit shall be filled with test liquid, deaerated, and the pressure therein shall be risen up to the design one. The preliminary angular deflection of the pipe axis shall correspond to the maximum deflection permitted by the manufacturer.

The oscillation amplitude shall be measured at a distance of 1 m from the support at the free pipe end connected with the rotating element (refer to Fig. 8.5.4.8-2).

The test parameters shall correspond to those given below:

The pressure during the tests shall be monitored. In case of development of leakage or pressure drop the tests shall be repeated in accordance with 8.5.4.8.1. The absence of defects shall be confirmed by visual examination.

8.5.4.8.5 Tests by fluctuating pressure.

These tests shall be carried out to confirm the proper performance of the mechanical joints under the effect of the fluctuating pressure. Rigid joints shall be tested in accordance with the present procedure. A test specimen undergone the test according to 8.5.4.8.1 may be used for the tests.

For compression, screwed nipple and nipple union joints, the vibration tests and tests by fluctuating pressure shall be carried out simultaneously.

The test unit shall be connected to pressure source capable of generating a fluctuating pressure in accordance with the diagram in Fig. 8.5.4.8-3.

The fluctuating pressure shall change from 0 up to 1,5 the design pressure with a frequency of 30 to 100 cycles per minute. The number of cycles shall be not less than 5×10^5.

Number of cycles	Amplitude, mm	Frequency, Hz
3×10^6	$\pm 0{,}06$	100
3×10^6	$\pm 0{,}5$	45
3×10^6	$\pm 1{,}5$	10

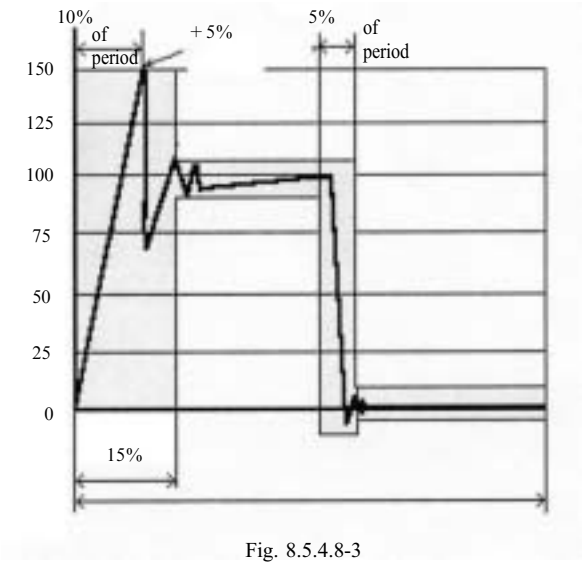


Fig. 8.5.4.8-3
Impulse pressure diagram

Absence of the leak and damage indications shall be confirmed by visual examination.

8.5.4.8.6 Test by collapsing pressure.

To confirm the capability of the mechanical joints of withstanding the pressure given in 2.4.5.5, Part VIII "Systems and Piping" of Rules for the Classification and Construction of Sea-Going Ships, they shall be subjected to tests by collapsing pressure.

The test unit shall be assembled with due account of the recommendations of 8.5.4.6, filled with test liquid, deaerated and loaded to test pressure at the pressure increase rate not more than 10 % per minute. Joints intended for rigid fixing the pipe ends shall not be relieved from the axial loads.

The time during which the unit shall be kept under the maximum pressure shall be not less than 5 min.

If necessary, test specimens undergone the tightness test in accordance with 8.5.4.8.1 may be used in these tests.

The deformation of the test sample may be permitted when subjected to test pressure with no visible damages or leaks.

8.5.4.8.7 Test by tensile load.

The test by tensile load shall be carried out to confirm the capability of the test sample of withstanding axial loads without disconnection from the pipe ends.

Two pipe lengths shall be connected through the test specimen. The test unit at the design pressure shall be subjected to tensile force determined from the formula:

$$L = \pi D^2 p/4$$

where D = outside pipe diameter, mm,
L = tensile force, N,
p = design pressure, N/mm^2.

Time during which the unit is kept under load shall be not less than 5 min. The pressure during the tests and relative position of the joint and pipe ends shall be monitored.

The specimen shall be checked for the lack of pressure drop, leaks or damages.

No movement of the joint in relation the pipe ends shall be permitted.

8.5.4.8.8 Fire endurance test.

In order to establish capability of the mechanical joints to withsrand effects of fire which may ne encountered in service, mechanical joints shall be subjected to a fire endurance test. The fire endurance test shall be conducted on the selected test specimen as per the following standards:

ISO 19921:2005(E): Ships and marine technology – Fire resistance of metallic pipe components with resilient and elastomeric seals – Test methods.

ISO 19922:2005(E): Ships and marine technology – Fire resistance of metallic pipe components with resilient and elastomeric seals – Requirements imposed on the test bench.

Clarification for standards requirements:

1. If the fire test is conducted with circulating water at a pressure different from the design pressure of the joint (however at least 0,5 MPa), the subsequent pressure test shall be carried out to twice the design design pressure.

2. A selection of representative nominal bores may be tested in order to evaluate fire-resistance of a series pf range of mechanical joints of the same design. When a mechanical joint with a given nominal bore DN shall be tested, then other mechanical joints falling in the range DN to 2DN (both inclusive) are considered accepted.

8.5.4.8.9 Vacuum tests.

To confirm proper performance of the mechanical joints at subatmospheric pressure, vacuum tests shall be conducted.

The test unit shall be connected to the vacuum pump and the pressure therein shall be decreased down to absolute pressure of 17 kPa. When the pressure becomes stable, the unit shall be disconnected from the vacuum pump and kept at the test pressure during 5 min.

The pressure value shall be monitored. No pressure rise shall be permitted.

8.5.4.8.10 Check of repeat unit.

The mechanical joint shall be installed and removed 10 times according to the manufacturer's instruction and then checked for tightness in accordance with 8.5.4.8.1.1.

8.6 SPARK ARRESTERS OF EXHAUST GAS SYSTEMS AND BOILER UPTAKES

8.6.1 Spark arresters shall be manufactured in accordance with the technical documentation approved by the Register. During the supervision, it is necessary to check:

.1 compliance of the materials, technological processes and scope of inspection of the welded joints with the approved technical documentation;

.2 tightness of the joints, closures, penetrations of pipes and fittings;

.3 availability of structural arrangements to provide effective spark arresting;

.4 availability of arrangements for clearing and draining tar;

.5 reliability of devices preventing in the wet type spark arresters water penetration into the engines and/or boilers;

.6 reliability of the measures to protect the insulation from damages.

8.7 PIPES

8.7.1 The pipes of the systems being subject to the technical supervision by the Register shall meet the requirements of Part XIII "Materials" of Rules for the Classification and Construction of Sea-Going Ships. The Register documents for pipes shall be issued in accordance with the guidelines of the RS Nomenclature.

8.7.2 Plastic pipes shall be tested in accordance with 21.5, Part VIII "Systems and Piping" of Rules for the Classification and Construction of Sea-Going Ships.

8.7.3 For obtaining a Type Approval Certificate for plastic pipes shaped components of the pipes and their joints the information specified below in 8.7.3.1 to 8.7.3.3 shall be submitted to the Register for consideration.

8.7.3.1 General information:

.1 pipe and fitting dimensions;

.2 maximum internal and external working pressure;

.3 working temperature range;

.4 intended services and installation locations;

.5 the level of fire endurance;

.6 electrically conductive;

.7 intended fluids;

.8 limits of flow rates;

.9 serviceable life;

.10 installation instructions;

.11 details of marking.

8.7.3.2 Drawings and supporting documentation:

.1 certificates and reports for relevant tests previously carried out;

.2 details of relevant standards;

.3 all relevant design drawings, catalogues, data sheets, calculations and functional descriptions;

.4 fully detailed sectional assembly drawings.

8.7.3.3 Materials:

.1 the resin type;

.2 catalyst and, accelerator types, and concentration employed in the case of reinforced polyester resin pipes or hardeners where epoxide resins are employed;

.3 a statement of all reinforcements employed where the reference number does not identify the mass per unit area or the tex number of a roving used in a filament winding process, these are to be detailed;

.4 full information regarding the type of gel-coat or thermoplastic liner employed

during construction, as appropriate;

.5 cure/post-cure conditions. The cure and post-cure temperatures and times employ resin/reinforcement ratio;

.6 winding angle and orientation.

8.7.3.4 Testing.

Testing for obtaining of Type Approval Certificate shall demonstrate compliance of pipes, fittings and joints with the requirements of Section 3, Part VIII "Systems and Piping" and 6.8, Part XIII "Materials" of the Rules for the Classification and construction of Sea-Going Ships for each type subject to approval. Specimens of pipes, fittings and joints shall be tested in accordance with the requirements of standards accepted by the Register as applicable. Recommended standards and requirements for conducting tests of plastic pipes and fittings are given in Table 8.7.3.4.

8.8 SHIP'S HOSES

8.8.1 Supervision during the manufacture of ship's hoses intended for taking over and transfer of chemical cargo, crude oil, petroleum products, fuel oil, oil, bilge water and dirty water ballast as well as for transfer of cargo vapours shall provide for:

check for the compliance of the trade marks of materials used for the manufacture of the hose sleeves with the requirements of the technical documentation with respect to the parameters specified by the RS rules;

test by hydraulic pressure equal to 1,5 the working pressure;

verification of the hose markings.

8.8.2 When surveying the prototypes, the following shall be checked:

resistance to the conveying medium;

resistance to fracture, attrition and exposure to solar rays and atmosphere, impermeability for sea water;

buoyancy;

exclusion of the possibility of spark formation during interaction of the end components and flanges with the ship's hull.

Hoses shall be subjected to hydrostatic tests in accordance with 6.2, Part VIII "Systems and Piping" of Rules for the Classification and Construction of Sea-Going Ships.

8.8.3 Sleeves for the cargo hoses shall be generally delivered with Type Approval Certificates. Where there are no Type Approval Certificates, the sleeves may be used for the manufacture of the hoses, provided that samples from each sleeve batch are subjected to test according to 6.2.1, Part VIII "Systems and Piping" of Rules for the Classification and Construction of Sea-Going Ships.

Table 8.7.3.4

It. No.	Testing	Recommended standards or paragraph of the Rules	Notes
Recommended standards and requirements for conducting of pipes for all systems			
1	Internal pressure	6.8.2 [1], ASTM D 1599, ASTM D 2992, ISO 15493	1, 2, 6, 7
2	External pressure	6.8.2 [1], ISO 15493	1, 2, 6, 7
3	Axial strength	6.8.3 [1]	1, 2
4	Load deformation	ASTM D 2412	1
5	Temperature limitations	6.8.5 [1], ISO 75 Method A	3
6	Impact resistance	ISO 9854, ISO 9653, ISO15493, ASTM D2444	4
7	Ageing	ISO 9142	4
8	Fatigue	Manufacturer's standards	4
9	Fluid absorption	ISO 8361	
10	Material compatibility	ASTM C581	5, 6
Recommended standards and requirements for testing of pipes depending on service and location onboard			
11	Fire endurance	Appendixes 1 and 2 to IMO Resolution A753 (18)	4, 5, 6, 7
12	Flame spread	3.3.2 [2]	4, 5, 6, 7
13	Smoke generation	[3]	4, 6
14	Toxicity	[3]	5, 6
15	Electrical conductivity	ASTM F1173-95 or ASTM D257	5, 6, 7

Notes: 1 The largest, the least and mean diameter of dimension-range are to be tested.
2. Tests are carried out on the assemblies of pipes and fittings of various sizes.
3. For each type of material.
4. For each type of structure.
5. For each type of joint.
6. If applicable.
7. To be carried out in the presence of the Surveyor.
References: [1] – Part XIII "Materials" of the Rules for the Classification and construction of Sea-Going Ships;
[2] – Part VIII "Systems and Piping" of the Rules for the Classification and construction of Sea-Going Ships;
[3] – International Code for Application of Fire Test Procedures.

9 BOILERS, HEAT EXCHANGERS AND PRESSURE VESSELS

9.1 GENERAL

9.1.1 The provisions of this Section apply during technical supervisions of boilers, heat exchangers and pressure vessels listed in the RS Nomenclature.

9.1.2 The Section contains requirements for the technical supervision during the manufacture of the mentioned supervised items at the manufacturer's.

9.1.3 General provisions concerning arrangement of the technical supervision during the manufacture of the supervised items are given in Part I "General Regulations for Technical Supervision" and those concerning the technical documentation – in Part II "Technical Documentation".

9.1.4 Related equipment and all materials including forgings and castings intended for boilers, heat exchangers, pressure vessels and the components thereof shall have documents confirming their compliance with the approved technical documentation. The documents for the products and materials shall be drawn up in accordance with the guidelines of the RS Nomenclature.

9.1.5 The scope and procedure of surveying in case of stable production of components, assemblies and products as a whole shall meet the requirements of Table 9.1.5, and the composition of the supervised items depending on their parameters shall be specified according to 1.3.2, Part X "Boilers, Heat Exchangers and Pressure Vessels" of Rules for the Classification and Construction of Sea-Going Ships.

9.2 TECHNICAL DOCUMENTATION

9.2.1 Boilers, heat exchangers and pressure vessels, their components and assemblies shall be manufactured and the production operations shall be performed under the Register supervision in accordance with the approved technical documentation listed in 1.3.4, Part X "Boilers,

Table 9.1.5

Nos	Item of technical supervision	Checking of					
		documentation for materials and extenal examination	component treatment	welding operatioons	manufacture of components and assembblies of products	product assembbling	Hydraulictests
1	Steam and waters heating boilers, thermal fluid boilers:			+	+	+	+
1.1	shells, end plates and drums	+	+	+	+		
1.2	headers and chambers	+	+	+	+	+	+
1.3	combustion chambers	+	+	+	+		
1.4	fire tubes	+	+	+	+		
1.5	boiler tubes and coils	+	+	+	+		+
1.6	boiler stays	+			+	+	
1.7	oil burner unit	+			+	+	
1.8	economizers	+				+	+
1.9	steam collectors (steam separators)	+	+	+	+	+	+
1.10	steam superheaters	+	+	+	+	+	+
2	Heat exchangers and pressure vessels:						
2.1	boiler feed heaters and deaerators	+				+	+
2.2	condensers of main turbines and electric generator turbines	+	+	+	+	+	+
2.3	condensers of auxiliary steam turbines	+	+	+	+	+	+
2.4	distillers					+	+
2.5	oil fuel and lubrication oil heaters	+				+	+
2.6	lubricating oil and water coolers of main and auxiliary machinery	+				+	+
2.7	air receivers	+	+	+	+	+	+
2.8	hydraulic accumulators	+				+	+
2.9	pressure vessels and heat exchangers of fire-fighting installations	+		+		+	+
3	Fittings:						
3.1	safety valves	+				+	+

Heat Exchangers and Pressure Vessels" of Rules for the Classification and Construction of Sea-Going Ships.

9.3 MATERIALS

9.3.1 Materials intended for the manufacture of the components and assemblies of boilers, heat exchangers and pressure vessels shall meet the requirements of the technical documentation approved by the Register.

Along with that, presence of the Register brands and compliance of the manufacturer's marking with the documents confirming the quality of this material shall be checked.

Where the marking does not comply with the submitted documents on the material or no brands are available, the surveyor to the Register has the right to require repeated tests of this material.

9.3.2 Material intended for the manufacture of the components and assemblies shall be checked by external examination for absence of defects (dents, hollows, cracks, etc.) which may be considered as an indication for rejecting the material.

9.3.3 The materials which shall be branded by the Register are specified in the RS Nomenclature.

9.3.4 The procedure for branding, transferring brands during treatment of the components is set out in the Instructions on Branding of Items Supervised by the Register (refer to Appendix 2 to Part I "General Regulations for Technical Supervision").

9.4 TREATMENT OF MATERIALS

9.4.1 Cold bending of steel plates shall be allowed to a radius not less than trice the plate thickness.

In case of cold bending of the steel shapes, the minimum bending radii r shall be as follows:

for angle bars $r \geqslant 50(a - 0{,}95s)$;

for channel along horizontal axis $r \geqslant 25h$;

for channel along vertical axis $r \geqslant 45h$

where a and s are the height and width of angle bar, respectively;

h is the height of channel.

9.4.2 After being drilled out, holes in the tube plates shall be checked to expose defects (cracks, lamination) and for the compliance of the dimensions of holes and tube plate portions between tubes with those indicated on the drawing.

The permissible deviations are given in Table 9.4.2.

Table 9.4.2

Diameter, mm		Permissible deviations		
		holes	straight tube plate portion between tubes	oblique tube plate portion between tubes
Tubes	29,0	±0,1	±0,5	±0,7
	44,5	±0,2	±0,7	±1,1
Holes	29,2	±0,1	±0,5	±0,7
	44,8	±0,2	±0,7	±1,1

The permissible deviations to the distance between the centres of the extreme holes shall not exceed ±3 mm, and between the axes of the extreme rows along an arc shall not exceed ±4 mm.

9.4.3 Heating of plates for forming, flanging, flaring and other similar work as well as the conditions and heating monitoring method shall comply with the practice approved by the Register.

The formed and flared parts and other components after hot treatment shall have no bursts, cracks, shoulders, crumples, folds, lamination, dents, etc.

9.5 WELDING

9.5.1 Prior to welding, edge preparation which shall be carried out in compliance with national standards or drawings approved by the Register shall be checked.

The surface of the edges shall be free of cracks, lamination and other defects.

9.5.2 Welding may be permitted after verification that the used welding consumables comply with the technical documentation approved by the Register; along with that, the welders shall have documents certifying their qualifications.

9.5.3 Welding of the components, their subsequent dressing and after-welding heat treatment shall be performed in compliance with the technological process approved by the Register.

9.5.4 Inspection of the welded joint quality shall be performed after heat treatment, if provided.

9.5.5 The scope of the butt weld inspection as well as the choice of the inspection method (external examination of the weld surfaces, mechanical tests of test assemblies and tests by non-destructive methods) shall comply with the technical documentation approved by the Register; the inspection scope shall be not less that that given in Part XIV "Welding" of Rules for the Classification and Construction of Sea-Going Ships.

9.5.6 When assessing the weld quality, the guidelines of Part XIV "Welding" of Rules for the Classification and Construction of Sea-Going Ships shall be taken as a guide.

9.6 CHECK OF MANUFACTURE OF THE PRODUCT COMPONENTS AND ASSEMBLIES. FITTING-UP

9.6.1 General.

9.6.1.1 Before assembly, the components of the products shall be checked for compliance with the drawing dimensions (plate thickness, flanging radii, hole pitch, etc.), markings and documents for them. The regularity of the spherical surfaces shall be checked by gauges; for edge preparation for welding refer to 9.5.1.

9.6.1.2 The components and assemblies shall be fitted up within tolerance for the clearances between elements according to the technical documentation approved by the Register.

9.6.1.3 In order to obtain the required mating between them, the components joined shall not be straightened through an excessive interference by bolts, tacks or mated in cold condition by blows.

If necessary, on agreement with the Surveyor to the Register, mating may be carried out by heating.

9.6.1.4 Deviations in dimensions given in this Chapter shall apply unless other tolerances for the manufacture and fitting-up of the product components and assemblies are specified in the technical documentation.

9.6.2 Manufacture of shells, end plates, tube plates.

9.6.2.1 Welded shells, end plates and tube plates shall be manufactured according to the production procedures and techniques developed by the manufacturer and approved by the Register.

9.6.2.2 After welding, the shell shall be calibrated to eliminate the shape distortions.

The deviations in dimensions of the shells (see Fig. 9.6.2.2) up to 3000 mm in diameter shall not exceed the following values:

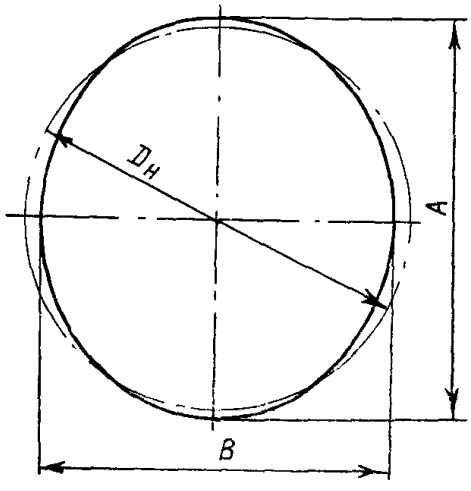


Fig. 9.6.2.2

for nominal outside diameter ΔD_o — $\pm 0{,}20$ %;

for relative ovality $(A-B)/D_o$ and at wall thickness $s \leqslant 30$ mm – 0,7 % and at $s >$ 30 mm – 0,45 %.

Skewness of the longitudinal weld in relation to the drum axis shall be not more than 2 mm per 1 m; shell sag – not more than 2 mm per 1 m.

9.6.2.3 After heat treatment and machining, the end plates shall be thoroughly examined. No bulges, dents, deep scores, metal thinning-out shall be permitted. Longitudinal scores of not more than 1 mm deep shall be permitted on the cylindrical part.

9.6.2.4 Deviations in dimensions of the stamped end plates shall be within the following limits (refer to Fig. 9.6.2.4):

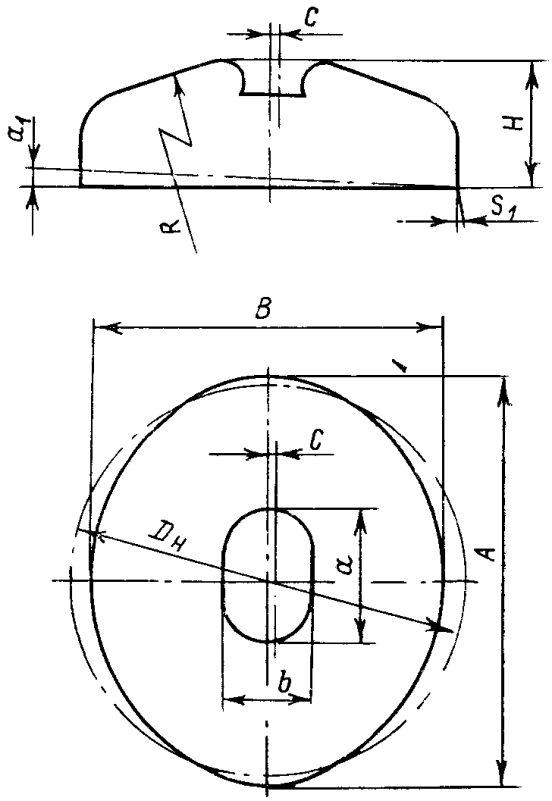


Fig. 9.6.2.4

as regards outside diameter ΔD_o — $\pm 0{,}20$ %;

as regards relative ovality $(A-B)/D_o$ – not more than 0,4 %;

as regards skewness of side edge a_1/D_o not more than 2,5 mm per 1 m;

as regards shoulder thickness s_1 — ± 10 %;

as regards manhole offset c — ± 5 mm;

as regards manhole dimension deviation, mm $\Delta a = {}^{0}_{-1,0}$; $\Delta b = {}^{+1}_{-3}$;

as regards end plate radius $\Delta R = \pm 0{,}5$ %;

as regards end plate height ΔH not more than $0{,}02H$, mm.

Deviations in the diameter of the forged end plates shall not exceed $\pm$1mm, and the manhole dimension $\pm 0{,}5$ mm.

9.6.3 Manufacture of headers and chambers.

9.6.3.1 Headers and chambers shall be manufactured according to the procedures and techniques developed by the manufacturer and approved by the Register.

9.6.3.2 Displacement of the abutting edges of the shell and end plates shall not exceed $a \leqslant 0{,}1s \leqslant 3$ mm, where s = wall thickness.

9.6.3.3 Nozzles, branch pieces and pads shall be welded to the header with preheating. In this case, offset of the holes and nozzles, branch pieces or pads shall not exceed ± 2 mm.

9.6.3.4 After assemblage and heat treatment, each header shall be subjected to hydraulic test in accordance with 9.7.

Upon finalization of the tests, the header shall be measured. Deviations in length Δl and deflection Δd of the header shall be within the following limits:

for headers up to 5000 mm in length

$$\Delta l = {}^{-5}_{+10};\ \Delta y = 2{,}0;$$

for headers of 5000 mm and over in length

$$\Delta l = {}^{-10}_{+20};\ \Delta y = 1{,}5.$$

9.6.4 Manufacture of boiler tubes and coils.

9.6.4.1 Equipment used for bending tubes shall provide a bent tube portion of a regular geometric shape.

The thickening of the tube wall shall not exceed 18 % at $R/d_0 < 2{,}5$. The relative ovality of the tube $\theta = 2(d_{0max} - d_{0min})/(d_{0max} + d_{0min}) \cdot 100$ shall not exceed 11 % at $R/d \leqslant 3{,}5$, and 8 % at $R/d > 3{,}5$ where d_o is outside diameter; R = bend radius.

For tubes made of steel of austenite class the relative ovality shall not exceed 5 %.

The minimum bend radius in case of cold bending shall exceed $2d_o$, in case of hot bending it shall exceed $1{,}5d_0$.

9.6.4.2 After bending, each tube shall be subjected to:

check for ovality by means of rolling a steel ball (the ball diameter shall be accepted according to standard);

check on a surface plate against a gauge to determine configuration and deviations in the bend radii which shall not exceed:

± 2 mm for tubes up to 32 mm in diameter and

± 3 mm for tubes of 32 mm and over in diameter;

visual examination to make sure that no surface defects (dents, scores, etc.) exist;

hydraulic test according to the RS rules.

9.6.4.3 Flat and cylindrical coils for the boilers and heat exchangers shall be manufactured according to the procedures and techniques of the manufacturer approved by the Register.

After manufacture and heat treatment the coils shall be measured and subjected to the hydraulic tests in accordance with 9.7.1.

The deviations in dimensions of the coils shall be within the limits given in Table 9.6.4.3

Table 9.6.4.3

Coil type	Permissible deviations, mm		
	in outside diameter ΔD_3	in coil radius, ΔR	in coil pitch, Δt
Pancake	± 10	± 5	± 4
Cylindrical:			
for heaters	± 5	± 3	± 3
for steam boilers	± 3	± 2	± 1

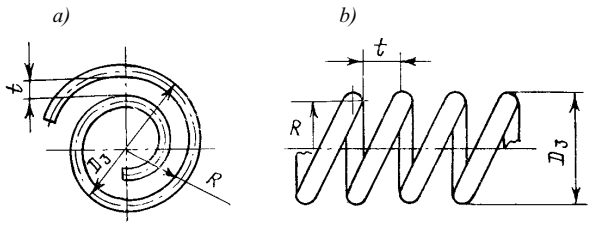


Fig. 9.6.4.3

Ovality of the coils shall be checked by means of rolling a steel ball of a diameter equal to 0,8 the inside diameter of tube.

9.6.5 Manufacture of fire tubes, combustion chambers and fastening elements.

9.6.5.1 Corrugated fire tubes shall be manufactured according to the procedures and techniques of the manufacturer, approved by the Register.

9.6.5.2 Corrugated fire tubes with through cracks or wall thinning at flanging by more than 2 mm shall not be accepted.

Correction of slight tears up to 2 to 3mm on the corrugated surface of the fire tube shall be allowed when using procedures and techniques approved by the Register.

9.6.5.3 The following deviations are permitted in the fire tube dimensions: in wall thickness $^{+10\%}_{0}$, in length $=^{+15\%}_{0}$, in ovality – 1 % of the mean diameter.

9.6.5.4 Bents and unevenesses on the surface of flat end plates and tube plates shall not exceed 0,2 % of the diameter or the greatest dimension of a rectangular tube plate.

9.6.5.5 The correctness of the stay installation and the length of the protruding parts shall be checked by external examination. Tightness of the welds shall be checked during the hydraulic test of the boiler.

9.6.6 Boiler shell fit-up.

9.6.6.1 When installing headers, the correctness of their positions shall be checked against axes and dimensions between centres. Deviations (refer to Fig. 9.6.6.1, *a* and *b*) shall not exceed the following values:

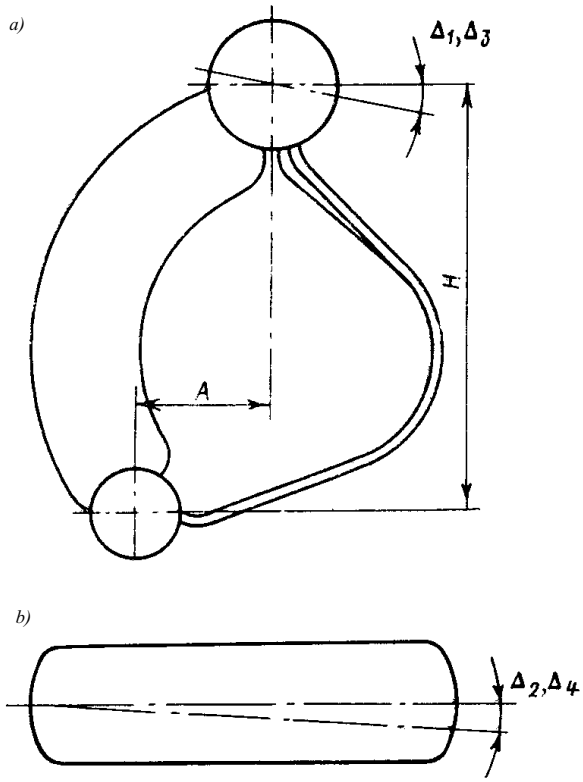


Fig. 9.6.6.1

between the header axes, horizontally $A \pm 2$ mm, vertically $H \pm 5$ mm;

turn of the horizontal header axis Δ_1 – 3mm per 1 m;

slope of the longitudinal header axis Δ_2 – 0,35 mm per 1 m.

9.6.6.2 Before being installed in boilers, the tube ends shall be cleaned off bright over a length of about 100 mm and the end edges dulled. When the tubes are fastened by flaring, their ends shall be annealed before cleaning.

The external surface of the tubes shall be free of blisters, cracks, cavities, dents, scores, etc. Particular attention shall be given to cleanness of the tube ends.

Tubes prepared for one row shall not be rebent once more for use in other row.

9.6.6.3 Holes in the tube plates shall be clean and free of scores and dents. Ellipticity of the holes shall not exceed 0,25 for diameters of 50 mm and over. The maximum value of the ellipticity of holes over 50 mm in diameter shall be subject to special consideration by the Register in each case.

9.6.6.4 The tube flaring degree shall meet the standards approved by the Register.

9.6.6.5 The welded joints of the tubes and coils to headers and chambers shall be performed according to

the procedures and techniques of the manufacturer approved by the Register.

9.6.6.6 After flaring of all tubes and dismounting of the fit-up framework, the turn of the horizontal axis Δ_3 and slope of the steam and water header Δ_4 shall not exceed 2 to 6 mm and 5 to 14 mm per 1 m, respectively.

9.6.6.7 Flared joints shall be checked by external examination. After flaring, the internal surfaces of the tube ends shall be smooth, without dents, score marks, fins, cracks and lamination. Transition from the flared portion to the non-flared part of the tube shall be smooth, without notches, spiral or annular scores.

The height of the protruding ends of the tubes and their expansion angle shall be checked by a gauge and shall correspond to the drawing dimensions.

9.6.6.8 The tubes mounted shall be checked for passability by steel calibrated balls which diameter shall be by 10 % less than the inside diameter of the tube.

9.6.6.9 The tightness of the flared joints shall be checked during hydraulic tests (refer to 9.7.2).

The same tube shall not be flared more than two times, otherwise it shall be replaced.

9.6.6.10 Before the fittings are installed, the surfaces of pads and flanges of the fittings shall be cleaned from dirt, oil, rust.

No scratches and scores (especially the radial ones) shall be permitted on the surface of pads and flanges.

9.6.6.11 Before being installed in regular positions, the boiler fittings shall be subjected to hydraulic test in accordance with the requirements of Table 1.7.1, Part X "Boilers, Heat Exchangers and Pressure Vessels" of Rules for the Classification and Construction of Sea-Going Ships.

9.6.6.12 The quality of the fittings installation shall be checked by external examination. The positions of the water level indicators, interiors of the headers shall be checked for compliance with the requirements of the technical documentation.

Tightness of the fittings connection shall be checked during the hydraulic tests of the boiler.

9.6.6.13 After installation of the insulation and complete fit-up, the boiler casing shall be tested for tightness (by air); the test pressure and allowable air pressure drop shall meet the requirements of the approved technical documentation.

9.6.6.14 Prior to the installation of the brickwork, the enclosure walls and drain pans shall be examined. They shall have no bulges, concavities and unevenesses exceeding 10 mm per 1 m.

9.6.6.15 The quality of the brickwork after installation shall be checked by external examination. The brickwork surface shall be smooth; as an exception, individual steps not more than 2 to 3 mm at butts and total uneveness not more than 10 mm shall be allowed per 1 m.

Deviation in the tuyere hole diameter from the prescribed value shall not exceed ± 5 mm, and the misalignment of the axes of the burner tuyere hole — 2 mm.

9.6.6.16 The quality of insulation installation of the headers, fittings and other hot parts of the boiler shall be checked by external examination.

9.6.7 Fit-up of heat exchangers and pressure vessels.

9.6.7.1 When fitting up heat exchangers and pressure vessels, all components and assemblies shall be examined to expose surface defects.

9.6.7.2 In fitting up such components and assemblies, it is necessary to be guided by the requirements of 9.6.1 to 9.6.4 and 9.6.6, if applicable.

9.7 HYDRAULIC TESTS

9.7.1 General.

9.7.1.1 Hydraulic tests by proof pressure shall be conducted by permit and in the presence of the Surveyor to the Register on condition that:

all assembling, welding and weld inspecting operations are completed and accepted by the technical control body of the manufacturer;

components of the product have no insulation and other protective coatings;

entries in the manufacture book and also entries to the effect that no deviations from the technical documentation approved by the Register exist, are verified;

there is a document of the manufacturer's technical control body on the readiness of the component or product for hydraulic test;

component or product has been surveyed by the surveyor to the Register;

devices intended for tests (presses, instruments, etc.) have documents of the appropriate competent authorities.

9.7.1.2 Hydraulic tests shall be conducted with the current regulations and the manufacturer's instructions being adhered to.

9.7.1.3 Components and products shall be filled with water in such manner that they are completely deaerated. The temperature of water and ambient air shall be not lower than + 5 °C. The difference in water and ambient air temperature shall preclude sweating.

9.7.1.4 Pressure gauges used in hydraulic tests shall have an accuracy class not lower than 2,5 and the diameter of the casing not less than 150 mm. The pressure gauge scale shall be such that at the proof pressure the pointer is positioned in the third quarter of the scale. The pressure gauges shall be verified and have marking of the date of verification by a competent authority.

The product being tested shall be fitted with at least two similar pressure gauges arranged at the same level in the upper part of the product, and one more pressure

gauge to be arranged directly on the pump. In all cases, the difference in indications of the pressure gauges fitted shall not exceed 3 % of the upper limit of the indication.

9.7.1.5 The pressure during the test shall rise smoothly without water hammers. Use of injectors or feed pumps for generating pressure shall not be permitted.

9.7.1.6 No other works accompanied by noise hindering the tests shall be performed during the hydraulic tests.

9.7.1.7 During the hydraulic tests the pressure shall be raised up to the proof pressure and shall be maintained during the time period required for examination but not less than 10 min.

9.7.1.8 During the hydraulic tests of the casings of headers, chambers and boiler assemblies, the pressure shall be gradually raised up to the working pressure. At such pressure, the welds shall be tapped all the way along with a copper hammer of not more than 1 kg in mass with a handle of not more than 300 mm long. Thereafter the pressure shall be raised up to the proof pressure, maintained during 5 to 10 min, then again reduced down to the proof pressure and maintained constant until the examination is completed.

9.7.1.9 If during the tests, knocks, booms are heard in the product, or defects affecting the strength thereof are detected, the test shall be interrupted and resumed anew only after correction of these defects.

When the product is held under the proof pressure, no pressure drop shall take place.

Appearance of sweating and water drops on the welds shall not be permitted. Such welds shall be chipped out and welded anew.

Correction of the weld defects by caulking, centre-punching or other mechanical methods shall not be permitted. Re-rolling or application of a back-up weld to the components of products subject to pressure shall not be permitted.

9.7.1.10 Upon completion of the hydraulic test of the product, the surveyor to the Register shall carry out internal examination (if the product is accessible for examination), in the process of which the accessible areas shall be checked for condition of the working surfaces, absence of residual deformation and other defects.

9.7.1.11 The products shall be considered as having passed the test by proof pressure, if weld leaks, cracks, local bulges, residual deformations and other indication of any joint disturbances are not found.

9.7.2 Hydraulic tests of boilers.

9.7.2.1 Prior to hydraulic tests of boilers it is necessary to make sure that all components thereof have been subjected to hydraulic tests by test pressure given in Table 1.7.1, Part X "Boilers, Heat Exchangers and Pressure Vessels" of Rules for the Classification and Construction of Sea-Going Ships.

9.7.2.2 Boilers after assembly but without fittings shall be tested in the workshop for strength by test pressure given in Table 1.7.1, Part X "Boilers, Heat Exchangers and Pressure Vessels" of Rules for the Classification and Construction of Sea-Going Ships.

9.7.3 Hydraulic tests of heat exchangers and pressure vessels.

9.7.3.1 Heat exchangers, pressure vessels and their components shall be tested in the workshop for strength by test pressure given in Table 1.7.1, Part X "Boilers, Heat Exchangers and Pressure Vessels" of Rules for the Classification and Construction of Sea-Going Ships.

9.7.4 Issuance of the Register documents and branding.

9.7.4.1 Where the results of the internal examination and hydraulic test of a boiler, heat exchanger or air receiver are successive, the surveyor to the Register shall issue a certificate. Along with that, marking shall be applied and the Register brand put on the product in accordance with the Instruction on Branding of Items Supervised by the Register (refer to Appendix to Part I "General Regulations for Technical Supervision").

9.8 DETAILS OF TECHNICAL SUPERVISION DURING MANUFACTURE OF PROTOTYPES

9.8.1 Prototypes shall be surveyed by the Surveyor to the Register according to the RS Nomenclature.

9.8.2 All the requirements of this Section which apply to the manufacture of the items of supervision in case of stable production shall apply equally to the manufacture of the prototypes.

The assemblies and components of ultimately new engineering designs or manufactured according to new production procedures and techniques shall be additionally subjected to a special check by the Register.

9.8.3 Prototype of a boiler, other than the waste-heat boiler, shall be subjected to comprehensive tests on a bench according to an extended program approved by the Register to check the reliability and long-term performance of the components, assemblies and the products as a whole as well as to check for the compliance of the parameters and characteristics with the approved technical documentation.

If the check of all parameters of the prototype with regular equipment under conditions of a test bench is impracticable, then on a special agreement with the Register, the bench tests may be conducted partially on board.

9.8.4 The findings of the surveys and tests of the prototype shall be presented in the Prototype (Pilot) Sample survey Report.

In cases specified in Section 6, Part I "General Regulations for Technical Supervision" this Report serves as a basis for the issuance of Type Approval Certificate.

9.8.5 Where, based on the survey and test results, a decision is taken on the possibility of installing the prototype on board, the surveyor shall draw up the certificate and put the Register brand in accordance with 9.7.4.

10 ELECTRICAL EQUIPMENT

10.1 GENERAL

10.1.1 The provisions of this Section apply during technical supervision of electrical equipment listed in the RS Nomenclature.

10.1.2 The Section contains the basic provisions on surveying and testing at the manufacturers' of product prototypes and products at steady production.

The technical instructions and test standards specified in 10.3 to 10.7 pertain equally to product prototypes and products at steady production.

The instructions relating to the scope of checks and tests during surveying products at steady production are given in 10.8.

General and special types of tests and checks of product prototypes and products at steady production are given in Tables 10.1.2-1 and 10.1.2-2.

10.1.3 The general provisions on the organization of technical supervision during manufacture of technical supervision items are given in Part I "General Regulations for Technical Supervision", and on technical documentation, in Part II "Technical Documentation".

Table 10.1.2-1

General types of tests and checks of product prototypes and products at steady production of electrical equipment

Nos.	Products	Inspection and checks		Measurements of insulation resistance		Check of operability		Tests of electrical insulating strength		Tests for compliance with operational conditions (mechanical and environmental)		Tests of protective enclosures		Heat tests		Overcurrent tests		Check of radio interference level		Tests for immunity to electromagnetic emission (EMC)	
		P	S	P	S	P	S	P	S	P	S	P	S	P	S	P	S	P	S	P	S
1	Electrical machines	+	+	+	+	+	+	+	+	+		+	+	+		+	+	+			
2	Transformers	+	+	+	+	+	+	+	+	+		+	+	+		+[1]	+				
3	Static converters	+	+	+	+	+	+	+	+	+		+	+	+		+	+	+		+	
4	Accumulators	+	+	+	+			+	+	+		+									
5	Switchgear	+	+	+	+	+	+	+	+	+		+	+	+				+[2]		+	
6	Electrical apparatus (switching, protective, etc.)	+	+	+	+	+	+	+	+	+		+	+	+				+		+	
7	Capacitors and capacitor sets to raise a power factor	+	+	+	+			+	+	+		+									
8	Busducts	+	+	+	+			+	+	+		+	+	+		+					
9	Electrical measuring instruments	+	+	+	+	+	+	+	+	+		+	+	+				+		+	
10	Electric drives (as a set)	+	+	+	+	+	+	+	+	+		+						+		+	
11	Electrical equipment of electrically-started internal combustion engines	+	+	+	+	+	+	+	+	+		+		+				+		+	
12	Lighting fixtures and control gear of gas-discharge lamps	+	+	+[3]	+	+	+	+[3]	+	+		+	+	+[3]				+[4]		+	
13	Wiring accessories	+	+	+	+	+	—	+	+	+		+		+				—			
14	Ship's control and monitoring, communication and alarm devices	+	+	+	+	+	+	+	+	+		+		+				+[5]		+	
15	Cable products	+	+	+	+	—	—	+	+	+		+		+							
16	Heating and cooking appliances	+	+	+	+	+	+	+	+	+		+									
17	Radio-frequency interference filter	+	+	+	+	+	+	+	+	+		+		+						+	

Symbols: P = prototype; S = production sample.

[1] For power transformers only.
[2] For navigation lights commutators.
[3] Excepting accumulator, portable, explosion-proof lighting fixtures.
[4] For lighting fixtures with gas-discharge lamps.
[5] For engine telegraphs, sensors of rudder angle and blade angle indicators, tachometers, telephone switchboards and apparatus of light and sound alarm devices, switches.
[6] For a.c. and d.c. electric motors.
[7] For propulsion motors, anchor and mooring machinery motors, and motors of the direct drive of the rudder and steering gear.
[8] For a.c. and d.c. generators.
[9] For d.c. generators and motors, control generators, phase-wound motors and other commutator machines.
[10] For power transformers and current transformers.
[11] For liquid-filled power transformers.
[12] Tests for heat resistance of the acid battery mastic.
[13] Checking of acid battery monoblocks tightness.

[14] Applied to circuit breakers, switches, breakers, disconnectors, contactors, current relays and other relays connected in series in power circuits.
[15] For circuit breakers, starters, controllers, electromagnetic brakes, electrohydraulic pushers.
[16] For circuit breakers, switches, breakers, disconnectors, starters, field rheostat controllers.
[17] For insulators, busducts and other insulators.
[18] For anchor and mooring machinery and directly-driven steering machinery.
[19] For boat winches, lifts, watertight door drives.
[20] For steering machinery and watertight doors machinery.
[21] Periodically and selectively by agreement with the Register.
[22] Fuel-oil and luboil heaters if covered by 1.3.2.1, Part XI "Electrical Equipment" of Rules for the Classification and Construction of Sea-Going Ships.

10.2 SCOPE AND PROCEDURE OF ELECTRICAL EQUIPMENT SURVEYING

10.2.1 Prior to tests of electrical equipment, the following shall be available at the manufacturer's:

.1 Register approved technical documentation for the equipment under test and an agreed list of supervision items (refer to 12.2, Part I "General Regulations for Technical Supervision");

.2 documents for parts confirming the Register technical supervision during their manufacture if such supervision is required by the RS Nomenclature;

.3 the Register approved test program;

.4 documents of competent bodies which confirm positive results of special types of tests if provided by the test program (for flameproofness, etc.);

.5 testing equipment specified in the program with pertinent documents confirming equipment parameters, certificates or reports on the recognition of a laboratory;

.6 instruments having the accuracy rating of at least 1,5.

10.2.2 In surveying, the surveyor shall satisfy himself that tests are carried out in consistency with the Register approved program following the test procedures set forth in this Section or other equivalent procedures.

10.2.3 Breaks are allowed during the performance of single types of tests or between them if these do not affect testing.

10.2.4 The surveyor can reject survey or tests performance if an item is inadequately prepared for tests, and also when defects effecting the safety of survey or test performance are revealed.

10.2.5 If damages to single parts are identified or product operability is effected during testing, the product shall be inspected in the the presence of the Surveyor with a view to detect defects, whereupon the Surveyor takes decision on the further test performance.

10.2.6 If a product has failed to pass a certain kind of tests and, as the result, its design has been changed or improved, the tests shall be repeated in accordance with the test program. The scope of those tests is established by the Surveyor.

10.3 SEQUENCE OF TESTS AND CHECKS PERFORMANCE

10.3.1 Inspection.

10.3.2 Tests:

.1 functional;

.2 mechanical and environmental for:

detection of resonance frequencies;

vibration strength;

vibration resistance;

shock strength;

shock resistance;

immunity to temperature changes;

heat stability;

humidity resistance;

strength of insulation;

cold endurance;

resistance to hoarfrost and moisture after thawing;

resistance to motions;

resistance to prolonged inclinations;

.3 other types of tests in the sequence specified in the test program for single types of products;

.4 checking of the voltage level and radio interference field strength level;

.5 tests for immunity to electromagnetic environment.

Notes. 1. It is permitted to combine tests for vibration resistance and vibration strength or shock resistance and shock strength if test methods specified are followed.

2. Irrespective of the sequence specified and need not be on the specimens being subjected to other types of tests, the following tests may be performed:

.1 for exposure to salt mist;

.2 for exposure to solar radiation;

.3 for fungus resistance;

.4 some others specified in the provisions on tests of particular types of products.

3. It is permitted to combine tests for immunity to temperature changes and for heat stability and cold endurance.

4. The test for heat stability may be combined with a heating test for single products.

10.3.3 The tests and checks shall be carried out on common specimens in a sequence to be specified in test programs and methods.

The types of tests and checks not required for single types of products may be ignored in the program, but the general sequence shall be retained. Prior to, and after the completion of, each type of the test, insulation resistance is measured.

Table 10.1.2-2

Special types of tests and checks of product prototypes and products at steady production of electrical equipment

Nos.	Products	Torque overload tests		Stalling tests		Tests for immunity to shortcircuit		Overspeed tests		Check of commutator machines commutation		Check of operability at load loss and increase		Check of secondary voltage variation value		Tests for limiting commutation stability		Check for operate and release values		Check of manual interlocks operation		Check of manual drive and an indicator of commutation positions		Check of electromagnetic brakes operation		Check of minimal voltage protection		Check of track and limit switches operation		Heat stability tests		Check of on-load and no-load operation		Check of capacitors discharge time		Insulation breakdown tests		Tests for tightness of tanks, cans, monoblocks and other products		Check of automatic starting after voltage recovery		Measuring of loss-angle tangent		Check of protection and alarm systems		Check of mechanical and thermoplastic properties of cables	
		P	S	P	S	P	S	P	S	P	S	P	S	P	S	P	S	P	S	P	S	P	S	P	S	P	S	P	S	P	S	P	S	P	S	P	S	P	S	P	S	P	S	P	S	P	S
1	Electrical machines	+[6]		+[7]		+[8]		+		+[9]																																		+	+		
2	Transformers					+[10]								+[1]																								+[11]	+								
3	Static converters					+						+																																+	+		
4	Accumulators																													+[12]								+[13]	+								
5	Switchgear					+																								+																	
6	Electrical apparatus (switching, protective, etc.)					+										+		+[15]		+	+	+[16]	+																								
7	Capacitors and capacitor sets to raise a power factor																													+				+	+			+	+			+	+				
8	Busducts					+																																		+[20]	+			+	+		
9	Electrical measuring instruments																																			+[17]											
10	Electric drives (as a set)			+[18]																+[13]	+	+	+	+	+	+		+	+			+	+														
11	Electrical equipment of electrically-started internal combustion engines																							+																							
12	Lighting fixtures and control gear of gas-discharge lamps																													+				+[4]													
13	Wiring accessories																																							+[22]	+					+	+[21]
14	Ship's control and monitoring, communication and alarm devices																																														
15	Cable products																																			+											
16	Heating and cooking appliances																																														
17	Radio-frequency interference filter																																														

Symbols and footnotes see in Table 10.1.2-1.

10.4 BASIC INSTRUCTIONS ON TESTS AND CHECKS PERFORMANCE

10.4.1 Inspection and checks.

10.4.1.1 An inspection and checks are carried out with a view to establish:

.1 compliance of product specimens with approved technical documentation;

.2 compliance of product specimens with the RS rules requirements of which the observance is not specified in approved technical documentation;

.3 availability of the product submitted for testing.

10.4.1.2 The following shall be checked during the inspection (including openings-up and single disassemblies if needed):

.1 technical documentation for materials the product is made of;

.2 accessories being part of the equipment inspected;

.3 mounting of the electrical circuit of the product;

.4 structural design of the product;

.5 strength of connecting and fastening units, current-carrying parts, welded, screwed and other structural and contact joints;

.6 availability of anticorrosion coatings;

.7 availability of necessary markings and inscriptions;

.8 contact and protective terminations of cables and wires;

.9 arrangements ensuring electrical safety (protective earthing, interlocks, etc.).

10.4.2 Functional tests.

10.4.2.1 Functional tests apply to each product specimen at the manufacturer's prior to performance of single types of tests.

10.4.2.2 Prior to functional tests performance, it shall be ascertained that product completeness, spare parts and insulation resistance are consistent with technical documentation.

10.4.2.3 The functional tests of electrical equipment shall be carried out at the design conditions specified in technical documentation at normal environmental conditions.

10.4.2.4 In the functional tests, the necessary measurements are conducted and characteristics are taken both at the rated supply voltage and frequency, and the prolonged (simultaneous) deviations of voltage by +6 % and —10 % and of frequency by ± 5 %, and at the short-term (simultaneous) deviations of voltage by ± 20 % and frequency by ± 10 %. The equipment intended for operation from accumulator batteries shall be tested at the voltage deviation from a design value within the range +30 % to -25 % if supplied from the battery connected to a charger, and within the range +20 % to -25 % if not connected to the battery being charged. To be checked are the conformity of measurements and characteristics with the values specified in technical documentation, and the operability of a product within the set parameters.

10.4.2.5 Characteristics of electrical equipment operating under load are taken after reaching a steady working temperature.

10.4.3 Measurement of insulation resistance.

10.4.3.1 In testing electrical equipment at the manufacturer's, insulation resistance shall not be less than specified in Appendix 1.

10.4.3.2 The mesurement of insulation resistance is compulsory at the following stages of tests performance:

.1 prior to, and after the completion of, all types of tests under normal environmental conditions with a product being practically in the cold state;

.2 during tests for heat stability in the heated state, as well as during heating tests immediately after their completion;

.3 at the end of tests for humidity resistance and resistance to hoarfrost and moisture after thawing;

.4 after tests for cold endurance and resistance to hoarfrost and moisture after thawing;

.5 after product tests for short-circuit under normal environmental conditions.

10.4.3.3 The d.c. voltage produced by a megohmmeter during measurements of insulation resistance shall be at least as specified:

Rated voltage of a product or circuit U_r, V	Measuring voltage of a megohmmeter, V
Up to 50	100
51 – 100	250
101 – 500	500
501 – 1000	1000
over 1000	2500

Notes: 1. The measuring voltage for electrical machines and transformers at $U_r < 100$ V shall be at least 500 V.

2. The measuring voltage for capacitors of sets for raising power factor (cos φ) for a voltage $U_r \geqslant 380$ V shall be equal to 2500 V.

10.4.3.4 Insulation resistance shall be measured between:

.1 all product parts intended for operation at the same voltage and connected together during measurements and any metallic product part within reach that can be touched (enclosure, handle, etc.);

.2 product parts being alive in operation and electrically not interconnected, between various windings;

.3 each insulated core of cable products and the other cores in any sequence and the metallic cable sheath (armor, screen), and in the absence of these latter, with an electrode in water wherein the cable product is being immersed.

10.4.3.5 Megohmmeter indications of insulation resistance values shall be taken once the voltage applied becomes steady.

10.4.4 Tests of insulation strength.

10.4.4.1 The insulation strength of products, excepting single types specified in 10.4.6 where the time, voltage and frequency are specially stipulated, shall be

tested during 1 min by the application of alternating voltage of the practically sinusoidal form with a frequency of 50 Hz at normal environmental conditions according to the following:

Voltage, V	
rated U_r	test
up to 65	$2U_r$ + 500
66 – 250	1500
251 – 500	2000
501 – 1000	$2U_r$ + 1000
1001 – 3600	10000
3601 – 7200	20000
7201 – 11000	28000

Note. 1. For electrical devices with semiconductor elements, the test voltage is subject to special consideration by the Register in each case.

2. The error in measuring the test voltage is not more than $\pm 1{,}5$ %.

10.4.4.2 General instructions on the performance of insulation strength tests and the explanations thereto are given in Table 10.4.4.2.

Table 10.4.4.2

Nos.	Stages of tests performance	Test voltage	Comments
1	Immediately after the completion of tests for heat stability (heating) at a temperature of single parts equal to, or near, the maximum one reached during the above tests under normal environmental conditions	Full normalized	
2	After product short-circuit tests (if any) under normal environmental conditions[1]	0,8 normalized	For products with windings and products with elements inaccessible for inspection of which the insulation was exposed to short-circuit currents
3	Upon completion of vibration and shock exposure of the poduct in its practically cold state under normal environmental conditions of tests	0,7 normalized	
4	At the end of product tests for humidity resistance under the conditions specified for tests in a humidity chamber	0,5 normalized, but at least 1,25 times the rated voltage of the product	

[1] This test also covers the apparatus tested for the limiting switching capacity by the current equal to the rated short-circuit current (or near short-circuit currents).

10.4.4.3 The test voltage shall be alternately applied between windings or other current-carrying parts of a product, as well as between windings and other current-carrying parts and the metal case of the product.

10.4.4.4 The test results are considered satisfactory if no insulation breakdown or damage, tracking across its surface are detected, being visually checked by the sudden decrease of readings of the voltmeter, which is part of the test circuit, or by the noticeable heating of insulation.

10.4.4.5 In testing insulation strength, d.c. current may be used (from a rectified voltage installation). Cable products and some others depending on their design features may be exposed to d.c. tests. The distinction between those tests is in the values of the testing voltage which are specified for each particular product. The test voltage values for the products ignored in this Section are subject to special consideration by the Register in each case.

10.4.5 Tests of interturn insulation strength.

10.4.5.1 Windings of electrical machines, transformers, electromagnetic couplings, etc. are subject to interturn tests.

10.4.5.2 The interturn insulation of electrical machine (electromagnetic coupling) windings is tested when the one runs idle. The tests are carried out in the heated machine (coupling) at a temperature near the maximum reached during the heat test. The test voltage shall be equal to 1,3 times the rated voltage. The test duration is 3 min (5 min for turbogenerators) unless otherwise specified.

10.4.5.3 The interturn insulation of voltage transformer windings is tested by the twofold rated voltage (of higher frequency) of which the value is specified in 10.4.6.2.1.

10.4.5.4 The results of interturn insulation tests are considered satisfactory if no insulation breakdown or damage has happened.

10.4.6 Testing insulation strength of single types of equipment.

10.4.6.1 Electrical machines and electromagnetic couplings.

10.4.6.1.1 The insulation of electrical machine windings is to withstand without breakdown or damage the test voltage of which the root-mean-square values are specified in Table 10.4.6.1.1.

10.4.6.1.2 Additionally to the tests given in Table 10.4.6.1.1, electrical machines and electromagnetic couplings shall have their interturn insulation tested according to 10.4.5.2 with due regard for the following:

.1 machines operating within a certain range of voltage shall withstand the interturn insulation test for a voltage equal to at least 1,3 times the highest level of voltage;

.2 if the off-load voltage of synchronous machines (excepting turbogenerators) at the rated exciting current exceeds 1,3 times the rated voltage, the test shall be carried out at that higher off-load voltage corresponding to the rated exciting current;

.3 if a field system of synchronous machines includes a power transformer, the interturn insulation of

Table 10.4.6.1.1

Nos.	Electrical machine or its parts	Test voltage (root-mean-square value), V
1	Machines rated under 1 kW (1 kVA) for the rated voltage below 100 V	500 + twofold rated voltage
2	Machines rated 1 kW (1 kVA) and over for the rated voltage below 100 V	1000 + twofold rated voltage
3	Machines rated:	
3.1	under 1000 kW (1000 kVA) excepting those in items 1 and 2 above;	1000 + twofold rated voltage, but not less than 1500
3.2	1000 kW (1000 kVA) and over for the rated voltage, V:	
	up to 3300	1000 + twofold rated voltage
	3301 – 6600	2,5 – fold rated voltage
	above 6600	3000 + twofold rated voltage
4	Field windings of synchronous generators	Tenfold rated voltage of the field system, but not less than 1500 and not more than 3500
5	Field windings of synchronous motors and synchronous compensators:	
5.1	for a machine directly-started from an a.c.source with the field winding closed to a resistor, which has resistance not exceeding the tenfold one of the field winding at d.c. current, or to the source of winding supply	Tenfold rated voltage of the field system, but not less than 1500
5.2	ditto, but for a machine started with the opened sectioned field winding	100 + tenfold rated voltage of the field system, but not less than 1500
5.3	ditto, but for a machine started with the opened non-sectioned field winding	1000 + 20-fold rated voltage of the field system, but not less than 1500 and not more than 8000
5.4	synchronous motors and synchronous compensators started with special starting motors	Tenfold rated voltage of the field system, but not less than 1500
6	Exciters of electrical machines:	
6.1	rated up to 1 kW for the rated voltage below 100 V excepting the exciters in 6.4 and 6.5	500 + twofold rated voltage
6.2	rated over 1 kW for the rated voltage below 100 V excepting the exciters in 6.4 and 6.5	1000 + twofold rated voltage
6.3	for the rated voltage above100 V excepting the exciters in 6.4 and 6.5	1000 + twofold rated voltage
6.4	Exciters of synchronous generators	Tenfold rated voltage, but not less than 1500 and not more than 3500
6.5	Exciters of synchronous motors and synchronous compensators	Tenfold rated voltage, but not less than 1500
7	Secondary windings of induction motors other than permanently short-circuited:	
7.1	for motors allowing reverse-current braking	1000 + fourfold rated secondary voltage
7.2	for motors not intended for reverse-current braking	1000 + twofold rated secondary voltage
8	Assembled group of electrical machines and apparatus	If a test on an assembled group of several new just installed and connected together electrical machines and apparatus, each one of which has previously passed its high-voltage test, is made, the test voltage to be applied to such an assembled group shall not excceed 85 % of the test voltage for the machine (or apparatus) having the lowest value of that voltage

Notes. 1. The test voltage for machines having various insulation classes is specified in technical documentation and is subject to special consideration by the Register in each case.

2. For two-phase windings having one terminal in common, the rated voltage U_r for the purpose of calculating the test voltage shall be taken as 1,4 times the voltage of each separate phase.

3. For windings of one or more electrically-connected machines, the maximum voltage with reference to the frame is taken as the rated one.

the latter is tested along with the machine winding insulation at the same voltage;

.4 the interturn insulation of three-phase multispeed motors shall be tested for each speed;

.5 if the test voltage increased up to 1,3 U_r results in the impermissible rise of voltage between the bars of d.c. motors with more than four poles, tests may be carried out at the lesser value of the test voltage than that specified in the approved technical documentation for the machine;

.6 if the voltage of a field-forced exciter exceeds 1,3 times the rated voltage, the test shall be carried out at the maximum forced voltage during 1 min.

10.4.6.2 Transformers.

10.4.6.2.1 In testing of winding insulation for transformers rated at up to 1000 V at the manufacturer's,

the windings shall withstand the test voltage of rms values given in Table 10.4.6.2.1.

Table 10.4.6.2.1

Transformers	Rated voltage of windings, V	Test voltage, kV
Power ones:		
three-phase rated at up to 6,3 kVA	Up to 50	1,0
single-phase rated at up to 4,0 kVA	51 – 250	1,5
	251 – 400	2,0
	401 – 660	2,5
	661 – 1000	3,0
three-phase rated over 6,3 kVA	127 – 1000	3,0
single-phase rated over 4,0 kVA	127 – 1000	3,0
Instrument ones:		
voltage	Primary winding (up to 660)	6,0
	Secondary winding	2,0
current	Primary winding (up to 660)	3,0
	Secondary winding	2,0

10.4.6.2.2 The interturn insulation of transformer windings is tested by the twofold rated voltage of higher frequency applied to terminals of one of the windings with the others being open-circuited.

The test duration t, in min, shall be at least as determined from the formula:

$$t = 2f_r/f$$

where f_r = rated frequency, Hz;
f = higher frequency of the test voltage equal to $2f_r$ to $5f_r$ (any value within these limits).

In all other cases, the test duration is at least 15 s.

10.4.6.2.3 The open-circuited secondary winding interturn insulation of current transformers shall withstand during 1 min the test voltage induced in it when the primary winding carries the rated current.

10.4.6.3 Accumulator batteries.

10.4.6.3.1 Whatever the voltage, accumulator batteries shall be tested by the voltage of 2000 V (rms value).

10.4.6.4 Electrical switchgear, busducts, apparatus, electrical accessories and lighting fixtures.

10.4.6.4.1 The insulation of electrical (switching, protective, control) apparatus, switchboards and consoles, busducts, lighting fixtures and accessories for a voltage of up to 1000 V shall withstand without breakdown and tracking the test voltage applied of which rms values are as follows:

Rated voltage of apparatus by insulation, U_r, V	Test voltage (rms value), V
60	1000
60 – 250	2000
251 – 660	2500
661 – 800	3000
801 – 1000	3500
1001 – 3000	3 U_r

Notes. 1. In testing switchboards, consoles, busducts, their accessories previously tested independently for insulation strength may be disconnected. Instead of disconnecting such elements, the test voltage may be reduced by 20 % as compared with the above.

2. The test voltage for apparatus rated over 3 kV is specified in a separate table of this Section.

3. The insulation of electromagnetic releasing machinery windings is tested at a rms value of 2000 V.

10.4.6.4.2 The test voltage for fuses up to 500 V rating shall be 3000 V.

10.4.6.4.3 Capacitors shall withstand the test voltage applied between connected armatures and the body, of which rms values are given below, and between the armatures, according to 10.4.6.9:

Rated voltage of a capacitor, U_r, V	Test voltage (rms value), V
220	3000
380	3000
500	3000
660	6000
1000	6000
3150	16000
6300	22000

10.4.6.5 Ship's control and monitoring, electrical internal communication and alarm devices.

10.4.6.5.1 Insulation strength of ship's control and monitoring, electrical internal communication and alarm devices shall withstand the test voltage of the following rms values:

Rated voltage of a device, U_r, V	Test voltage (rms value), V
up to 60	500 + 2 U_r
61 – 250	1500
251 – 380	2000

10.4.6.5.2 The test voltages in 10.4.6.5.1 are irrelevant to tachometers for which the voltages specified in 10.4.6.1.1 (for tachometer sensors) and 10.4.6.4.1 (for secondary devices of meters) shall be applied.

10.4.6.6 Cable products.

10.4.6.6.1 Each insulated core of a finished cable shall withstand without breakdown during 5 min the application of an a.c. single-phase sinusoidal voltage having a frequency of 50 (60) Hz or the d.c. voltage specified in Table 10.4.6.6.1. These test voltages for a finished cable are used both after products holding in water and without such holding, in testing with an immersion into water and without the immersion.

Table 10.4.6.6.1

Cables	Test voltage, V	
	A.c. 50 (60) Hz current	D.c. current
Power cables for rated voltage, V:		
250	1500	3000
750	2500	5000
1000	3000	—
3000	7000	—
Alarm and communication cables for rated voltage 250 V	1500	3000

Notes: 1. The Table refers to cables having rubber, PVC and polyethylene insulation in a rubber or PVC sheath.
2. The test voltage for the cables of which the rated voltage is ignored in the Table, is stipulated by technical documentation and is subject to special consideration by the Register in each case.
3. The test voltage may be reduced by 25 % as compared with the one in the Table for cables with screened cores if these latter account for more than 50 % of all the cores.

10.4.6.6.2 All the insulated cores of a cable prior to its lay, as well as installation single-core wires with no sheathing shall additionally withstand without breakdown the application of the sinusoidal 50 Hz test voltage of a rms value specified in Table 10.4.6.6.2.

The duration of being at the test voltage for each point of the insulation in such a test shall be at least 0,1 s.

Table 10.4.6.6.2

Cables	Nominal cross-sectional area of a core, mm^2	Test voltage (rms value) for cables and wires for rated voltage, V	
		250	750
Power	0,75 — 16	6000	10000
	16 — 25	8000	10000
	over 25	10000	12000
Telephone	—	4000	—

10.4.6.7 Electrical heating and cooking appliances.

10.4.6.7.1 Electrical heating and cooking appliances with tubular electric heaters, excepting fuel oil and lubricating oil heaters, shall withstand the test voltage of which rms values are specified in Table 10.4.6.7.1.

Table 10.4.6.7.1

Rated voltage of a heating device, V	Test voltage (rms value), V		
	In practically cold state		Heated up to a working temperature irrespective ot the tubular electric heater diameter
	tubular electric heater diameter up to 10 mm	tubular electric heater diameter over 10 mm	
12 — 60	800	1000	600
110 — 127	1300	1500	1200
220	1500	1700	1200
380	1800	2000	1200

Note. The above voltages may be reduced by 20 % in tests of heating and cooking appliances with tubular electric heaters being tested at the manufacturer's.

10.4.6.7.2 Fuel oil and lubricating oil heaters for rated voltages 220 V and 380 V shall be tested at a voltage of 2000 V in a cold state and 1500 V in the state heated up to a working temperature.

10.4.6.8 Electrical measuring instruments.

10.4.6.8.1 Analog and digital devices for measuring electrical quantities, transducers, as well as components of devices for measuring nonelectric quantities, if an electric quantity is fed to the input of these components, are classed with the electrical quantity measuring devices covered by the requirements of Table 10.4.6.8.2.

10.4.6.8.2 The insulation of measuring instruments designed for various operating voltages shall withstand the test voltage of which rms values are given below:

Operating voltage, V	Test voltage (rms value), V
Up to 130	500
131 – 250	1500
251 – 660	2000
661 – 1000	3000
over 1001	by special agreement with the Register

Notes. 1. The above voltages are taken for testing insulation between current-carrying parts and a device case.
2. D.c. current may be used for tests. In this case, the above voltages shall be increased 1,41 times.

10.4.6.9 Capacitor sets to raise a power factor.

Capacitor sets to raise a power factor (cos φ) shall withstand the test voltage of an a.c. sinusoidal current of 50 Hz between armatures applied to their terminals during 10 s and equal to 2,15 times the rated voltage, or the d.c.voltage equal to 4,3 times the rated one.

10.5 TESTS OF EQUIPMENT FOR COMPLIANCE WITH OPERATIONAL CONDITIONS ONBOARD A SHIP

10.5.1 General.

10.5.1.1 The list of electrical equipment products subjected to various kinds of mechanical and environmental tests is given in Table 10.5.1.1.

10.5.1.2 For single large-sized or heavy products which are impractical for testing on standard test benches and in standard test chambers, the scope and types of their tests regarding mechanical and environmental effects are subject to special consideration by the Register in each case.

10.5.2 Definitions and explanations.

10.5.2.1 Vibration strength of equipment means a capability of equipment to withstand the effect of vibration without damage retaining all parameters within the set limits after the vibration effect.

10.5.2.2 Vibration resistance of equipment means a capability of equipment to function under conditions of vibration with its parameters remaining within the set limits.

Table 10.5.1.1

Tests of equipment for compliance with operational conditions onboard a ship

Products	Mechanical tests for							Environmental tests for								Tests of enclosure protection
	Detection of resonance frequencies	Vibration resistance	Vibration strength	Shock resistance	Shock strength	Resistance to motions	Resistance to prolonged inclinations	Heat stability	Cold endurance	Exposure to temperature changes	Humidity resistance	Resistance to hoarfrost and dew after thawing	Resistance to salt mist	Resistance to solar radiation	Fungus resistance	
Electrical machines	+	+	+	+	+	(+)	+	+	+	(+)	+	(+)	(+)	(+)	(+)	+
Transformers	+	+	+	+	+	(+)	(+)	+	+	—	+	—	(+)	—	(+)	(+)
Static converters	+	+	+	+	+	(+)	—	+	+	—	+	—	(+)	—	(+)	
Switch,protective and control appratus	+	+	+	+	+	+	+	+	+	(+)	+	(+)	(+)	—	(+)	(+)
Electrical measuringinstruments	+	+	+	+	+	(+)	+	+	+	—	+	—	(+)	+	(+)	+
Electrical switch-boards and consoles	+	+	+	+	+	(+)	(+)	+	+	(+)	+	(+)	(+)	(+)	(+)	+
Electrical drives	+	+	+	+	+	(+)	+	+	+	(+)	+	(+)	(+)	(+)	(+)	+
Ship's control and monitoring devices	+	+	+	+	+	(+)	+	+	+	(+)	+	(+)	(+)	(+)	(+)	+
Internal communication and alarm devices and apparatus	+	+	+	+	+	+	(+)	+	+	(+)	+	(+)	(+)	(+)	(+)	+
Electrical heating and cooking appliances	+	+	+	+	+	(+)	(+)	+	+	—	+	—	(+)	—	(+)	
Accumulators and accumulator batteries	+	+	+	+	+	+	+	+	+	—	—	—	(+)	—	(+)	—
Capacitors and capacitor sets to raise a power factor	+	+	+	+	+	(+)	(+)	+	+	—	+	—	(+)	—	(+)	(+)
Lighting fixtures	+	+	+	+	+	—	(+)	(+)	(+)	(+)	+	(+)	(+)	—	(+)	(+)
Wiring accessories	+	+	+	+	+	—	—	(+)	+	—	+	(+)	(+)	(+)	(+)	(+)
Radio interference filters (attached)	+	+	+	+	+	—	—	+	+	—	+	—	(+)	—	(+)	(+)
Cables and wires	+	—	+	—	+	—	—	+	+	—	+	—	(+)	(+)	(+)	—
Busducts	+	+	+	+	+	(+)	(+)	+	+	—	+	—	(+)	—	(+)	(+)

Symbols:
" + " = products are subject to testing;
" (+) " = the test is not compulsory for some products of the given type or, in some cases, the products may be exempted from this test (refer to the provisions on this test performance and on testing the products of the given type);
" – " = the test is not needed.

10.5.2.3 Humidity resistance means a capability of equipment to retain its parameters within the set limits on prolonged exposure to increased humidity.

10.5.2.4 Duration of impact momentum is the time while an acceleration of the same sign determined with regard to the impact momentum is acting.

10.5.2.5 Protection of equipment means a degree of protection of the equipment integrated in the enclosure against the penetration of solid foreign objects, and also a degree of protection of the electrical equipment inside the enclosure against the ingress of water.

10.5.2.6 Corrosion resistance means a capability of metal products of the equipment to withstand corrosion in the atmosphere saturated with aqueous salt (identical to sea salt) solutions.

10.5.2.7 Normal environmental conditions feature the following values of environmental factors:

.1 temperature 25 $\pm$10 °C;

.2 relative humidity 60 $\pm$30 %;

.3 atmospheric pressure 0,1 $\pm$0,004 MPa.

10.5.2.8 Mould resistance (fungus resistance) means equipment capability to withstand the growth of fungus mould in the environment infected with fungus spores.

10.5.2.9 Practically steady temperature of a product means the temperature of the product or its part of which the change within 1 h does not exceed 1 °C provided the product loading and environmental temperature remain unchanged.

10.5.2.10 Practically cold state of a product means the state of the product wherein the temperature of any part of it differs from that of a cooling medium not more than by 3 °C.

10.5.2.11 Resonance is a phenomenon of increasing the amplitude of vibrations of the product or its units and parts two and more times as compared with that of fastening points vibrations, which is brought about at the coincidence of the disturbing force frequency with the resonance frequency of the product.

10.5.2.12 Resonance frequency is a frequency of natural vibrations of a product or its units wherein the resonance phenomenon with the product at large or its single units and parts develops.

10.5.2.13 Standard environmental conditions feature the following values of environmental factors:

.1 temperature 20 ±1 °C;

.2 relative humidity 65 ±2 %;

.3 atmospheric pressure 0,1 ±0,004 MPa.

10.5.2.14 Thermal equilibrium of a product means the equilibrium that is considered as reached when the temperature of all parts of the product differs from the environmental temperature by not more than 3 °C.

10.5.2.15 Heat stability of equipment means a capability of equipment to function at the highest ambient air temperature, which is likely to occur in operational conditions, sustaining no damages and with its parameters remaining within the set limits.

10.5.2.16 Shock strength of equipment means a capability of equipment to withstand exposure to impacts without damage and with its parameters remaining within the set limits following the impacts.

10.5.2.17 Shock resistance of equipment means a capability of equipment to perform its functions, while being impacted, with its parameters remaining within the set limits.

10.5.2.18 Cold endurance of equipment means a capability of equipment to function at the lowest ambient air temperature, which is likely to occur in operational conditions, sustaining no damages and corrosion, with its parameters remaining within the set limits.

10.5.2.19 Cycle of frequency sweeping means the variation of frequency from the lowest to the highest.

10.5.3 Mechanical tests.

10.5.3.1 General.

10.5.3.1.1 Products shall be fastened directly to the platform of a test bench or, if this is impractical, to a special fixture secured on it. The products shall be fastened in the same way as specifeid for their operation.

10.5.3.1.2 Shock-mounted products at all types of mechanical tests (excepting those for detecting resonance frequencies) shall be installed on shock-absorbers, but to be hard-mounted in tests for detecting resonance frequencies.

10.5.3.1.3 During the test by vibratory and impact loads, products shall be subjected to their effect in each of three mutually perpendicular directions. In all cases, one of those directions shall be perpendicular to the normal operational position of the product.

10.5.3.1.4 The test of products for vibration resistance in an operating condition and for vibration strength in an off-condition is carried out within the frequency range of 2 Hz to 80 Hz (refer to Table 10.5.3.3.2). The test of equipment mounted on vibration sources (diesels, compressors, etc.) or installed in the steering room is carried out in the range of 2 Hz to 100 Hz with an amplitude of 1,6 mm at a frequency of 2 Hz to 25 Hz and with an acceleration of ± 4*g* at frequencies from 25 Hz to 100 Hz.

10.5.3.1.5 The frequency standards specified in 10.5.3.1.4 refer to products having mass up to 200 kg. The equipment over 200 kg by mass, if it is made up of separate structurally-split blocks, sections, etc., may be subjected to tests by the block (section).

The documentation confirming the compliance of the equipment with the operating conditions specified in Part XI "Electrical Equipment" of Rules for the Classification and Construction of Sea-Going Ships shall be submitted for unsplit equipment.

10.5.3.2 Tests for detection of resonance frequencies.

10.5.3.2.1 The purpose of tests for detecting resonance frequencies is to bring out the presence of these latter at products, their units and parts, and to determine these frequencies.

10.5.3.2.2 The tests are carried out at the same vibration parameters (frequency range, amplitude) as in the test for vibration resistance (refer to Table 10.5.3.4.3) in all the subbands of frequencies.

10.5.3.2.3 The hunting for resonance frequencies shall be performed by a continuous variation of frequency within each range at a constant amplitude. The duration of the continuous variation of frequency within a subband is at least 2 min.

10.5.3.2.4 The methods of resonance frequencies detection and determination shall be specified in an approved test program for particular products.

10.5.3.2.5 The resonance frequencies revealed shall be recorded both for a product at large and for separate units or parts for their taking into account during subsequent testing for vibration resistance and vibration strength.

10.5.3.3 Tests for vibration strength.

10.5.3.3.1 A product is tested for vibration strength in an off-condition.

10.5.3.3.2 Frequency subbands, amplitudes and test time period are given in Table 10.5.3.3.2.

Table 10.5.3.3.2

Frequency subband, Hz	Prolonged tests		Short-term tests	
	Amplitude, mm	Time, h	Amplitude, mm	Time, h
2 — 8	1,4	450	2,5	9
8 — 16	0,7	220	1,3	4,5
16 — 31,5	0,35	110	0,7	2,2
31,5 — 63	0,2	55	0,35	1,1
63 — 80	0,12	25	0,2	0,5

10.5.3.3.3 During tests, an amplitude shall be maintained constant. The continuous variation of frequency within a subband shall be carried out during at least 1 min.

Tests may be carried out at the stepwise variation of frequency between limiting values of subbands. The number of frequency steps is established by the Register in each particular case.

10.5.3.3.4 The vibration strength test is carried out in the range wherein a resonance phenomenon takes place, and in the absence of the latter, in any of the subbands specified in Table 10.5.3.3.2 (a check at the frequency 30 Hz is recommended).

10.5.3.3.5 The method of the prolonged or short-term test is selected by agreement with the Register.

10.5.3.3.6 The test time period shall be uniformly distributed between testing positions of the product on a bench, i.e. the number of cycles of frequency sweeping shall be approximately the same for each position.

10.5.3.3.7 The product is approved for vibration resistance tests if no break-downs of product parts have occurred and no other visible damages have been found during tests.

10.5.3.3.8 The priority of tests including those specified in 10.5.3.2 to 10.5.3.6 shall be consistent with that in Table 10.5.1.1.

10.5.3.4 Tests for vibration resistance.

10.5.3.4.1 The vibration resistance tests shall be carried out in an operating condition under electric load.

The load is specified in approved programs and procedures for testing particular products.

10.5.3.4.2 Prior to testing products with switching contact devices, it is necessery to make sure that pressures of contacts (by a load gauge) are consistent with those in approved technical documentation. Setting regulators shall be in position wherein the holding force is the least.

10.5.3.4.3 Frequency subbands and amplitudes in testing for vibration resistance are given in Table 10.5.3.4.3.

Table 10.5.3.4.3

Frequency subband, Hz	Amplitude, mm	Time
2 — 8 8 — 16 16 — 31,5 31,5 — 63 63 — 80	1,0 0,5 0,25 0,15 0,10	As necessary for check in operation and occurrence of resonance of the product and its parts, but at least 2 h, on each resonance frequency (if any) or on the frequency whereon parameters become unstable
Notes. 1. The Register may approve other test parameters based on national standards it has recognized and approved. 2. For electrical equipment mounted on engines and other sources of higher vibration, test standards may be increased by the Register's special requirement.		

10.5.3.4.4 The test is carried out by a continuous variation of frequency at a constant amplitude within each subband. The duration of the continuous variation of frequency within each subband shall be at least 2 min.

10.5.3.4.5 The product is considered to have passed the test if during testing the switching positions of contacts have not changed, operation instability was not revealed and parameter values were within the tolerable limits, no part failures, mounting wire breaks, movable parts seizure, fastenings loosening, insulation condition deterioration after tests were not detected.

10.5.3.5 Tests for shock strength.

10.5.3.5.1 The test is performed with products cut out of the circuit. The product is impacted at least 1000 times with an acceleration of at least $7g$ and a frequency 40 to 80 shocks/min. The total number of shocks shall be uniformly distributed between tests at different positions of the product on a bench.

10.5.3.5.2 The duration of the shock acceleration action shall be consistent with that specified in Table 10.5.3.5.2.

Table 10.5.3.5.2

Value of the lowest resonance frequency of a product,Hz	Duration of shock acceleration action, ms
Up to 60 60 — 100 100 — 200 200 — 500	18 ± 5 11 ± 4 6 ± 2 3 ± 1
Note. If the technical charateristics of equipment do not provide the required duration of the shock acceleration action, the test may be carried out at the duration of the shock acceleration action determined by the formula: $J = 3000 / f_{ol}$ where J = duration of shock acceleration, ms; f_{ol} = lowest resonance frequency of a product, Hz.	

10.5.3.5.3 The product is considered to have passed the test if no failures of product parts have occurred or no other visible defects have emerged.

10.5.3.6 Tests for shock resistance.

10.5.3.6.1 The product in an operating condition is subjected to jarring on a bench in three mutually perpendicular positions with measurements of parameters in each position.

10.5.3.6.2 The total number of impacts with an acceleration of $5g$ and a frequency 40 to 80 shocks/min shall be at least 20. The duration of impact momenta is adopted according to Table 10.5.3.5.2.

10.5.3.6.3 The assessment of this test results is similar to that in 10.5.3.4.5.

10.5.3.7 Tests for resistance to motions and prolonged inclinations.

10.5.3.7.1 During testing, the product shall be in an operating condition under normal environmental conditions.

The tests are not required for products without movable parts.

10.5.3.7.2 In tests for resistance to motions, the equipment is held in a motions condition sequentially in two mutually perpendicular positions with measurements of parameters in each position. A limiting angle of inclination in each position is 30° with the vertical to each side with a period of 7 s to 9 s.

10.5.3.7.3 The duration of tests in each position shall be sufficient for product monitoring and parameters measuring, but not less than 15 min.

10.5.3.7.4 In tests for resistance to prolonged inclinations, the product is held in an inclined position sequentially in two mutually perpendicular planes alternately to each of four sides by an angle of 22,5°, and emergency equipment, by an angle of 30° with the horizontal.

10.5.3.7.5 The duration of inclined product tests in an operating condition shall be sufficient for monitoring product operation and measuring parameters in each position, but not less than 5 min to each side.

10.5.3.7.6 The products of which the technical documentation contains the restrictions on their location onboard a ship due to prolonged inclinations are tested taking into account such restrictions approved by the Register.

10.5.3.7.7 The product is considered to have passed the test if it functioned properly, maintained the set parameters and had no jammings, seizures or overheats of movable parts during testing.

10.5.4 Environmental tests.

10.5.4.1 Tests for heat stability.

10.5.4.1.1 From the tests for heat stability specified in this Chapter are exempted the lighting fixtures subjected to more strict thermal tests, as well as the products subjected to heating tests which, due to their dimensions, cannot be tested in a heat chamber.

10.5.4.1.2 Equipment is tested in an operating condition at a nominal load during 16 h. Product parameters shall be measured at least three times (on reaching the thermal equilibrium, at the end of the test mode and after test in a practically cold state).

10.5.4.1.3 The temperature inside the chamber during tests shall be in accordance with that in Table 10.5.4.1.3.

10.5.4.1.4 The products (switching, protective, etc.) used in automation equipment, as well as electronic elements and devices shall be tested for heat stability according to the standards and procedures in Section 12.

10.5.4.1.5 The check of products functioning at the limiting deviations of voltage and frequency shall be performed following the test for heat stability at the end of a holding regime.

10.5.4.1.6 The product is considered to have passed the test for heat stability if during testing the parameters remained within the tolerable limits, no damages potential for making the product inoperative were detected in inspection, and tests of insulation strength and measurements of insulation resistance on the hot product were satisfactory.

Table 10.5.4.1.3

Equipment location	Temperature in chamber during tests, °C	
	For ships of unrestricted service	For ships operating outside tropical zone
Machinery and special electrical spaces, galleys	+55	+45
Open decks	+55	+50
Other spaces	+45	+40

Notes. 1. The product having no restrictions on the environmental design or location onboard a ship shall be tested from the largest corresponding values given in the Table.

2. Testing the products for installation in machinery and special electrical spaces, galleys ventilated independently with ambient air supply, the test chamber temperature may be reduced by 5 °C as compared with the one in the Table.

3. The electronic elements and devices to be built into switchboards, consoles and enclosures shall reliably function at the ambient temperature up to 55 °C.

Elements, devices and systens shall be damage-free at temperatures up to 70 °C.

10.5.4.2 Tests for cold endurance.

10.5.4.2.1 All products shall be tested for cold endurance. The testing temperature in the chamber with products disconnected from supply sources is set gradually in accordance with Table 10.5.4.2.2. On reaching the thermal equilibrium, a product is held at the testing temperature during 6 h whereupon it is energized for a rated load and checked in operation.

10.5.4.2.2 The temperature in the chamber during the test shall comply with that in Table 10.5.4.2.2.

Table 10.5.4.2.2

Equipment location	Temperature in chamber during tests, °C	
	For ships of unrestricted service	For ships operating outside tropical zone
Machinery, pump, cargo, special category spaces, control stations and non-heated service and production spaces	−10	−10
Open decks	−40	−40
Accommodation, heated service and production spaces	0	0

Notes. 1. The products having no restrictions on the environmental design and/or location onboard a ship shall be tested at the lowest values of temperature given in the Table.

2. The testing temperature for products installed in heated spaces, but cooled with outdoor air, shall be the same as for the products located on open deck.

10.5.4.2.3 The check of products for limiting voltage and frequency deviations is effected immediately following their switching-on after the cold chamber.

10.5.4.2.4 The product is considered to have passed the test if after its switching-on for operation, no failures in its functioning (including those due to lubricant thickening), break-downs or inadmissible deviations of parameters have occurred.

10.5.4.3 Tests for exposure to temperature changes.

10.5.4.3.1 To be tested are the products intended for installation on open decks.

10.5.4.3.2 The test procedure is as follows:

.1 a product is held in a humidity chamber during 5 days under conditions of the test for humidity resistance (95 % to 100 % at a temperature of 25 °C);

.2 after the holding in the chamber during 2 h to 3 h under normal environmental conditions, the product is subjected in succession to at least two cycles of the following tests:

gradual cooling in the chamber down to the temperature specified in Table 10.5.4 .2.2 (−40 °C);

switching-on under the rated load with a temperature at the end of tests elevated up to that in Table 10.5.4.1.3 (+55 °C).

On reaching the thermal equilibrium, the cycle is completed;

.3 after completing the last cycle, the product is placed in the humidity chamber and the test for humidity resistance is carried out in a full scope according to 10.5.4.4.

10.5.4.3.3 The test for exposure to temperature changes is recommended to combine with tests for heat stability and cold endurance.

The product is considered to have passed the tests if it had passed the test for humidity resistance performed immediately after the completion of the last cycle of the tests specified in 10.5.4.3.2.

10.5.4.4 Tests for humidity resistance.

10.5.4.4.1 The electrical equipment of any construction shall be tested for humidity resistance in standard enclosures as the whole unit excepting the equipment of watertight construction of which the covers during tests in chamber shall be opened.

The tests are carried out with periodical equipment switchings-on for operation.

10.5.4.4.2 The tests for humidity resistance may be conducted in a cyclic or continuous mode.

The mode is selected depending on the product purpose, operational conditions and structural details, and is specified in the Register approved test program for particular products.

10.5.4.4.3 Impregnated winding products (electrical machines, transformers, contactors, relays, etc.) shall be tested in the cyclic mode. The other products, including those sealed with compound, are recommended to test in the continuous mode.

10.5.4.4.4 The test conditions in the cyclic mode are given in Table 10.5.4.4.4.

The tests at other cyclicity are subject to special consideration by the Register in each case.

10.5.4.4.5 The test conditions in the continuous mode are given in Table 10.5.4.4.5.

10.5.4.4.6 As a rule, products are tested in the prolonged mode.

The tests in the short-duration (accelerated) mode may be performed when justified and specially agreed with the Register.

The tests are carried out at a temperature of 40 ±2 °C and relative humidity 90 to 95 % with no condensation.

In particular cases, based on approved technical documentation, a temperature of 25 ±2 °C for products intended for installation in ships operating outside the tropical zone only is allowed.

10.5.4.4.7 Following the completion of tests in the chamber, insulation strength is tested. This test for

Table 10.5.4.4.4

Nos.	Purpose of products by environmental conditions of operation (navigation area)	Product location	Cyclicity 12 – 12 h		
			Mode duration, days	Relative humidity (RH), % and temperature in chamber (t°C)	
				The first 12 h of cycle	The following 12 h of cycle
1	For ships of unrestricted service	Open decks, particularly wet spaces	10	The first 3 h: RH = 95 – 100 % t° = min 25±3 °C, max 40±2 °C The following 9 h: RH = 93±2 % t° = 40±2 °C	RH = 95 – 100 % Within 3 h to 6 h, t° is reduced down to 25±2 °C and maintained within these limits till the end of cycle
		Other spaces	7		
2	For ships operating outside tropical zone	Open decks, particularly wet spaces	7	RH = 93±3 % t° = 40±2 °C	
		Other spaces	5		

Note. In each cycle of tests, condensate shall be formed on the product which shall not fall on the product under test from walls and ceiling of the chamber.

Table 10.5.4.4.5

Purpose of products by environmental conditions ofoperation (navigation area)	Product location	Mode duration, days		Relative humidity (RH), % and temperature in chamber (t°C)	
		Prolonged mode of tests	Accelerated mode of tests	Prolonged mode of tests	Accelerated mode of tests
For ships of unrestricted service	Open decks, particularly wet spaces	21	14	RH — 95^{+2}_{-3} %	RH — 95^{+2}_{-3} %
	Other ship's spaces	10	7	t° — 40±2 °C	t° — 55±2 °C
For ships operating outside tropical zone	Open decks, particularly wet spaces	7	5	RH — 93^{+2}_{-3} % (95±2 %)	RH — 95^{+2}_{-3} %
	Other ship's spaces	5	4	t° — 40±2 °C (25±2 °C)	t° — 55±2 °C
Note. The duration of tests for products having no restrictions by their environmental design and/or their location on board a ship shall be the largest that corresponds to the one in the Table.					

products intended for installation on open decks and in particularly wet spaces is performed with the product remaining in the chamber. For other products, the test by higher voltage may be carried out within 3 min after the removal of the product from the humidity chamber.

10.5.4.4.8 Measurements of parameters and other checks not associated with access to the product shall be carried out at the end of the first part of a cycle in the cyclic mode and at the end of the last hour in the continuous mode.

10.5.4.4.9 The product is considered to have passed the test for humidity resistance if:

.1 insulation resistance has not lowered below the standards;

.2 insulation breakdown or surface tracking has not occurred in insulation strength testing;

.3 the product was functioning properly with periodical switchings-off during tests;

.4 no corrosion is revealed on metallic parts;

.5 deviations of product parameters remained within the tolerable limits.

10.5.4.5 Tests for exposure to hoarfrost and dew.

10.5.4.5.1 The products installed on open decks and in other places potential for hoarfrost formation on the product shall be tested for exposure to hoarfrost and dew.

The products of watertight construction and tested for humidity resistance in the cyclic mode are exempted from such tests.

10.5.4.5.2 The tests are carried out according to the following procedure:

.1 the switched-off product is placed in a cold chamber and held there during 2 h at a temperature of −20±5 °C;

.2 the product is removed from the chamber and the voltage specified in a test program (the maximum permissible value of the operating voltage is considered as adequate) is applied to its terminals. The product is held at such voltage (no load) under normal environmental conditions till hoarfrost thawing and drying, but at least for 2 h;

.3 during the thawing, tests are carried out by applying the above voltage both between the leads, and between the leads and an enclosure.

10.5.4.5.3 The product is considered to have passed the test if no breakdown of, or damage to, the product insulation has occurred.

10.5.4.6 Tests for exposure to salt (sea) mist.

10.5.4.6.1 All the kinds of products irrespective of the navigation area, i.e. of any environmental design, are subject to the test.

10.5.4.6.2 The products are tested in their standard enclosures with closed covers, doors, capped openings for cable entries. All the other holes, e.g. the ventilation ones, shall be opened.

10.5.4.6.3 The tests are performed by the cyclic atomization of an aqueous salt solution (sea fog) in a chamber at a temperature of 27±2 °C:

.1 cyclic atomization – 15 min during 1 h of testing;

.2 solution composition, g/l: sodium chloride – 27, magnesium chloride – 6, calcium chloride – 1, potassium chloride – 1, distilled water – 1 l;

.3 mist dispersivity – 1 to 10 μm (up to 90 – 95 drops);

.4 water content of the solution – 2 to 3 g/m^2 (at the end of atomization).

10.5.4.6.4 The duration of tests depending on the equipment location is specified in Table 10.5.4.6.4.

10.5.4.7 Tests for fungus resistance.

10.5.4.7.1 All the products for ships of unrestricted service, excepting those in watertight enclosures having mold-resistant coatings, shall be subjected to tests for fungus resistance.

10.5.4.7.2 The kinds of molds for preparing an aqueous suspension of mold spores are given in Table 10.5.4.7.2.

10.5.4.7.3 The products are subjected to tests according to the following procedure:

Table 10.5.4.6.4

Product location	Product types	Duration of chamber tests,days
Open decks	Any (excepting products for installation in hovercraft)	7
Internal spaces	Any	2

Notes. 1. Duration of tests for equipment intended for installation on the open deck of dynamically supported craft shall be at least 10 days.

2. The products intended for integration inside enclosures of the electrical equipment installed on the open deck are not separately subject to tests.

3. If tests are performed in the continuous mode of atomization at a temperature of 35 ± 2 °C, the test duration for products installed on the open deck may be reduced down to 4 days.

.1 test specimens are selected among the supplied products without their special precleaning;

.2 prior to the beginning of tests, the equipment is held at a temperature of 55 ± 2 °C during 4 h to 6 h, whereupon under the standard environmental conditions for a period of 2 h to 6 h during which electric parameters and product functioning are checked;

.3 the tests are performed in the special chamber of fungus formation in the environment infected with fungus mold in the absence of lighting and air movement at a temperature of $(27 — 30) \pm 1$ °C and relative humidity 95 ± 3 %;

.4 the check Petri dish with a nutrient solution shall be in the chamber together with product specimens.

As the nutrient solution is recommended the wort or Chapek – Dox's synthetic medium of the following composition:

Sodium nitrate $NaNo_3$ – 2 g,

Potassium dihydrophosphate KH_2PO_4 – 0,7 g,

Potassium hydrophosphate K_2HPO_4 – 0,3 g,

Magnesium sulfate $MgSO_4 7H_2O$ – 0,5 g,

Potassium perchlorate KCl – 0,5 g,

Ferrous sulfate $FeSo_4 7H_2H$ – 0,01 g,

Sucrose[1] – 30 g,

Distilled water – 1000 cm^3,

Agar-agar – 25 g;

.5 disconnected from power sources, the product and the Petri dish with the nutrient solution in the chamber are sprayed, using a glass pulverizer with an outlet diameter of at least 1 mm, with the aqueous suspension of mold fungus spores on the basis of 50 mg of the suspension for 1 l of the chamber volume.

The aqueous suspension shall consist of the mixture of mold fungus spores of which the names are given in Table 10.5.4.7.2;

.6 the equipment is held in the chamber under the above conditions during 48 h. If no growth of mold fungi in the check Petri dish is observed during that time, the spraying is repeated and the time-keeping is resumed from the beginning;

.7 following the display of fungi growth in the check Petri dish, the product is held in the chamber under the above environmental conditions during 28 days;

.8 after the expiry, the equipment is kept under the normal environmental conditions for 24 h followed by its inspection and parameters measurements.

10.5.4.7.4 The product specimens are considered to have passed the test if, resulting the inspection by the unaided eye, no noticeable growth of mold is revealed or single germinating spores only are seen on them with a 5X magnifying glass.

10.5.4.7.5 The tests for fungus resistance are performed at a microbiological laboratory by competent personnel.

The Surveyor may ignore the technical supervision of the tests, but their results shall be submitted in the form of a record and to be consistent with the above procedure.

10.5.4.8 Tests for exposure to solar radiation.

10.5.4.8.1 To be tested are the products designed for operation on the open deck and which will fully or partially

Table 10.5.4.7.2

Spore	Strain	Typical cultures	Properties
Aspergillus niger	v. Tieghem	ATCC. 6275	Flourishes on many materials, resistant to copper salts
Aspergillus terreus	Thom	POMD. 82j	Attacks plastics
Aureobasidium pullulans	(De Barry) Arnaud	ATCC. 9348	Attacks paints and varnishes
Penicellium funiculosum	Thom	JAM. 7013	Attacks many materials, textile materials in particular
Penicellium ochrochloron	Biourge	ATCC. 9112	Resistant to copper salts
Scopulariopsis brerioaulis	(Sacc.) Buin Var. Glabra Thon	JAM. 5146	Attacks rubber
Trichoderma viride	Pers. Ex Fr	JAM. 5061	Attacks cellulose, textile, plastics
Paecilomyces varioti	Bainier	JAM. 5001	Attacks plastics and leather

[1] If glucose is used instead of sucrose, the content is accordingly reduced.

be exposed to continuous solar radiation while in service.

10.5.4.8.2 The tests are carried out in a special chamber at an air temperature of 55 ± 2 °C in the chamber shade. The product or its part is subjected to irradiation from infrared and ultra-violet radiation sources during 120 h. The radiation plant intensity shall provide the total heat-flux density not less than 1125 W/m^2, the flux density of the ultra-violet part of the spectrum with a wave length of 280 to 400 nm shall be at least 42 W/m^2.

10.5.4.8.3 The product is considered to have passed the test if:

.1 no deformation, cracking, delamination, buckling, ungluing of parts made of plastic and other materials have occurred;

.2 parameters and insulation resistance have remained normal;

.3 visibility and distinguishability of inscriptions and symbols on scales or other parts of the product have not deteriorated.

10.5.5 Tests of enclosure protection.

10.5.5.1 Protection against penetration of hard objects.

10.5.5.1.1 These tests apply to products with voltage up to 1000 V.

Procedures for testing the protection degree for voltage over 1000 V are subject to special consideration by the Register in each case.

10.5.5.1.2 The protection degree against penetration inside the product of foreign hard objects is checked during the tests.

10.5.5.1.3 The designation of the protection degree and its definition are specified in Appendix 9.

The test procedure for product enclosures for the conformity of the protective enclosure regarding the penetration inside the product of foreign hard objects and criteria for tests assessment are given in Table 10.5.5.1.3.

10.5.5.2 Water protection.

10.5.5.2.1 The test procedure and the provisions on the assessment of testing the protective product enclosure against the ingress of water are given in Table 10.5.5.2.1.

10.6 ELECTRICAL TESTS

10.6.1 Heat test.

10.6.1.1 The test of electrical machines for heating shall be carried out under the normal environmental conditions at an air temperature of 25 ± 10 °C up to a steady-state temperature.

The test for heating may be combined with the test for heat stability.

10.6.1.2 In testing, a product shall operate in a nominal mode.

10.6.1.3 Products intended for operation in a short-time mode shall be tested being from the start in a practically cold state. The test duration shall be not less than that of the mode specified for product operation.

The other produts may be tested starting both with the practically cold state and hot state. The test continues until practically steady-state temperature.

10.6.1.4 The test of products designed for supply by three-phase current (e.g. of switching devices of which the poles therewith are connected in series) may be carried out by single-phase current at currents up to 400 A.

10.6.1.5 The product shall be tested in an operational position.

10.6.1.6 During tests, the opening parts of enclosures (doors, covers, detachable casings, etc.), as well as holes for cable entries shall be in a regular operational position.

Table 10.5.5.1.3

Protection degree (first numeral after IP)	Test procedure and assessment criteria
1	A ball 52,5 mm in diameter is applied to any holes in the product enclosure with a force of 30 N for all the products and 50 N for electrical machines. The results are considered satisfactory if the ball does not pass through and touch current-carrying parts inside the product.
2	A test prod (refer to Appendix 11) connected by one positive side to a safety voltage (not below 40 V) source is applied in any possible position with a force of up to 30 N, as well as a ball 12,5 mm in diameter is applied to any holes with the same force. The results are considered satisfactory if the pilot lamp of the test prod does not illuminate, and the test ball does not get through any of the holes and touch current-carrying or moving parts inside the product enclosure.
3	A steel wire of 2,5 mm in diameter is applied to any hole in the enclosure. The results are considered satisfactory if the wire does not get through any of the holes in the enclosure.
4	Similar to the protection degree 3, but the wire diameter is 1 mm.
5	The chamber is vacuum-pumped for a pressure differential of 2×10^3 Pa. The product is blown over with talc screened through a mesh with a clear opening of 0,071 mm on the basis of 2 kg of talc per 1 m^3 of the chamber volume. The test is conducted during the time adequate for the transfer with a vacuum pump of the air volume in the chamber 80 to 120 times that of the air volume in the enclosure, but not less than 2 h.
6	The results are considered satisfactory if the amount of talc penetrating the product enclosure does not effect its proper operation (equipment parameters and operability are checked). Similar to the protection degree 5, but an assessment is considered satisfactory if dust deposits inside the enclosure are absent (full protection against dust penetration).

Table 10.5.5.2.1

Protection degree (second numeral after IP)	Test procedure and assessment criteria
1	Protection against vertically-falling water drops. The product in a normal working position is exposed to vertically-falling water drops from a tank with water through holes in its bottom arranged at nodes of an imaginary net with a mesh dimensioned 22 mm. The area of the bottom shall be larger than that of the product under test. Rain intensity is to be 3 mm/min, test duration, at least 10 min. The test results are considered satisfactory if water drops penetrating the product do not break its normal functioning and water does not accumulate in single places and close to cable entries.
2	Protection against water drops. Tests are conducted in the same way as above with the alternate deflection of the product from the vertical position through an angle of 15° to any sides. The assessment of test resuls is also as above.
3	Protection against rain drops. The product in a normal working position is sluiced with fine water jets from holes in a pipe bent in the shape of a semicircle. The pipe deflects from a vertical position above the product during 1 s through an angle of $\pm 60°$. The water pressure in the pipe is about 1×10^5 Pa. The test duration is at least 10 min. After 5 min of tests, the product is turned through an angle of 90° about its vertical axis to any side. The test results are assessed as for the protection degree 1.
4	Similar to the protection degree 3, but the product is sprayed on all sides (i.e. the pipe is to swing deflecting from the vertical up to 180°). The results assessment is similar to that for the protection degree 1.
5	Protection against water jets. The product is sluiced with water on all sides from a distance of 3 m using a nozzle of 13 mm in size at a pressure in the main about 1×10^5 Pa. The test duration is 10 min. The results assessment is similar to that for the protection degree 1.
6	Protection against ship's deck conditions. Similar to the protection degree 5, but from a distance of 1,5 m. The results are considered satisfactory if the water does not penetrate the product enclosure.
7	Protection against immersion in water. The product is completely immersed in water to a depth of 1 m above it. Electrical machines are immersed to a depth of at least 0,15 m above their top. The test duration is 30 min. At certain pressure and time, the water shall not penetrate an enclosure.
8	The product is placed in a tank filled with water wherein a hydrostatic pressure is exerted which is 1,5 times larger than the one corresponding to the maximum depth of product immersion specified in technical documentation. The product is held under these conditions for 15 min, whereupon the pressure is lowered down to normal. Then the pressure is raised up to the value corresponding to the maximum depth of immersion and held for 24 h. During the test and after it, the product shall normally function and maintain its parameters and insulation resistance within the set limits. The water shall not penetrate into the product.

N o t e s : 1. Electrical machines having degrees of protection 1, 2, 3 and 7 are tested in a non-operating condition, while those with degrees of protection 4, 5 and 6, in both an operating and a non-operating conditions.The duration of each test is at least 10 min.

2. Following product enclosure tests against water penetration, electrical machines are immediately subjected to tests for insulation strength.

If tests are carried out on non-rotating machines, prior to insulation strength testing, these latter shall be operational under idling conditions for 15 min. The test voltage therewith shall make up 50 % of the normal test voltage, but at leasr 125 % of the rated voltage.

Electrical equipment designed for underwater operation regarding its structure and insulation is considered equivalent to the degree of protection 8.

10.6.1.7 The parts to be monitored in heating shall be specified in the product test program and procedure.

10.6.2 Overcurrent test.

10.6.2.1 Generators after heating up to the steady-state temperature corresponding to the rated load shall withstand overcurrent loads specified in Table 10.6.2.1.

Table 10.6.2.1

Generator	Overcurrent, %	Overcurrent duration, s
Alternating current	50	120
Direct current	50	15

10.6.2.2 Electric motors shall withstand torque overloads specified in Table 10.6.2.2 without a stop or sudden speed change.

Table 10.6.2.2

Electric motors	Torque overload, %	Overload duration, s	Comments
Polyphase synchronous, as well as squirrel-cage motors with a starting current less than a 4,5-fold rated current	50	15	Frequency, voltage and excitation shall be maintained at the level of rated values
Polyphase squirrel-cage and slip-ring induction motots for continuous and intermittent operation	60	15	Frequency and voltage shall be maintained at the level of rated values
As above, but for short-time operation and for continuous operation under variable load	100	15	Ditto
D.c. motors	50	15	Voltage shall be maintained at the level of a rated value

10.6.2.3 The test shall be performed at the maximum values of the temperature of product parts reached in the heat test and at the same temperature of a cooling medium.

10.6.2.4 The product is considered to have passed the test if, after its inspection following the test, no deformations, damages, noticeable changes of an insulation colour have been detected, and product parameters have remained within the set limits.

10.6.3 Tests in checking radio interference level.

10.6.3.1 The check of the voltage level and field strength of radio interference generated by equipment is carried out with use of devices with a quasi-peak detector specified in CISPR 16-1 and 16-2, GOST P 51319-99 in compliance with the procedure set forth in 3.4 of Appendix to Section 12. The bandwidth of a radio interference meter shall be 200 Hz in the frequency range 0,01 MHz to 0,15 MHz, 9 kHz in the frequency range 0,15 MHz to 30 MHz, and 120 kHz in the frequency range 30 MHz to 2000 MHz excepting the range 156 MHz to 165 MHz where the bandwidth shall be 9 kHz.

10.6.3.2 The following tolerable levels of radiated electromagnetic emission are set for the equipment installed on the open deck and navigating bridge.

An electromagnetic field at a distance of 3 m in the following frequency ranges shall be:

150 kHz to 300 kHz – 80 dB μV/m to 52 dB μV/m;

300 kHz to 30 MHz – 52 dB μV/m to 34 dB μV/m;

30 MHz to 2000 MHz – 54 dB μV/m, but 24 dB μV/m for the frequency range 156 MHz to 165 MHz.

The voltage of emission in supply and input-output circuits measured with use of the artificial mains network according to CISPR 16 in the following frequency ranges shall be:

10 kHz to 150 kHz – 96 dB μV/m to 50 dB μV/m;

150 kHz to 350 kHz – 60 dB μV/m to 50 dB μV/m;

350 kHz to 30 MHz – 50 dB μV/m.

10.6.3.3 The following tolerable levels of radiated electromagnetic emission are set for the equipment installed in the machinery and other enclosed spaces of a ship.

An electromagnetic field at a distance of 3 m in the following frequency ranges shall be:

150 kHz to 30 MHz – 80 dB μV/m to 50 dB μV/m;

30 MHz to 100 MHz – 60 dB μV/m to 54 dB μV/m;

100 MHz to 2000 MHz – 54 dB μV/m, but 24 dB μV/m for the frequency range 156 MHz to 165 MHz.

The voltage of emission in supply and input-output circuits measured with use of the artificial mains network according to CISPR 16-2 in the following frequency ranges shall be:

10 kHz to 150 kHz – 120 dB μV/m to 69 dB μV/m;

150 kHz to 500 kHz – 79 dB μV/m;

500 kHz to 30 MHz – 73 dB μV/m.

10.6.4 Tests for immunity to electromagnetic emission (EMC).

10.6.4.1 The check of equipment immunity to electromagnetic emission is carried out in accordance with the procedure set forth in 3.4 of Appendix to Section 12.

10.7 ELECTRICAL TESTS OF PARTICULAR TYPES OF EQUIPMENT

10.7.1 Tests of electrical machines.

10.7.1.1 The scope of tests and checks for electrical machines is given in Table 10.7.1.1.

Table 10.7.1.1

Electrical machines	Technical inspection and checks	Measurements of insulation resistance	Tests of insulation strength	Tests for conformity with operational conditions	Heat test	Short-time overcurrent test	Short-time torque overload test	Check of commutator machines switching	Stalling test	Overspeed test	Test for electric and thermal strength at short-circuit current	Test for permissible levels of industrial radio interference voltages	Check of operability at load loss and increase	Check of operability with load variation from idling to rated load	Other tests and checks
A.c.synchronous generators	+	+	+	+	+	+	—	—	—	+	+	+	+	+	Refer to 10.7.1.10
D.c. generators[1]	+	+	+	+	+	+	—	+	—	+	+	+	—	—	
A.c. induction motors	+	+	+	+	+	+	+	—	+[2]	+	—	+	—	—	
D.c. motors	+	+	+	+	+	+	+	+	+[2]	+	—	+	—	—	
Converters	+	+	+	+	+	+	—	(+)	—	+	(+)	+	—	—	
Rotary amplifiers	+	+	+	+	+	+	—	+	—	+	—	+	—	—	
Other machines	+	+	+	+	+	(+)	(+)	(+)	—	(+)	(+)	+	—	—	

Symbols:
" + " = test (check) is needed;
"(+)" = test (check) performance depends on the particular machine;
" – " = test (check) is not needed.

[1] Exciters of synchronous machines may be tested in combination with these machines.

[2] The stalling test is applied only to propulsion motors, motors for a direct drive of the rudder and steering gear, and also to motors driving anchor and mooring machinery.

10.7.1.2 Additionally to the specified in 10.4.1, the following shall be checked:

.1 the quantity and symmetry of an air gap between a stator and rotor (between poles and an armature);

.2 the axial symmetry of the stator and rotor (of poles and the armature);

.3 the uniformity of poles and brushes arrangement in a circle;

.4 a brush pressure;

.5 the runout of a collector, slip rings, a shaft end, the axial displacement of the rotor (armature) (it is expediently also to check the runout of the collector after a test at a higher speed);

.6 the results of the test of a water air cooler, as well as of the systems of direct water cooling of the machine, for tightness and strength;

.7 the results of measuring the resistance of insulation between a bearing base and a foundation;

.8 the results of measuring the ohmic resistance of windings.

10.7.1.3 If large-dimension assembled machines are impractical to test for humidity resistance, these may be tested in knock-down form (e.g. separate tests of armatures, rotors and parts of split stators). In such cases, the values of insulation resistance received in measurements after testing shall be referred (converted) to the machine as a set.

10.7.1.4 In testing a.c. generators for a short-time overcurrent, it is recommended to simultaneously check the sufficiency of their excitation reserve. The check is carried out at a power factor of 0,6 ($\cos \varphi$).

The excitation reserve is considered sufficient if the generator voltage is not lowered by more than 10 % during 2 min of testing by a current 150 % of the rated one at the above power factor.

10.7.1.5 Testing a.c. generators with their voltage regulation systems, the following shall be checked:

.1 voltage variation up to the rated voltage at the rated power factor with the change of loading starting from the idling. In this case, the voltage shall not change by more than 2,5 % of the rated voltage for main generators and 3,5 % for emergency ones;

.2 voltage variation with the sudden change of the symmetrical load of a generator operating at the rated speed and voltage, and at the current and power factor available. In this case, the voltage drop shall not be below 85 % and its increase above 120 % of the rated voltage. After that change of loading, the generator voltage shall be restored within + 3 % of the rated one during not more than 1,5 s. For emergency generators, these values may be increased up to 5 s in time and up to + 4 % in voltage.

If precise data on the maximum sudden load, being applied at the existing generator load, are lacking, a load valued 60 % of the rated current with an inductive power factor of 0,4 and less, being put during idling and switched-off later, may be used;

.3 a capability to withstand the 3-fold rated current of a generator within 2 s at a short-circuit.

10.7.1.6 The test of motors for a short-time torque overload shall be carried out in compliance with 10.5.2, Part XI "Electrical Equipment" of Rules for the Classification and Construction of Sea-Going Ships.

The torque for d.c. motors may be in terms of overcurrent.

10.7.1.7 Checking the commutation of commutator machines, the following shall be taken into account:

.1 the check shall be carried out both in a rated mode and during short-time overcurrent;

.2 the check at a rated load shall be carried out following the time period required for a machine to reach a practically steady-state temperature;

.3 the check of commutation at a rated load is expediently to combine with the heat test, the overcurrent check, with the test for short-time overcurrent;

.4 a degree of machine sparking in the rated mode of operation shall not exceed 1,5 unless otherwise specified in the technical documentation for the machine in exceptional justified cases.

The sparking degree during overcurrent in all cases shall be specified in the technical documentation for the machine.

10.7.1.8 The stalling test shall be carried out under the following conditions:

.1 the rated mode of motor operation, a temperature of motor heating is the maximum during operation in that mode;

.2 the motor under test shall be mechanically locked, a stalling time shall be counted off since the rotor (armature) stop;

.3 the stalling duration for motors of the steering gear for directly-driven rudders is 60 s, the stalling duration and modes for motors of anchor and mooring machinery shall be consistent with the provisions in 5.6.2, Part XI "Electrical Equipment" of Rules for the Classification and Construction of Sea-Going Ships;

.4 following the test, the machines shall be thoroughly examined for any damages, deformations, the noticeable change of an insulation colour.

10.7.1.9 The overspeed test shall follow the short-time overcurrent test, and as to the machines subjected to the stalling test, after the latter at a temperature of machine parts close to a steady-state temperature reached at the end of the heat test, with the following conditions to be met:

.1 the test duration for all machines excepting starters is 2 min (20 s for starters);

.2 series-wound motors shall be tested at a speed exceeding by 20 % the maximum specified in their rating plate, but exceeding by not less than 50 % the rated speed (at 120 % of an idle speed for starters in all cases);

.3 adjustable speed motors, as well as those having several rated speeds shall be tested at a speed exceeding

by 20 % the maximum specified in their rating plate; all the others – at a speed exceeding the rated one by 20 %;

.4 machines may be tested in the mode of both a generator and motor; the mode corresponding to the machine purpose is preferred;

.5 the test duration is counted off since the moment when the machine has reached its test speed;

.6 following the test, the machine shall be thoroughly examined for any damages and deformations.

10.7.1.10 The test for immunity to shock short-circuit current shall be carried out under the following conditions:

.1 the short-circuit mode shall be produced by a sudden simultaneous closing of all the three phases (poles) when a machine runs idle at a voltage of 105 % of the rated voltage with an automatic voltage regulation device switched on;

.2 the motor output in test shall be not less than the service one;

.3 the length of conductors from the machine to a closing device shall be the least, a cross-sectional area, the largest among specified in the technical documentation for a generator, the conductors material is copper;

.4 parameters of the short-circuit mode shall be recorded using an oscillograph;

.5 the assessment of test results (mechanical strength of the machine) is performed by means of the thorough examination of the machine, particularly of the condition and securing of frontal parts of the stator winding, welds and other mechanical joints, with due regard for the results of an insulation strength test carried out after the test for immunity to short-circuit current.

The evaluation of the results of testing machines rated over 1000 kVA is additionally carried out also for indications obtained from the strain measurement of stresses in the fastenings of an active steel and insulation of frontal parts, as well as from the measurements of vibrations (with vibration transducers) of the same parts, and also of the machine case and bearings.

10.7.1.11 Other tests and checks depending on a particular machine may binclude:

.1 check in operation of interlocks, protection and alarms (e.g. overspeed protection);

.2 check of the reserve of a.c. generators excitation (refer to 10.7.1.4);

.3 check of the voltage setting range for a.c. generators with a static field system;

.4 test of functioning of the electric heating of the machine;

.5 measurement of electric voltage between shaft ends, as well as between a bearing base insulated from a foundation and the latter (both measurements are conducted with use of a voltameter having small inner resistance when the machine runs at rated voltage and frequency in the same mode). In measuring the voltage between the bearing base and foundation, oil films between shaft necks and both bearings shall be shunted.

The above-listed tests (checks) may be performed in any sequence at any stage of testing.

10.7.2 Tests of transformers.

10.7.2.1 The scope of transformer tests and checks is given in Table 10.7.2.1.

10.7.2.2 To check the variation of secondary voltage on a percentage basis (ΔU, %), the measurements of voltages at secondary winding terminals in idling U_o and at the active rated load U_r are compared. The check is

Table 10.7.2.1

Nos.	Transformers	Inspection and check	Measurement of insulation resistance	Insulation testing	Test of electrical strength of air gaps (see Footnote, 2)	Test for compliance with operational conditions	Check of measurement of a secondary voltage value	Heat test	Overcurrent test	Test for electrodynamical and thermal strength at short-circuit current	Test of a tank for tightness and strength at a higher internal pressure	Test of a sample of non-combustible liquid dielectric
1	Power ones:											
	three-phase rated at 6,3 kVA and over, and single-phase rated at 4,0 kVA and over	+	+	+	+	+	+	+	+	+	+	+
	three-phase rated under 6,3 kVA, and singlephase rated under 4,0 kVA	+	+	+	—	+	+	+	+	+	—	—
2	Instrument ones:											
	voltage	+	+	+	+	+	—	+	—	+	—	—
	current	+	+	+	+	+	—	+	—	—	—	—

Notes: 1. Symbols – refer to Table 10.7.1.1.
2. The test of electrical strength of air gaps is carried out for transformers for voltage 1 kV and over.

combined with the heat test. The value to be checked is calculated from the formula:

$$\Delta U = \frac{U_0 - U_r}{U_r} 100.$$

A value of ΔU shall be less or equal to 5 % for transformers rated below 6,3 kVA, less or equal to 2,5 % for those rated 6,3 kVA and over.

10.7.2.3 In heat testing, the following shall be taken into account:

.1 the test shall be carried out by direct loading of transformers at rated voltages across terminals and rated currents in windings;

.2 in testing transformers with a non-combustible liquid dielectric, a temperature rise for upper layers of the latter over the temperature of a cooling medium is also determined.

10.7.2.4 The test for electrodynamical and thermal strength at short-circuit current is performed at an external short-circuit for compliance with the maximum values specified in the technical documentation for a transformer.

For three-phase rated 6,3 kVA and over, and single-phase rated over 4 kVA transformers, the test shall be performed under the following conditions:

.1 a test set shall provide the required value of a shock short-circuit current via the transformer with an accuracy of ± 5 % of the rated one and the duration of short-circuit conditions therewith at least 0,5 s;

.2 the test set shall provide the flow of a steady-state short-circuit current via the transformer with an accuracy of ± 10 % of the rated value and the duration of short-circuit conditions corresponding to the time of thermal short-circuit strength of the transformer (at least 3 s);

.3 the voltage (of frequency 50 Hz) shall ensure the above conditions;

.4 prior to the beginning of the test, the transformer shall be thoroughly examined with a view to compare its condition prior to, and after, the test. Moreover, prior to the beginning of these tests, open-circuit and short-circuit tests of the transformer shall be carried out. The data of insulation resistance measurements and insulation strength tests, also necessary for the following comparison, may be taken from the previous tests;

.5 the test may be performed both by using a special appararus for producing a short-circuit at terminals of the second winding of the transformer pre-connected in a circuit and by connecting in the circuit the transformer with the preliminary closed-coil secondary winding;

.6 the test shall be performed for each secondary winding, but if these have taps, then both with all the turns connected and with their minimal number.

The results of adjusting short-circuits are ignored as the test ones;

.7 the test shall be performed with the heated transformer at a temperature close to the maximum reached in the heat test;

.8 during the tests, the voltage and current at input, and the current in a short-circuited winding shall be recorded using an oscillograph.

It is recommended to measure forces in support structures;

.9 following the tests, the check open-circuit and short-circuit tests shall be carried out, insulation resistance shall be measured and the thorough examination of the transformer shall be performed. If all checks are satisfactory, insulation strength (at voltage equal to 0,8 time the full test voltage) and interturn insulation shall be tested, whereupon the transformer shall be disassembled if necessary;

.10 the transformer is considered to have passed the test if no deformations, turns sliding, essential change of colour were revealed in examination, and comparison tests were satisfactory. Insignificant residual axial shiftings of windings and insignificant residual deformations of yoke beams, if these are within the standard limits, may be ignored in evaluating the test results.

The test for electrodynamical and thermal strength at short-circuit current of other transformers shall be carried out in accordance with standards or, if these latter are lacking, with the other approved technical documentation for transformers.

10.7.2.5 Transformer tanks for non-combustible liquid dielectric shall be tested for tightness and strength at an surplus pressure. The test technique, surplus pressure and criteria for evaluating the results shall be specified in the technical documentation for such transformers. Additionally, the records shall be submitted on testing the liquid dielectric taken from the tank of such a transformer, and on determining the conformity of breakdown voltage and the dielectric loss tangent with technical documentation.

10.7.3 Tests of static converters.

10.7.3.1 The scope of tests and checks for static converters is given in Table 10.7.3.1.

10.7.3.2 In testing insulation, the strength of interturn insulation of the converter transformer (or the document to the effect that the transformer has passed such a test) shall also be checked.

10.7.3.3 In testing for overload, having completed a duty at the maximum temperature reached by the converter in overload, the functioning of overload protection, if provided, shall be checked. The current and the time of protection activation, as well as other pertinent parameters shall be checked for conformity with technical documentation.

10.7.3.4 The test for electrodynamical and thermal strength at short-circuit current shall be carried out under the following conditions:

.1 the short-circuit test shall be performed at the maximum short-circuit current withstood by the converter;

.2 the test at the maximum permissible short-circuit current shall be performed with the converter in

Table 10.7.3.1

Static converters	Inspection and checks	Measurement of insulation resistance	Insulation testing	Tests for compliance with operational conditions	Heat test	Overload test	Test for electrodynamical and thermal strength at short-circuit current	Check of operation at load loss and increase	Test for immunity to switching overvoltage	Other checks	Test for permissible levels of radio interference voltage	Tests for immunity to electromagnetic emission
Rectifiers	+	+	+	+	+	+	+	+	+	+	+	+
Inverters	+	+	+	+	+	+	+	+	+	(+)	+	+
Frequency converters	+	+	+	+	+	+	+	+	+	(+)	+	+

Notes: 1. Symbols – refer to Table 10.7.1.1.
2. The scope of tests for the other types of static converters is determined in each particular case.

practically cold state, under the normal environmental conditions and at the maximum continuously permissible value of voltage at the input of the converter which picks up the rated load, by producing the short-circuit close to output terminals;

.3 the test may be performed at the minimum short-circuit current and the maximum permissible duration of its flow. This test shall be carried out with the converter in a hot state. The temperatures of the converter and the environment by the beginning of the test shall be the same as in the test for heat stability (heat test), i.e. this test shall be performed immediately after the completion of the test in a heat chamber;

.4 oscillographs shall be used in short-circuit processes.

10.7.3.5 The check of converter functioning at load loss and increase is effected at rated parameters at the converter input by means of sudden switching the load on and off according to the scheme: 0 – 50 % — 0, 0 – 100 % — 0, 0 – permissible load – 0. Oscillographs shall be used in the processes.

10.7.3.6 Tests for immunity to switching overvoltages are carried out by means of connecting the no-load converter to, and disconnecting it from, a supply source, and after that, of connecting the on-load converter carrying the maximum permissible load. An oscillogram shall evidence that the peak voltage at rectifiers therewith does not exceed their rated reverse voltage.

10.7.3.7 The other tests include checks of functioning of the control gear, alarms, filter, as well as the other checks specified in the approved technical documentation depending on the type of the converter. The stages and sequence of their performance are not regulated.

10.7.4 Tests of accumulators and accumulator batteries.

10.7.4.1 Each type of an accumulator battery shall be tested.

Accumulators are tested if delivered individually (not as a battery).

10.7.4.2 The scope of accumulator and battery tests and checks includes:

.1 inspection and checks including the level and density of electrolyte;

.2 measurement of insulation resistance (in batteries);

.3 test of insulation strength (in batteries);

.4 test for the conformity with operational conditions;

.5 test for heat stability of acid accumulators mastic;

.6 check of tightness of acid accumulator monoblock units;

.7 check for self-discharge.

10.7.4.3 Prior to the tests, batteries (accumulators) shall be subjected to the necessary number of charging-discharging cycles in order that their capacity may reach the values guaranteed in technical documentation, and the results of their rated capacity check shall be submitted.

10.7.4.4 Tests by vibratory and shock loads shall be carried out as follows:

.1 fully charged batteries (accumulators) prepared according to 10.7.4.3 shall be exposed to vibratory and impact effects in three mutually perpendicular directions; in this case, any plugs preventing an outflow of electrolyte may be used;

.2 in tests for vibration resistance and shock resistance, the batteries shall be connected to a monitoring circuit. The current and voltage therewith shall be stable.

10.7.4.5 Having completed all the tests by vibratory and shock loads, the batteries shall be subjected to discharging to check the rated capacity which shall not be less than that specified in technical documentation (minus the energy consumed in the monitoring circuit).

10.7.4.6 In the test for heat stability, the battery shall be charged and discharged at a temperature specified in Table 10.5.4.1.3. The charge and discharge modes may be normal or accelerated, being selected in each particular case. However the obtained values of voltage, current and capacity shall be consistent with those specified in the technical documentation for the battery.

The test for cold endurance is carried out in a similar way.

Starter batteries shall be discharged in a starter mode.

10.7.4.7 The batteries are tested for resistance to motions and prolonged inclinations only for the purpose of checking the absence of electrolyte leakage.

The batteries with the maximum permissible level of electrolyte shall be exposed to motions according to 10.5.3.7 followed by alternate inclinations at 40° to the vertical for 10 min to both sides lying in two mutually perpendicular planes. In motions and inclinations, no electrolyte traces shall appear on the accumulators surface (plugs may be closed, but no sealing parts are allowed).

10.7.4.8 The test for heat stability of acid batteries mastic may be carried out with specimens not used in other types of tests. At first, the batteries are tested without electrolyte during 6 h at a temperature of +60 °C inclined at 45° to a normal position, and then, after cooling down to the normal test temperature, during 6 h at a temperature of −40 °C in a normal position. No mastic runs are allowed after heating, and no mastic breaks, cracks and breaks-away from monoblock unit covers after cooling.

10.7.4.9 The check of tightness of an acid battery monoblock unit shall be carried out after the battery exposure to all mechanical and temperature effects with due regard for the following conditions:

.1 if the batteries other than those which had passed the mechanical tests, were tested for mastic heat stability, the check of tightness shall be performed both with the batteries which have passed the mechanical and environmental tests and with the batteries tested for heat stability only;

.2 the battery tightness is checked by applying inside it an increased or lowered pressure differing from the atmospheric one by 133 ± 9 N/m^2 during 4 s to 5 s.

The battery is considered to have passed the check if the manometer or vacuum gauge reading does not change.

The positive result of the check confirms the mastic stability to mechanical and thermal effects;

.3 the tightness of battery without topping-up necks is checked by applying inside it an overpressure until safety valves activation.

10.7.4.10 The check for self-discharge consists in checking the residual capacity of the previously fully-charged battery, which has passed the tests for compliance with operational conditions, after 28 days out of operation at a temperature of 25 ± 5 °C. The loss of capacity due to self-discharge shall not exceed 30 % of the rated capacity for acid accumulators and 25 % for alkaline ones.

10.7.5 Tests of switchgear.

10.7.5.1 The scope of switchgear tests and checks is given in Table 10.7.5.1.

10.7.5.2 In addition to the specified in 10.4.1, the following shall be checked in inspection and checks:

.1 arrangement of controls and indicators of the switching state of apparatus (on-off positions);

.2 arrangement of instruments and pilot lamps;

.3 colour of pilot lamps and control buttons;

.4 inscriptions and signs on plates and their arrangement, single-line diagrams of power circuits, mimic panels;

.5 composition, arrangement, installation, parameters and characteristics of apparatus, devices and accessories;

.6 arrangement, fastening and painting of busbars;

.7 wires laying and fastening;

.8 condition of surface treatment of current carrying and insulating parts and units;

.9 insulation distances;

.10 availability and workmanship of the earthing of fixed and slide-out elements and the elements fitted on opening structures to the console board frame, as well as availability and workmanship of the units for earthing each section of the console board to the ship's hull;

.11 implementation of arrangements on protecting current carrying parts against ingress of liquid if hydraulic or liquid-cooled devices and apparatus are available;

.12 holding of opening and slide-out doors, boards, panels, etc. in open position.

10.7.5.3 In addition to the provisions of 10.6.1, the heat test shall be carried out with due regard for the following:

.1 cables shall be terminated at products with a bottom entry in the same way as onboard a ship in order to take into account the additional heating of cables;

.2 the number of cables shall to correspond to the number of product power circuits which may function simultaneously in operational conditions;

.3 cables cross-section area shall correspond to that specified in a connection diagram;

.4 cables heat release, that is potential in operation, may be simulated in any other equivalent way;

.5 in testing, the temperature of heating current-carrying and insulating parts, the air inside an enclosure, the product enclosure and an ambient air shall be measured.

10.7.5.4 The test of switchgear for electrodynamical and thermal strength at a short-circuit current shall be carried out with due regard for the following conditions:

Table 10.7.5.1

Switchboards and consoles	Inspection and checks	Measurements of insulation resistance	Test of insulation strength	Tests for compliance with conditions of equipment operation onboard a ship	Heat test	Test for electrodynamical and thermal strength at short-circuit current	Other tests and checks	Test for permissible levels of industrial radio interference voltages	Tests for immunity to electromagnetic emission
Switchboards and consoles of electrical propulsion installation control, monitoring and alarm	+	+	+	+	+	(+)	refer to 10.7.5.6	(+)	+
Ditto for main machinery	+	+	+	+	+	—		(+)	+
Ditto for electric installation	+	+	+	+	+	—			
Ditto for auxiliary and deck machinery	+	+	+	+	+	—		(+)	+
Ditto for navigation lights	+	+	+	+	+	refer to 10.7.5.6.5		+	+
Main and emergency switchboards	+	+	+	+	+	+		(+)	+
Other switchboards and devices (including fuse boxes)	+	+	+	+	+	+		(+)	+
Charging switchboards	+	+	+	+	+	—			+
Switchboards of external feed source	+	+	+	+	+	(+)		(+)	+

Symbols:
" + " = test (check) is needed;
"(+)" = test (check) performance depends on the particular type of a product;
" – " = test (check) is not needed.

.1 three-phase current switchboards may be tested by a single-phase short-circuit current provided it is alternately conducted in each two adjacent phases of a power circuit. In such cases, the maximum value of a shock short-circuit current is reduced by 7 % as compared with the amplitude value of the limiting short-circuit current specified in the switchboard technical documentation;

.2 switchgear power circuits are subject to testing. The scheme of tests shall be approved by the Register as part of the test program and procedure;

.3 prior to the beginning of tests for electrodynamical strength, distances between currentcarrying parts in a number of cross-sections mostly potential for deformations shall be measured. These distances shall be checked each time after switching on a shock current;

.4 if the electrodynamical strength of apparatus is below the rated strength of switchboard busbars, such apparatus may be shunted or replaced by jumpers of which the locations shall be specified in the test scheme;

.5 tests of apparatus shall be carried out according to the requirements of 10.7.6.3 to 10.7.6.5.

10.7.5.5 A switchboard is considered to have passed the thermal short-circuit test if:

.1 no deformation or break-down of current-carrying parts and their fastenings has occurred;

.2 no actuation of disconnector blades, contacts disconnection or freezing have occurred;

.3 a temperature of current-carrying parts has not exceeded the permissible one;

.4 no other damages interfering with the normal switchboard functioning are detected;

.5 no deterioration of the switchboard insulation has been deteced in testing the insulation strength following the thermal short-circuit test.

10.7.5.6 Among other tests and checks depending on a particular switchgear may be:

.1 run-up of apparatus and drives thereof. It applies to the apparatus and drives jointed in assembly of a switchboard, to the apparatus consisting of separate parts (e.g. bladed-type apparatus), to generator and section switches, as well as to the other apparatus (e.g. contactors and relays) if these are not subject to the operational test;

.2 check of interlocks functioning. The reliability of interlocks operation shall be repeatedly checked during testing for vibration and shock resistance, heat stability and cold endurance, and after the completion of these tests. Electrical interlocks shall be checked at the maximum permissible deviations of voltage and frequency from the rated values;

.3 test of the switchboard structure for mechanical strength at repeated switching operations. Such a test applies to apparatus of which switching on and off need significant forces. The test is carried out by means of repeated switching operations (at least 100 cycles) using

each apparatus. After testing, the switchboard structure shall be thoroughly examined in the area of apparatus and their drives fastening;

.4 operational test. Such a test applies to control, monitioring and alarm circuits of all switchboards and consoles, where available, in testing for resistance to mechanical and environmental effects what is of the particular importance for circuits with relay-contact elements.

In addition, the operational test of navigation lights switchboard shall be carried out at the maximum permissible continuous and short-time deviations of voltage and frequency from the rated values (in testing for vibration and shock resistance, heat stability and cold endurance);

.5 the short-circuit test of navigation light switchboards provides for the check of protection actuation at a short-circuit in the line to a navigation light, and the check of the switchboard in the process. The test shall be performed alternately for two lines with two short-circuits in each line.

The results of short-circuit tests are considered satisfactory if:

protection has switched off an emergency line;

an alarm on the switching-off of the emergency line has been activated;

the other lantern lines have continued operation what is evidenced by functioning of the alarm of the circuit under test;

switchboard elements have remained operational with no replacements excepting fuse links of fuses;

the test of insulation strength has confirmed a satisfactory condition of insulation;

the examination result is positive;

.6 the check of the voltage drop at navigation light switchboard alarm elements connected into the circuits of these navigation lights confirms its tolerable level.

10.7.6 Tests of electrical (switch, protection, control) apparatus.

10.7.6.1 The scope of tests and checks of electrical apparatus is given in Table 10.7.6.1.

Table 10.7.6.1

Apparatus	Inspection and checks	Measurements of insulation resistance	Test of insulation strength	Tests for compliance with conditions of equipment operation onboard a ship	Heat test	Check of operate (and reset) value	Test for limiting switching capacity	Test for electrodynamical and thermal strength at short-circuit current	Check of functioning of manual and motor drives and of position indicator	Operatomal test of a circuit	Tests for permissible levels of industrial radio interference voltages	Tests for immunity to electromagnetic emission	Other tests (and checks)
Circuit breakers	+	+	+	+	+	+[1]	+	+[2]	+	+	—	+	—
Breakers, switches, disconnectors	+	+	+	+	+	—	+	+[2]	+	—	—		—
Fuses	+	+	+	+	+	+[1]	+[3]	—	—	—	—		+[4]
Contactors, relays	+	+	+	+	+	+	+	+[5]	—	—	—	+	+[6]
Starters and controllers (including master controllers), starter and starting-regulating rheostats	+	+	+	+	+	+[7]	+	+[5]	+	+	+[8]	+	+[6]
Field rheostats, resistors in boxes	+	+	+	+	+	—	—	—	+[9]	—	—		—
Electromagnetic couplings[10]	+	+	+	+	+	—	—	—	—	—	—	+	+[11]
Electromagnetic brakes of electric motors, brake electromagnets, electro-hydraulic pushers	+	+	+	+	+	+	—	—	—	—	—	+	+[12]
Push-button and limit switches	+	+	+	+	+	—	+	—	—	—	—		—
Magnetic amplifiers, reactors, chokes	+	+	+	+	+	—	—	(+)	—	+[13]	—	+	(+)
Apparatus, blocks, modules with contactless elements	+	+	+	+	+	—	—	—	—	—	(+)	+	(+)
Generator protection devices	+	+	+	+	+	+	+	(+)	—	+	(+)	+	(+)

Symbols:
" + " = test (check) is needed;
"(+)" = test (check) performance depends on the particular product (i.e. on its desgn, principle of operation, purpose, location onboard a ship, etc.);
" – " = test (check) is not needed.

10.7.6.2 In addition to the specified in 10.4.1, the inspection and checks shall be conducted when the following conditions are met:

.1 for apparatus intended for integration in electrical switchboards and other products, the fastenings, convenience of mounting and disassembly in operational conditions are checked;

.2 in products incorporating other apparatus (in controllers, rheostats, etc.), the adjustment of these apparatus for set parameters is checked;

.3 correct earthing and a contact pressure, a contact gap and follow-up are checked.

10.7.6.3 The check of operate and reset values for apparatus shall be carried out when the following conditions are met:

.1 it is essential to make sure that the apparatus operation and reset at the limiting permissible deviations from the rated values of voltage, current and frequency occur (do not occur if are not supposed to);

.2 in checks of electromagnetic apparatus, a power source (a supply circuit) shall provide an opportunity to receive steady parameters of electric power.

The travel of the electromagnet armature shall not essentially impact the set voltage and current;

.3 checks shall be carried out in the hot and cold state of the apparatus when its parts have reached the thermal equilibrium during tests for heat stability and cold endurance. In the apparatus with voltage coils in a hot state, sufficiency of the force developed by an electromagnet to activate the apparatus at the minimum permissible values of voltage and frequency is also checked; in the apparatus with voltage coils in a cold state, the check concerns the mechanical strength of the apparatus activated at the maximum permissible voltage across the electromagnet coil;

.4 at least three measurements of parameters shall be made in activation; for d.c. coils, at least six mesurements (by threes of each polarity);

.5 the measurements shall be evaluated in terms of the worst result;

.6 for apparatus with d.c. voltage coils, an operate voltage U_op may be determined indirectly, i.e. by measuring an operate current I_{op} with the following recalculation of the result by the formula:

$$U_{op} = I_{op}\ R_t$$

where R_t = active resistance of a coil at a test temperature, Ohm;

.7 protective characteristics, if a time delay depends on the apparatus temperature, are determined in heating with constant current beginning with the cold state of the apparatus.

10.7.6.4 The purpose of the test for limiting switching capacity is to make sure that this capacity corresponds to the one specified in technical documentation. The test shall be carried out when the following conditions are met:

.1 depending on the apparatus type and the requirements of the technical documentation for the apparatus, all or some of the following parameters are checked:

maximum breaking capacity;

maximum making capacity;

the apparatus capability to withstand one or more cycles consisting of the following one after the other operations of the switching-on and automatic switching-off of the maximum current which defines the maximum switching capacity of the apparatus;

the apparatus capability to switch off the currents which are lesser than those defining the maximum breaking capacity of the apparatus; it is also checked the apparatus capability to switch off its critical currents if the zone of such currents is not specified in the technical documentation for the apparatus;

.2 potentials of the test installation shall be consistent with the requirements of the Register approved technical documentation;

.3 the apparatus under test shall be installed and tested in a normal working position;

.4 all the apparatus parts to be earthed in operation, as well as all its current-carrying parts having no electrical links with the circuit under test, in order to ascertain that no arc overthrow to them occurs in testing for breaking capacity (including the switching-off of critical currents), shall be electrically-interconnected and terminated at the neutral of a power source or an artificial neutral point;

.5 if the ionized zone created by an arc is not limited by the apparatus enclosure, the boundaries of the ionized zone of the apparatus discharge shall be checked for compliance with the boundaries specified in technical documentation. For this purpose, steel gratings or perforated plates (recommended: plate thickness – 3 mm, hole diameter – 7 mm, distance between hole centres – 10 mm) electrically-interconnected and terminated as specified in 10.7.6.4.4 shall be arranged on the zone boundaries;

.6 the boundaries of a flameout in switching the maximum current off shall be checked (for this purpose, it is recommended to arrange flammable material on the flameout zone boundaries specified in the technical documentation for the apparatus);

.7 tests shall be carried out at the limiting value of the time constant (power factor) of the circuit, as well as at the values for which the most severe conditions of commutation are expected (to be specified in the test program and procedure). In each three-phase circuit, a power factor shall not depart from an arithmetic mean of the power factor of three phases by more than ± 15 %;

.8 to avoid the improvement of test conditions for apparatus for which an opening time essentially depends on the setting value of releases, such apparatus shall be tested being adjusted for the maximum and minimum values of the opening time;

.9 to avoid the improvement of test conditions for single-pole apparatus designed for operation in three-phase circuits (e.g. fuses), such apparatus shall be tested being simultaneously connected in all the phases in accordance with the conditions of their application (because during testing in a single-phase circuit, the opening may occur at a favourable current phase);

.10 during tests, oscillography shall be used for currents at apparatus poles and the voltage across input terminals;

.11 the test for maximum breaking capacity shall be carried out with fuses with fuse links for rated current;

.12 the test of switching capacity of controllers, starter and starting-regulating rheostats shall be carried out with controllers (rheostats) connected in the circuit of an electric drive.

The output of the motor used in the test and test conditions (starts, reverses, overloads, current commutation for a braked motor, etc.) are subject to special consideration by the Register in each case.

The apparatus is considered to have passed the test for switching capacity if during the test:

no damage interfering with the normal operation of the apparatus has occurred (a need of insignificant repair is allowed, e.g. contacts cleaning or replacement);

no enclosure failure, insulation degradation or other defects interfering with the further operation of the apparatus, but potentially hazardous for the service personnel have occurred;

no arc overthrow between poles, to the metallic enclosure and the other earthed and current-carrying parts has been observed;

the arcing time did not exceed the values specified in the technical documentation for the apparatus;

no contacts weld has occurred.

10.7.6.5 Test for electrodynamical and/or thermal strength.

The test purpose is to check the apparatus capability to withstand a mechanical and/or thermal action of limiting short-circuit currents specified in the technical documentation for the apparatus.

The test shall be conducted when the following conditions are met:

.1 the test circuit voltage shall be sufficient to prevent the current break in the circuit when contacts are opened by electrodynamic forces;

.2 if the apparatus design provides for an opportunity to adjust a contact pressure, the test shall be performed at the rated working values of pressure specified in the technical documentation for the apparatus;

.3 the test may be started with the apparatus in a cold state. A shock current shall be switched on at least three times (switchings-on in adjustment are ignored). Intervals between shock current supplies shall be such that the currentcarrying parts of the apparatus could cool down to a temperature corresponding to their continuous operation at the full load.

The test for thermal strength is recommended to combine with the last switching-on of shock current. Otherwise, it shall be started by the switching-on of shock current at the above working temperature of the apparatus;

.4 means for measuring a temperature in the test for thermal strength shall provide readings within not more than 2 s;

.5 switching-on and -off of the test circuit shall be carried out by the apparatus of a test installation. The parameters of the short-circuit process shall be monitored by means of an oscillograph.

The apparatus is considered to have passed the test in the absence of the following:

contacts weld;

spontaneous switching-off;

extreme heating of parts (in excess of the specified in the technical documentation for the apparatus);

arc overthrow between poles, to adjacent electrically-independent current-carrying parts, an enclosure and other earthed metallic parts;

occurrence of external effects hazardous for the service personnel;

damages preventing its further normal operation.

10.7.6.6 The check of the driving gear of a circuit breaker shall be carried out according to 10.7.6.3.

The following shall also be checked:

.1 reliability of breaker opening by means of any of releases with an excited closing device;

.2 impossibility to close the breaker if a closing operation begins while an opening device is still active;

.3 absence of hazard for the personnel and of breaker damages in wrong actions (actuation of the closing device with the closed breaker and of the opening device with the opened breaker);

.4 transition to a manual drive and vice versa;

.5 safety of the personnel and the lack of a possibility to damage the apparatus using the manual drive and simultaneously remotely closing (opening) driving gear circuits;

.6 functioning of interlocking against repeated closings of the breaker for short-circuit (recommended to be combined with the test for the limiting switching capacity of the apparatus).

10.7.6.7 The test for the maximum nonfusing current and the minimum fusing current applies to fuses with fuse links taking into account the following:

.1 the test for the maximum nonfusing current shall be performed with fuses with fuse links having the maximum electrical resistance, and for the minimum fusing current, with fuse links having the minimum resistance;

.2 the temperature in testing shall be consistent with the one specified in technical documentation.

If within the time specified in technical documentation, the fuse does not interrupt a circuit in the test for the

maximum nonfusihg current, and within the time not exceeding the one specified in technical documentation, interrupts the circuit in the test for the minimum fusing current, the fuse has passed the test.

10.7.6.8 Time-current and ampere-second characteristics of fuses shall be checked against the oscillograms obtained in testing for breaking capacity.

10.7.7 Tests of capacitors and capacitor sets for raising a power factor.

10.7.7.1 The scope of tests and checks for capacitors and capacitor sets includes:

.1 inspection and checks;

.2 measurement of insulation resistance;

.3 test of insulation strength;

.4 test for compliance with operational conditions of equipment onboard a ship;

.5 check for tightness;

.6 measurement of a loss-angle tangent;

.7 test for thermal stability;

.8 test for discharge;

.9 check of duration of capacitors operation;

.10 check of protection functioning;

.11 check of functioning of the set automation (if any).

10.7.7.2 Testing capacitor sets for compliance with operational conditions onboard a ship, instead of the test for heat stability, the test for so-called thermal stability is carried out at a temperature in a thermal chamber by 5 °C exceeding the one specified in Table 10.5.4.1.3 and at the voltage across the terminals at least 120 % of the rated one with a frequency of 50 Hz. After a warm-up to the thermal equilibrium, capacitors are held during 48 h. The results of tests are considered satisfactory if the loss-angle tangent and the change of an enclosure temperature during the last 10 h are within the limits set in technical documentation.

If essential changes are observed, the test is continued untill stabilization or breakdown.

10.7.7.3 The test of a protective enclosure is carried out on complete capacitor sets only (e.g. to be tested is the cabinet enclosure wherein capacitors are located).

10.7.7.4 The check for tightness is performed with a purpose to make sure that an impregnating dielectric does not leak. Capacitors are held in a thermal chamber at a temperature of 105 °C to 110 °C untill the full heating round the whole volume during 8 h to 16 h (depending on overall dimensions), and then are cooled down at a temperature of 5 °C to 35 °C during the same time, are heated again and cooled down in the same way.

10.7.7.5 The test for discharge is carried out by means of five short-circuited dicharges after charging by the d.c. double rated voltage. Not later than in 5 min after that, the strength of insulation between armatures shall be tested.

Capacitors are considered to have passed the test if the change of their capacity measured prior to the test for discharge and after the test of insulation strength does not exceed 2 %.

10.7.7.6 The check of capacitors protection functioning shall demonstrate that with the capacitor element breakdown its fuse operates and the capacitor does not fail, and to confirm the right choice of protection and the immunity of the capacitor set to short-circuit current effects.

On completion of the check, the set shall be thoroughly examined and insulation parameters shall be checked.

10.7.8 Tests of busbars.

10.7.8.1 The scope of busduct tests and checks shall include:

.1 inspection and checks;

.2 measurement of insulation resistance;

.3 test of insulation strength;

.4 test for compliance with operational conditions onboard a ship;

.5 heat test;

.6 overload test if overload specified in technical documentation;

.7 test for electrodynamical and thermal strength at short-circuit current (may be replaced by calculation for large values of output).

10.7.8.2 Mechanical tests apply to all the busbar elements being different from the others in design (straight, angular, tee and other sections, junction boxes) assembled in various combinations in several spans.

If supports are signicantly spaced, it is allowed to test several single busbar spans installed and secured to a stand on two supports each.

10.7.8.3 The heat test shall be performed at least with three interconnected and end-closed various elements of the busbar which are most representative for such a test. The same busbar elements shall be used in the overload test.

10.7.8.4 The test for electrodynamical and thermal strength at short-circuit current shall be performed with busbar sections and junction box types which are most representative for a given design. Otherwise, the provisions of 10.7.5.4 to 10.7.5.5 shall be followed in the test.

10.7.9 Tests of electrical measuring instruments.

10.7.9.1 Tests of electrical measuring instruments (voltmeters, ammeters, wattmeters, frequency meters, meggers, synchronoscopes, phase indicators, phase meters) and their parts outside the very instrument shall be carried out in the following scope:

.1 inspection and checks;

.2 measurement of insulation resistance;

.3 test of insulation strength;

.4 test for compliance with operational conditions onboard a ship;

.5 heat test;

.6 overload test;

.7 check of a basic error (including variations);

.8 check of a complementary error;

.9 check of the voltage and intensity level for an electromagnetic field of radio interference;

.10 tests for immunity to electromagnetic emmision.

10.7.9.2 The test for compliance with operational conditions onboard a ship is carried out with due regard fot the following:

.1 in tests for vibration resistance and shock strength, the electrical load of an instrument shall be equal to about 65 % to 70 % of the rated one, and half the amplitude of indicator oscillations and the change of readings shall not exceed the tolerable basic error of the instrument;

.2 in tests for resistance to motions and prolonged inclinations, the change of instrument readings in the working section of a scale shall not exceed the value of the basic error;

.3 in tests for heat stability and cold endurance, the changes of instrument readings due to the variation of the temperature of an ambient air in a test chamber within the range of the maximum and minimum working temperature shall be checked. The values obtained shall not exceed those permitted by technical documentation.

10.7.9.3 Heat and overload (long-term and impulse) tests, checks of a basic error, variation and complementary error (i.e. check of the effect of external factors defining the complementary error, like the change of an instrument inclination, of a temperature, voltage, frequency, voltage or current curve form, an external magnetic and electric field, the effect of an adjacent instrument and a ferromagnetic shield whereon the instrument is placed) are carried out according to the technical documentation agreed in accordance with an established procedure.

10.7.10 Tests of electric drives and electrical equipment of machinery and arrangements (as a set).

10.7.10.1 The accessories provided by the RS Nomenclature and being part of the electric drive or electrical equipment of a mechanism (an arrangement), prior to the beginning of tests as part of such circuits, shall pass post-manufacturing tests in the appropriate scope specified in this Section.

10.7.10.2 The scope of tests and checks of electrical equipment circuited as electric drives is given in Table 10.7.10.2. The latter ignores the electric drives of propulsion plants of which the scope of tests is subject to special consideration by the Register in each case.

10.7.10.3 The scope of tests according to Table 10.7.10.2 is compulsory for both the manufacturers (suppliers) of electric drives and the manufacturers of machinery if these provide machinery with electric drives.

10.7.10.4 If single types of tests of electric drive specimens cannot be carried out on a stand, the Register can allow the performance of such tests (checks) onboard a ship during mooring and sea trials (e.g. tests of electric drives of the propulsion plant) what shall be specially agreed by the developer (manufacturer) of the electric drive in the technical documentation for its supply for taking into account in the programs and procedures of ship's mooring and sea trials.

10.7.10.5 Additionally to electric drives, the sets of electrical equipment for lifts also include alarm and lighting circuits (with elements), for watertight doors include alarm circuits, for refrigerating plants in addition to electric drives may include measurement circuits and alarm circuits.

Because of this, the functioning of all the other circuits and elements in all potential and rule-required versions of their operation shall be checked during integrated tests of such electrical equipment.

10.7.10.6 The inspection and checks of electric drives are carried out in the main in order to ascertain the conformity of electrical equipment and its connection diagrams with technical documentation.

10.7.10.7 The insulation resistance of circuits shall be measured in a practically cold and hot (following the on-load test) states.

10.7.10.8 The check of functioning of a discharging magnetic field energy is carried out in the circuits of d.c. electric drives (with shunt- and compound-wound motors) both with the switched discharging resistor circuit of a parallel winding and with the permanently closed one. In the first case, the timeliness of circuit closing and the discharging effect are checked – voltage therewith is across the winding, in the second case, the discharging effect only.

10.7.10.9 If limit switches are impractical, due to design reasons, to arrange under stand conditions similarly to the operational version, they shall be at least connected to appropriate circuits to check the diagram functioning.

10.7.10.10 The check of a drive for no-load functioning involves repeated starts, stops, reverses and operation of the drive for every speed during the time sufficient for being convinced of the normal operation of the drive and for measuring the necessary parameters.

10.7.10.11 The test of a drive for on-load functioning at machinery manufacturers shall be carried out according to the Register approved program and procedure for tests of the mechanism in all the modes of its on-load and overload operation.

10.7.10.12 The stalling test shall be carried out to check the timeliness of drive protection activation.

Besides electric drives of anchor and mooring machinery, this test applies only to those electric drives of the rudder and steering gear which are rigidly joined to the rudder stock (e.g. with a gear drive, screw gear, steering line transmission).

10.7.10.13 The functioning of overload protection shall be checked at long-term and short-time overloads of a driving gear.

The check at electric drive manufacturers may be carried out with use of special electrical loading devices.

Table 10.7.10.2

Nos.	Apparatus	Inspection and checks	Measurements of insulation resistance	Check of manual interlock functioning	Check of functioning of discharging magnetic field energy	Check of electromagnetic brake functioning	Check of undervoltage protection functioning	Check of automatic start after voltage recovery	Check of limit switches functioning	Other checks of diagrm functioning	Check of no-load drive operation	Test of on-load drive operation	Stalling test	Check of overload protection functioning	Tests for permissible level of voltage and intensity of radio interference field	Tests for immunity to electromagnetic emission
1	For auxiliary machinery (pumps, compressors, fans, air blowers, separators, etc.)	+	+	—	(+)	—	+	—	—	(+)	+	+	—	+	+	+
2	For deck machinery:															
	.1 steering gear	+	+	(+)	(+)	—	—	+	+	(+)	+	+	(+)	+	+	+
	.2 anchor machinery	+	+	(+)	(+)	+	+	—	—	(+)	+	+	+	+	+	+
	.3 mooring machinery	+	+	(+)	(+)	+	+	—	—	(+)	+	+	+	+	+	+
	.4 towing machinery	+	+	(+)	(+)	+	+	—	—	(+)	+	+	—	+	+	+
	.5 ship's crane, derrick and hoist machinery	+	+	(+)	(+)	+	+	—	+	(+)	+	+	—	+	+	+
	.6 boat winches	+	+	+	(+)	+	+	—	+	(+)	+	+	—	+	+	+
3	For lifts	+	+	+	(+)	+	+	—	+	(+)	+	+	—	+	+	+
4	For watertight doors	+	+	+	(+)	—	—	+	+	(+)	+	+	—	+	+	+
5	For pipe fittings	+	+	+	(+)	—	(+)	(+)	+	(+)	+	+	—	+	+	+
6	For refrigerating plants	+	+	—	—	—	+	—	—	(+)	+	+	—	+	+	+

Symbols – refer to Table 10.7.5.1.

10.7.11 Tests of electrical equipment of electrically-started internal combustion engines.

10.7.11.1 The accessories specified in the RS Nomenclature and being part of the electrical equipment of electrically-started internal combustion engines, prior to the beginning of tests as part of the electrical equipment circuits of such engines, shall pass post-manufacturing tests in the appropriate scope specified in this Section.

10.7.11.2 The tests of the electrical equipment set for internal combustion engines shall be carried out when the equipment is mounted in its standard positions on the engine which it is intended for.

At the electrical equipment manufacturers, simulators (if an internal combustion engine is unavailable) may be used separately for a charging generator drive, loading of a starter and starting relay, etc.

Bench tests with use of simulators shall be fully equivalent to tests on an internal combustion engine.

10.7.11.3 Tests and checks shall be carried out in the following scope:

.1 inspection and checks (for conformity of products and their connection diagrams with technical documentation);

.2 measurement of insulation resistance in a practically cold state;

.3 test of starting circuit functioning;

.4 test for functioning of the accumulator battery charging circuit;

.5 check in operation of other circuits and elements (if any);

.6 measurement of insulation resistance in a hot state of products;

.7 test for the permissible level of industrial radio interference voltages;

.8 tests for immunity to electromagnetic emission;

.9 check of electrical equipment heating with an internal combustion engine;

.10 check of the electrical equipment condition after tests (with disassembly if needed).

10.7.11.4 The test of starting circuit functioning should be carried out by means of at least three series of starter switchings-on beginning with the practically cold state of the starter and the internal combustion engine. Each series comprises ten switchings-on having a duration of 5 s to 6 s at the maximum load of the starter. Intervals between working periods shall be within 6 s to 10 s, between series, the minimum necessary for starter cooling.

10.7.11.5 The test of the charging circuit of an accumulator battery shall be carried out in all possible modes of internal combustion engine operation untill the full charge of the discharged battery. The engine speed at which the battery is switched on for charging, the speed (at speed drop) at which the battery is switched off of the charging circuit, the presence and the value of reverse current shall be recorded.

Generator regulators (voltage regulators) with contact and contactless elements shall be checked with standard generators and a corresponding accumulator battery.

10.7.11.6 The test for the permissible level of industrial radio interference voltages shall be performed alternately for each circuit (battery charging, starting, etc.). All the equipment shall be interconnected with cables (wires) of the brands and cross-sections specified in circuits and the continuity of shielding for circuits with shielded cables shall be ensured.

10.7.12 Tests of lighting fixtures and control gear of gas-discharge lamps.

10.7.12.1 The scope of tests and checks of lighting fixtures and control gear of gas-discharge lamps is given in Table 10.7.12.1.

10.7.12.2 Control gear for lighting fixtures with gas-discharge lamps, if intended for installing separately from the lighting fixture, shall be tested in combination with the lighting fixtures excepting the cases specified in 10.7.12.3 and 10.7.12.4.

10.7.12.3 The heat stability test applies only to the control gear that is intended for installing separately from a lighting fixture.

10.7.12.4 The heat test shall be performed with due regard for the following:

.1 the test voltage shall be equal to 1,1 times the rated one, the lamp power is the largest the lighting fixture is designed for;

.2 in testing, deckhead and bulkhead lighting fixtures shall be secured on a wooden board of at least 15 mm thick coated with a black dull paint.

The lighting fixtures to be integrated in deckheads are installed on a mock-up.

10.7.12.5 The test for constancy of material characteristics shall be performed in a heat chamber when the following conditions are met:

.1 temperature in the chamber – according to Table 10.5.4.1.3;

.2 lighting fixtures with incandescent lamps shall be tested at the power by 15 % exceeding the rated power of the largest lamp the lighting fixture is designed for;

.3 lighting fixtures with gas-discharge lamps shall be tested at the voltage by 10 % exceeding the rated one;

.4 control gear intended for installing separately from a lighting fixture are not tested for the constancy of material characteristics;

.5 the test shall continue for at least 300 h;

.6 lighting fixtures are considered to have passed the test for the constancy of material characteristics if the following has not been revealed:

wire insulation drying-up and cracking;

loss of spring properties of lampholder central contacts;

flaking, cracking, fusing, burning or the change of the geometric shape of parts;

not permissible reduction of insulation resistance.

10.7.12.6 The thermal stability test shall be performed with due regard for the following:

.1 the test shall be applied to lighting fixtures having a degree of protection 1 and over (control gear intended for installing separately from the lighting fixture are not subject to testing);

.2 lighting fixtures with lamps of the largest power they are designed for, shall be kept switched on untill the thermal equilibrium is reached, whereupon the hot lighting fixtures are immediately to be exposed (being switched on) to water effects according to Table 2 of Appendix 9 (depending on the protective enclosure of lighting fixtures);

.3 a temperature of water in the test of lighting fixtures having enclosures IPX1 to IPX4 shall not exceed 20° C, enclosures IPX5 to IPX6, 15 °C;

.4 duration of water exposure shall be 15 min for lighting fixtures having enclosures IPX1, 10 min for IPX2 and 5 min for IPX3 to IPX6;

.5 the entire cycle of testing for IPX5 and IPX6 lighting fixtures shall be performed three times, i.e. after warming-up and drying-up, the hot lighting fixtures shall again be exposed to a water jet;

Table 10.7.12.1

Lighting fixtures	Inspection and checks	Measurement of insulation resistance	Test of insulation strength	Tests for compliance with operational conditions onboard a ship	Heat test	Test for constancy of material characteristics	Thermal stability test	Check of capacitors discharge time	Check of lighting fixture operation time	Test for permissible level of industrial radio interference voltage	Tests for immunity to electromagnetic emission
With incandescent lamps	+	+	+	+	+	+	+	—	—	—	+
With gas-discharge lamps	+	+	+	+	+	+	+	+	—	+	+
With accumulator and charging devices	+	+	+	+	+	+	+	—	+	—	+
Battery safe-type portable ligthing fixtures[1]	+	—	—	+	—	—	+	—	+	—	+

[1] Prior to the beginning of testing safe-type lighting fixtures (lanterns), the documents of a competent body confirming the safe type of a product shall be checked.

.6 the test for thermal stability is recommended to be combined with protective enclosure testing.

10.7.12.7 The time of capacitors discharge (after a switch-off) down to a value not exceeding 50 V shall not be more than 1 min.

10.7.13 Tests of electrical apparatus and accessories.

10.7.13.1 The scope of tests and checks of wiring accessories is given in Table 10.7.13.1.

10.7.13.2 In vibration and shock tests, all the wall plugs shall have cables of 1,4 m to 1,5 m long. These cables shall not be fitted to, or to rest on, something. They are free to hang down from wall plugs fitted into sockets. Prior to, and after the completion of, these tests, the forces applied to pull out plugs from sockets shall be measured. After testing, the forces shall not practically change. Following these tests, the state of the cable attachment and sheath in the plug shall also be checked.

Several sockets without plugs shall be tested at the same time.

10.7.13.3 In overload testing (at the voltage, current and power factor specified in technical documentation), plug junctions shall to withstand at least 60 disconnections with a frequency of 30 times per minute without contacts and insulation material burning, and plug junctions combined with breakers, 20 disconnections (not closings).

10.7.13.4 Plug-transformers with integrated fuses shall be checked for resistance to short-circuit currents by the two-fold short-circuiting of a secondary winding circuit (with the following replacement of fuse links of fuses).

Products are considered to have passed the test if the results of the electrical insulation inspection and test are satisfactory.

10.7.14 Tests of ship's apparatus and devices for intercommunication, alarm, monitioring and control.

10.7.14.1 The scope of tests and checks is given in Table 10.7.14.1.

10.7.14.2 The heat test shall be carried out at the largest continuously-permissible voltage at the inputs of products power supply. The lamps of scale lighting shall be completely switched on. The heat test of tachogenerators shall be carried out at the largest working speed and the largest (permissible) number of connected secondary devices.

10.7.14.3 The operational test of all products, excepting manual detectors and contactors, shall be performed during tests for vibration resistance, shock resistance, heat stability and cold endurance at the simultaneous limiting deviations of voltages and frequency from the rated values;

in so doing:

.1 with engine telegraphs, the precision of commands and responses transmission, and the alarm functioning are checked; with monitioring devices of ship's control, the accuracy of readings;

.2 no wrong actuations of automatic detectors of a fire detection system or instant breaks of the pilot circuit connected to them shall be recorded. Simulating the action which is to activate detectors, activations shall occur within the set limits of parameters and time period;

.3 with fire alarm stations, all monitoring and alarm circuits shall function properly. No wrong activations are allowed, but the precise one with any signal coming.

10.7.14.4 Other and special checks include:

.1 check of inscriptions and symbols distinguishability;

.2 check of audible signals loudness;

.3 electroacoustical tests, measurements and checks of telephone apparatus shall be performed in accordance with the approved technical documentation for these products following the completion of mechanical and environmental tests;

.4 operational test of fire alarm stations following the completion of mechanical and environmental tests, i.e. check of operation of all types of alarms, monitoring and interlocks in all potential versions.

10.7.14.5 The check of a permissible level of industrial radio interference voltages from monitoring devices of ship's control shall be carried out across the terminals of indicators, meters in their operation from standard sensors, tachogenerators to which they shall be connected with cables of not more than 15 m long

Table 10.7.13.1

Products	Inspection and checks	Measurement of insulation resistance	Test of insulation strength	Tests for compliance with operational conditions onboard a ship	Heat test	Overload test	Test for protection functioning at short circuit
Breakers and switches for lighting sets (for currents not exceeding 25 A)	+	+	+	+	+	+	—
Plug junctions	+	+	+	+	+	+	—
Ditto, combined with breakers	+	+	+	+	+	+	—
Plug-transformers	+	+	+	+	+	+	See 10.7.13.4
Junction (connection) boxes	+	+	+	+	+	+	—

Note. Fuses for lighting sets (for currents up to 25 A) relating to wiring accessories are ignored in the Table. They are tested, as well as junction boxes with integrated fuses, in accordance with 10.7.6.

Table 10.7.14.1

Apparatus and devices	Inspection and checks	Measurement of insulation resistance	Test of insulation strength	Tests for compliance with operational conditions onboard a ship	Heat test	Operational test	Other special checks	Check for permissible levels of industrial radio interference voltages	Tests for immunity to electromagnetic emission
Electric engine telegraphs	+	+	+	+	+	+	+	+	+
Sensors and indicators of a rudder angle and CPP blades position	+	+	+	+	+	+	+	—	+
Tachometers of propeller shafts[1]						+	+	+	+
General alarm system – devices and contactors of visual and audible alarms	+	+	+	+	+[2]	+	+	+	+
Switchboards and telephone sets	+	+	+	+	—	+	+	+	+
Devices of a fire detection system and of a warning alarm of fire-extinguishing medium release	+	+	+	+	+[3]	+	—	+[3]	+
Devices of a system warning about starting a local application fire-extinguishing system	+	+	+	+	+[4]	+	—	+[4]	+
Devices of a high bilge water level alarm system	+	+	+	+	+	+	+	+	+
Devices of a system for emergency call of engineers and of a personnel alarm	+	+	+	+	+	+	+	+	+
Devices of an alarm system on presence of people inside refrigerated holds	+	+	+	+	+	+	+	+	+
Devices of a system for control of side ports, fire and watertight doors position	+	+	+	+	+	+	+	+	+
Devices of an external/internal video surveillance system	+	+	+	+	+	+	+	+	+
Devices of an alarm system on rise of explosive gases concentration	+	+	+	+	+	+	+	+	+
Devices of a cargo hold water level alarm system of bulk carriers and dry cargo ships	+	+	+	+[5]	+	+[6]	+[7]	+	+
Devices of a top and ultimate cargo level alarm system	+	+	+	+	+	+	+	+	+

S y m b o l s – refer to Table 10.7.5.1.

[1] Tachometers shall be tested to the extent of and in accordance with 10.7.1, meters - to the extent of and in accordance with 10.7.9. The checks in Table shall be carried out with use of the tachometer circuit established.

[2] Contactors are not subject to testing.

[3] Detectots of an automatic fire detection system and manual fire alarms are not subject to testing.

[4] Detectors are not subject to testing.

[5] In respect of protective enclosure testing – see Appendix 16 “Requirements for testing of a cargo hold water level alarm system of bulk carriers and single-hold cargo ships other than bulk carriers”.

[6] Functionality tests shall be carried out in accordance with IMO Resolution MSC.188(79) “Performance standards for water level detectors on bulk carriers and single-hold cargo ships other than bulk carriers”.

[7] See Appendix 16 “Requirements for testing of a cargo hold water level alarm system of bulk carriers and single-hold cargo ships other than bulk carriers.

specified in the technical documentation for these devices.

10.7.15 Tests of cable products.

10.7.15.1 The scope of tests and checks of cable products is given in Table 10.7.15.1.

Prior to the beginning of tests and checks, the materials containing the results of testing physical, mechanical and other properties of insulation and sheathing of which the specimens were tested using the procedures specified in the approved technical documentation, shall be submitted to the Surveyor. For all products, such tests include the determination of strength at the rupture and lengthening of insulation and sheathing, of heat stability and cold endurance, thermal ageing and electrical characteristics.

For products designed for operation on open decks of ships, the sheathing resistance to seawater and solar radiation shall additionally be assessed.

For products designed for operation in engine rooms and on decks of tankers, the sheathing resistance to oil products shall also be assessed.

10.7.15.2 For testing cables or wires of a particular brand, the specimens of each structure and each number of cores with the minimal and maximum cross-sectional area, as well as with intermediate values, if needed, shall be selected. The number of specimens having the same number of cores of different cross-sections is established separately for each test.

10.7.15.3 The inspection and checks of cable products are carried out for the compliance with the Register approved technical documentation.

Table 10.7.15.1

Cable products	Inspection and checks	Measurement of insulation resistance	Test of insulation strength	Tests for compliance with operational conditions onboard a ship	Test for resistance to sea water[1]	Test for resistance to oil products[1,2]	Test for durability under repeated reverse bends by roller systems	Test for bend durability	Test for axial twisting durability	Test for durability to bending with axial twisting	Test for tension durability	Test for crushing durability	Test for flame resistance (flame retardance)
Cables for connecting stationary electrical equipment	+	+	+	+	+	+	—	+	—	—	+	—	+
Cables for connecting mobile electrical equipment (including portable)	+	+	+	+	+	+	+	+	+	+	+	+	+
Installation wires	+	+	+	+	+	+	—	—	—	+[3]	—	—	+
Mounting wires	+	+	+	+	+	+[4]	—	+	—	+[3]	—	—	+

[1] To testing are subject the products specially designed for operation on open decks of ships. The test is performed on both insulation and sheathing specimens (refer to 10.7.15.1), and cable specimens.

[2] To testing are subject the products both specially designed for operation in engine rooms, and not having such restriction. The test is carried out only on insulation and sheathing specimens (refer to 10.7.15.12).

[3] Related to particularly flexible wires.

[4] For some wire brands (e.g. used in electrical equipment of internal combustion engines).

10.7.15.4 Prior to the test of insulation and the measurement of its resistance, it shall be convinced of the absence of core breaks, and of the electrical serviceability of metallic braids, sheaths and armor by means of their connection to a pilot circuit.

Irrespective of the tests of electrical insulation strength performed on the specimens subjected to the other types of tests, the electrical insulation strength shall additionally be tested on separate specimens after their holding in water for at least 6 h for products and single cores having polyvinylchloride and polyethylene insulation.

10.7.15.5 The common types of tests for compliance with operational conditions onboard a ship, such as the tests for vibration strength and shock strength of cables and wires, shall be carried out with due regard for the following conditions:

.1 at least six specimens of each largest, least and several intermediate cross-sectional areas of each structure of the given cable (wire) brand shall be prepared for testing. All the specimens shall be separated into three equal groups regarding specimens number and structure;

.2 each specimen from the first group shall be curved like the sinusoid of the least radius permitted by technical documentation and secured on supports spaced apart according to Table 16.8.5.2 of Part XI "Electrical Equipment" of Rules for the Classification and Construction of Sea-Going Ships. An opportunity of displacement for those specimens in their secured position shall be prevented. Excepting the securing points, the specimens shall have no contacts over their entire length.

Each specimen from the second group shall be secured without bends on four supports welded to a common vertical foundation. The distances between supports shall exceed by 25 % those specified in Table 16.8.5.2 of Part XI "Electrical Equipment" of Rules for the Classification and Construction of Sea-Going Ships;

.3 the test for vibration strength of the first groups of specimens may be carried out when exposed to vibration perpendicular to their axes. The second groups of specimens shall be tested by exposures along, and perpendicularly to, axes.

In shock strength testing, the specimens of the first and second groups shall be subjected to mechanical actions initially directed perpendicularly to their axes, and then along the axes; for curved specimens – along sinusoid axes;

.4 the third group specimens shall be secured at one end each and to be freely suspended from a rack fastened on a stand. The length of the free-suspended part of a specimen shall be specified in the technical documentation for the cable (wire) of a given brand, number and cross-section area of cores. The end secured and the free-suspended part of a specimen shall be in straight line with one another. Specimens swinging with mechanical actions shall be limited along the entire length within their several diameters. Where the permissible length of the free-suspended part is too large for testing, the specimens may be shortened, if approved by the Register, compensating the mass of the lacking part with the load of the same mass fastened to the lower end of the suspended specimen;

.5 the test of free-suspended specimens for vibration strength shall be performed with the simultaneous exposure to vibration in two mutually-perpendicular directions of which one shall be lengthwise of their axes.

The test for shock strength with shock loads shall be performed lengthwise of specimen axes only;

.6 during tests for vibration and shock strength, all specimens shall be energized at a voltage (excepting the single-core ones) by 20 % exceeding the largest working voltage of a cable (wire);

.7 specimens are considered to have passed the test if no electrical breakdown of cores insulation has occurred, no cracks and other damages to specimens have been found on protective coatings, sheaths and insulation of cores in examination without use of magnifying devices.

10.7.15.6 The provisions of 10.7.15.5 fully apply to tests of cables for connecting mobile and portable electrical equipment. Such cables shall initially be tested in hanks, and thereafter test specimens shall be cut from them according to 10.7.15.5.1.

10.7.15.7 In heat stability testing, specimens shall be in a heat chamber at the maximum ambient air temperature and under the maximum load which are permissible for a cable (wire) of a given brand in a long run.

10.7.15.8 Prior to humidity resistance testing, the specimen leads shall be brought out from a humidity chamber, fanned out and prepared for measuring insulation resistance and testing insulation strength. Cores insulation and lead sheaths shall be sealed.

10.7.15.9 The test for cold endurance may be omitted for cables and wires specially designed for internal wiring. In the other cases, the test for cold endurance shall be carried out as follows:

.1 test specimens shall be wound in one layer around metallic hollow cylinders having diameters corresponding to the least permissible radii of specimens bending, and held in a cooling chamber at a temperature of – 50 °C during the time given below:

Outside diameter of a cable, mm	Time of holding in a cooling chamber, h
Under 15	1
15 – 30	2
30 – 50	3
Over 50	5;

.2 after holding in a room at the temperature corresponding to normal environmental conditions of the tests, all the specimens shall be removed without unbending from the cylinders and secured in such a condition (for use in tests in such a condition for resistance to solar radiation and seawater);

.3 the results of the given test are considered to be satisfactory if no cracks, ruptures, etc. are found on sheaths.

10.7.15.10 The test for exposure to salt mist applies to cables having outer metallic braids, sheaths and armor.

10.7.15.11 The specimens prepared according to 10.7.15.9.2 shall be tested for resistance to solar radiation and seawater in order to test on the same specimens most attacks the cable products may be exposed to, in service.

10.7.15.12 The test for exposure to solar radiation are carried out according to 10.5.4.8. Thereupon these unbent specimens shall be tested for resistance to seawater as follows:

.1 the preferable composition of a solution for the test is specified in 10.5.4.6.3;

.2 the water (solution) temperature – not below 20 °C;

.3 every 2 min to 3 min the specimens shall be immersed in the solution for 10 s to 15 s (specimen leads shall be brought out and reliably sealed);

.4 test duration – 5 days;

.5 on test completion, insulation resistance shall be measured and specimens insulation strength tested. If these measurements and tests give satisfactory results, the specimens have passed the tests.

10.7.15.13 Tests for durability under repeated reverse bends by roller systems, for bend durability, axial twisting durability, for durability to bending with axial twisting, for tension and crushing durability of cables intended for connecting mobile and portable electrical equipment shall be performed on standard test sets using the techniques specified in the approved technical documentation. These tests shall be carried out at normal environmental conditions. The number and details of operations with specimens shall be specified in the test program and procedure.

All the listed types of specimen tests, excepting those for tension and crushing durability, shall be performed at the voltage equal to the maximum working one the specimens are designed for, and in tests at the normal temperature, under load.

The test results are considered to be satisfactory if:

.1 cracks and ruptures of cores insulation and sheaths visible to the unaided eye are lacking;

.2 breaks of core wires are lacking;

.3 no electrical breakdowns of insulation are found and stability of load current during tests is maintained;

.4 the results of testing the electrical strength of insulation on completion of all mechanical actions are satisfactory.

10.7.15.14 The test for flame resistance (flame retardance) shall be performed on a standard test set according to the approved program and procedure.

10.7.16 Tests of electrical heating and cooking appliances.

10.7.16.1 The scope of tests and checks is given in Table 10.7.16.1.

10.7.16.2 If the cases of electric heating devices are pressurized in operation with water steam or fuel oil or luboil vapours (or may be pressurized with these resulting a malfuction or personnel's mishandling), and if therewith they are subject to 1.3.2.1, Part X "Boilers, Heat Exchangers and Pressure Vessels" of Rules for the Classification and Construction of Sea-Going Ships, then additionally to the specified in Table 10.7.16.1, they and their safety (emergency) valves shall pass tests in accordance with 9.7.3.

Table 10.7.16.1

Stationary cooking and heating appliances	Inspection and checks	Measurement of insulation resistance	Measurement of insulation strength	Tests for compliance with operational conditions onboard a ship	Heat test	Test by dousing with water	Test of protection against abnormal modes[1]
Fuel oil and luboil heaters (including the flowing ones)	+	+	+	+	+	—	+
Heaters and similar devices for heating spaces	+	+	+	+	+		+
Flowing air heaters	+	+	+	+	+	—	+
Boilers and water heaters (including the flowing ones)	+	+	+	+	+	+[2]	+
Cooking ranges, boilers and units	+	+	+	+	+	+[3]	—
Drying cabinets	+	+	+	+	+	—	

[1] Including protection against the dangerous elevation of a temperature, the drop of a liquid level, etc. (the protection functioning is checked for compliance with the values of parameters set in the Register approved technical documentation).

[2] The test applies to products in which, resulting from motions, heeling or boiling, water can overflow an edge or openings, and the product design does not entirely prevent the penetration of water to electroinsulating or current-carrying parts.

[3] The test is compulsory for cooking ranges. For electric cooking boilers and units, see Footnote 2.

10.7.17 Tests of radio-frequency interference filters.

10.7.17.1 The scope of tests and checks shall include:

.1 inspection and checks;

.2 measurement of insulation resistance;

.3 test of insulation strength;

.4 test for compliance with operational conditions onboard a ship;

.5 heat test;

.6 test for short-circuit stability;

.7 check of efficiency of radio-frequency interference suppression.

10.7.17.2 The heat test, as well as the test for short-circuit stability, apply to filters with inductance coils connected in series in a power circuit. The test is carried out similarly to 10.7.6.5.

10.7.17.3 The check of efficiency of radio-frequency interference suppression shall be carried out by a competent person with use of the special apparatus and the technique specified in the approved technical documentation on the frequencies the filter is designed for.

10.7.17.4 The efficiency of radio-frequency interference suppression is defined by the conformity of the product with the filter fitted with the requirements in 6.3 of this Section.

10.7.17.5 The means of protection against pulse interference, power filters, protective transformers, continuous supply units are subject to additional tests for checking the stability to interference and for measuring the filter attenuation or pulse interference limitation. The relevant characteristics shall be entered in technical documentation.

10.8 SURVEY OF PRODUCTS AT ESTABLISHED PRODUCTION AT THE MANUFACTURER'S

10.8.1 Technical supervision during manufacture of electrical equipment products at steady production at the manufacturer's is effected by surveying the finished products that have passed checks and tests carried out by technical control bodies of the manufacturer.

10.8.2 The survey of a product shall provide for:

.1 the check of documentation for accessories and materials subject to the Register supervision in accordance with the RS Nomenclature, and of the documents of technical control bodies for a finished product;

.2 the check of technical documentation for a product;

.3 the check of product and spare parts completeness;

.4 performance of external and internal examinations;

.5 the operational test;

.6 the product tests specified in 10.8.3 and 10.8.4.

10.8.3 All the products to be surveyed are subject to the following:

.1 an inspection and check for technical documentation conformity, a check of workmanship of assembly, wiring and earthing units, and for complete products, of accessories earthing as well;

.2 measurement of insulation resistance (in a practically cold state);

.3 the test of the electrical strength of insulation between current-carrying elements, circuits, as well as between these and the case (in a practically cold state);

.4 the test of a protective enclosure starting with protection degree IP55 and over. Every product having protection degree IP67 and IP68 shall be tested. Protective enclosures IP55, IP56, IP65 and IP66 are subject to periodical testing by sampling. The periodicity and scope of the sampling are determined in each particular case.

10.8.4 For single types of equipment, the scope and conditions of product tests at steady production are specified in Tables 10.8.4-1 to 10.8.4-5.

10.8.5 With the satisfactory results of tests and checks, the Register Surveyor issues a certificate for a product and, if specified in the RS Nomenclature, stamps the product.

Table 10.8.4-1

Products	Tests and checks in accordance with 10.8.2 and 10.8.3	Test at increased speed[1]	Measurements of collector runout (of slip rings), check of axial displacement of a rotor (armature)	Test of interturn insulation strength	Check in operation at nominal parameters and short-time current overload	Check of interlocks, protection and alarm operation	Other specific checks and tests
Electrical machines[2]	+[3,4]	+[5]	+[6]	+	+[7]	+	+[8]
Electromagnetic couplings	+[3,4]	+	+[6]	+	+	—	—
Transfomers	+	—	—	+	+[7]	—	+[9]
Static converters	+	—	—	+[10]	+	+[11]	+[12]

[1] Performed prior to insulation testing.
[2] Synchronous and d.c. generators, induction and d.c. motors, converters, rotary amplifiers.
[3] If necessary (as a rule, for large produscts), with measurements of air gaps, with a check of documents on balancing, testing a water-cooling system for tightness and strength.
[4] With mass production of machines rated up to 5 kW (kVA), insulation strength may be tested during 1 s at a voltage equal to 1,2 times the full normalized test voltage.
[5] Excepting cage induction motors.
[6] As a rule, applies to large products. With propulsion plant motors and couplings, the runout of a shaft end shall also be measured.
[7] For a.c. machines and transformers, the check may be replaced by an open-circuit and short-circuit tests.
[8] Check of commutator machines switching at the rated load and short-time current overload, the check of limits of voltage setting variation for generators with a static field system, the check of electric heating of the machine, the measurement of voltage between the insulated bearing base and foundation, as well as between shaft ends of such machines.
[9] With nonflammable liquid-filled transformers, the tank test for tightness and the test of a dielectric sample taken from the tank.
[10] Applies to converter transformers lacking such a test.
[11] Check of overload and short-circuit protection in operation.
[12] Check of operation at load loss and increase, the check of control appararus and filter operation.

Table 10.8.4-2

Products	Tests and checks in accordance with 10.8.2 and 10.8.3	Check of operation of drives and indicators of switching positions	Check of interlocks operation	Check of adjustment and operation of elements (releases, integrated relays, etc.)	Check of electrical resistance value	Operational test	Other specific checks
Circuit breakers	+	+	+	+	—	—	—
Breakers, switches, disconnectors, push-button and limit switches	+	—	—	—	—	+	—
Fuses	+	—	—	—	+[1]	—	+[2]
Contactors, contact relays	+	—	—	—	—	—	+[3]
Starters, controllers	+	—	+	+	—	+	—
Rheostats	+	+	—	+	+	—	—
Resistors in boxes	+	—	—	—	+	—	—
Electromagnetic brakes of electric motors, brake electromagnets, electrohydraulic pushers	+	—	—	—	—	+	+[4]
Magnetic amplifiers, apparatus, blocks and modules with contactless elements	+	—	—	—	—	+	—
Reactors, chokes	+	—	—	—	+[5]	—	—
Generator protection devices	+	—	+	+	—	+	—
Electrical measuring (switchboard) instruments	+	—	—	—	—	+[6]	+[7]
Electical switchboards and consoles	+	+	—	—	—	+[8]	—
Apparatus and devices for intercommunication and alarm	+	—	—	—	—	+	—
Ship's control and monitoring devices[9]	+	—	—	—	—	+	+[10]
Electrical heating and cooking appliances	+	—	—	—	—	—	+[11]
Lighting fixtures	+	—	—	—	—	—	—
Wiring accessories	+	—	—	—	—	+[12]	—
Radio-frequency interference filters (attached)	+	—	—	—	—	+[13]	—
Busducts	+	+	—	—	—	—	—

[1] Applies to fuse-links, performed periodically by sampling.

[2] Test for the maximum non-fusing current and minimum fusing current. Performed periodically by sampling.

[3] Check of contact gaps, follows-up and pressure. Check of actuation parameters.

[4] Check of the value of the force developed, check of operation of the manual unbraking arrangement (of brakes).

[5] Measured inductive impedance.

[6] Performed with instruments inclined. Periodical sampling inspection of operation at ambient air temperatures above 25 °C; at mechanical actions (in a reduced scope as compared with prototype tests); at the limiting permissible deviations of voltage and frequency from rated values.

[7] Determination of a basic error and variation.

[8] Applies to control, monitoring and alarm circuits.

[9] Sensors (tachogenertors) and indicators of tachometers of propeller shafts shall be additionally tested as electrical machines and electrical measuring instruments respectively.

[10] Check of accuracy of indicator readings.

[11] Test of fuel oil and luboil heaters for tightness and strength (or check of documents if such tests are carried out in production), as well as of products operating under a steam pressure, or potentially being pressurized with steam, if these are subject to the requierements of 1.3.2.1, Part X "Boilers, Heat Exchangers and Pressure Vessels" of Rules for the Classification and Construction of Sea-Going Ships. Check of operation of protection against abnormal operating modes (an elevated temperature, the drop of a liquid level, etc.).

[12] Excepting connection boxes.

[13] Check may be replaced by measurements of element parameters.

Table 10.8.4-3

Complete sets of products[1]	Inspection and check for compliance with technical documentation	Measurements of insulation resistance in a practically cold state	Starts, stops, reverses, operation at each speed in no-load	Check of electromagnetic brake operation	Check of interlocks, protection and alarm operation	Check of operation of a switched discharging resistor circuit[2]	Check of an automatic start after voltage recovery[3]	Test combined with a driving mechanism[4]	Operational test of all systems in combination with an internal combustion engine	Measurements of insulation resistance in a hot state
Electric drives of propulsion plants	The scope of tests and checks is subject to special consideration by the Register in each case									
Other electric drives at manufacturers'	—	—	+	+[5]	+	+	+	—	—	—
Ditto at manufacturers' of machinery provided with electric drives	+	+	+	+	+	+	+	+	—	+
Electrical equipment of electrically-started internal combustion engines at its manufacturers'	—	—	—	—	—	—	—	—	+[6]	—
Ditto at manufacturers' of internal combustion engines	+	+	—	—	—	—	—	—	+	+

[1] It is implied that all the other products of the set (electrical machines, apparatus, etc.) have passed the necessary acceptance tests according to the relevant programmes.
[2] Applies to d.c. shunt-wound and compound-wound motors.
[3] Applies to circuits of the steering gear and watertight door drives.
[4] Performed according to the Register approved programme and the procedure for mechanism (arrangement) testing.
[5] Check of braking electromagnet (if no brake) operation.
[6] If the internal combustion engine is lacking, the check is performed on specially equipped stands.

Table 10.8.4-4

Products	Tests and checks in accordance with 10.8.2 and 10.8.3	Check for tightness[1]	Check of rated capacity	Measurement of loss-angle tangent	Check of automation operation
Accumulator batteries (accumulators[2])	+[3]	+[4]	+[5]	—	—
Capacitors for raising a power factor	+	+	+	+	—
Capacitor sets for raising a power factor	+	—[6]	+	—[6]	+

[1] Performed in any effective way.
[2] If intended for independent supply.
[3] Restricted to the inspection and check for compliance with technical documentation.
[4] Applies to acid battery monoblocks.
[5] With the check of initial and final voltage, current, a discharging time, an electrolyte temperature, etc. This check may be performed periodically by sampling. The periodicity and scope of sampling shall be agreed with the Register.
[6] If capacitors have not passed such a test, the one shall be carried out.

Table 10.8.4-5

Tests (checks) of cables and wires	Inspection and check for compliance with technical documentation	Check of integrity (continuity) of cores, shields, braids and other metallic sheaths	Test of insulation strength of cores prior their sheathing[4] and of finished products after holding in water	Measurements of insulation resistance	Tests of mechnical, thermoplastic and electrical properties of materials used for cores insulation and sheaths[1]
On each factory length	+	+	+[4]	+	—
Periodically by sampling[2]	—	—[3]	—[3]	—	+

[1] If the operational inspection is specified.
[2] The periodicity and scope of sampling shall be agreed with the Register.
[3] The test is performed if Footnote 4 is applicable.
[4] The Register may allow cores insulation testing with use of a dry test apparatus for a breakdown test.

APPENDIX 1

PERMISSIBLE VALUES OF ELECTRICAL EQUIPMENT INSULATION RESISTANCE

1. Insulation resistance to case, as well as between phases (poles) of electrical equipment shall not be less than that specified in the Table.

The insulation resistance specified in the Table for electrical equipment above 500 V rating, as well as for electrical machines above 1000 kW (kVA) is subject to special consideration by the Register in each case.

2. It is recommended that, in measurements at the manufacturer's, the insulation resistance of electrical cable cores R_i, in MΩ/km, between each insulated core of cable products and the other cores in any sequence, and the metallic sheath (armor, screen) of a cable or, if the latter is lacking, an electrode in the water wherein the product is immersed, shall not be less than the one according to the formula:

$$R_i = k_i \, log D/d$$

where k_i = insulation resistance constant specified in Table 1 of Appendix 10;
d = design core diameter, mm;
D = design insulation diameter equal to $d+2t$ (t = insulation thickness); for multicore cables having overall insulation, t = total of thicknesses of the core insulation and overall insulation, mm.

Table

Electrical equipment	Minimum insulation resistance at an environment temperature 20 ± 5°C and normal humidity, MΩ	
	In cold state	In hot state
Electrical machines up to 100 kW (kVA), 1000 rpm	5	2
Electrical machines from 100 to 1000 kW (kVA), 1000 rpm[1]	3	1
Transformers	5	2
Switchboards	1	—
Switch, protection and control gear	5	—
Ship's devices for intercommunication, alarm, monitioring and control	20	—
Cooking and heating appliances[2]	1	0,5
Static converters	10	5

[1] For electrical machines rated above 1000 kW (kVA), the insulation resistance R_i MΩ in a hot state is calculated by the formula:

$$R_i = \frac{P+1000}{3U}$$

where
U = rated voltage of a winding (phase), V;
P = rated power, kW (kVA).

[2] For voltages above 5000 V, the insulation resistance is assumed on the basis of 2 kΩ per 1 V of rated voltage.

APPENDIX 2

PERMISSIBLE TEMPERATURES

1. Permissible temperatures of heating insulating materials of different classes for long-term operation are as follows:

Insulation class	Permissible temperature, °C
A	105
E	120
B	130
F	155
H	180
C	above 180

If insulation consists of different materials, the temperature of potential heating for each of these materials shall not exceed the one permissible for a given material.

If insulation consists of several layers of different materials and it is impractical to measure the temperature of single layers heating, the permissible temperature for use of the lowest class material is considered as the permissible one of such insulation heating.

The material used for mechanical protection and spacers only may be of a lower insulation class.

2. The permissible excesses of temperature for electrical machines are given in Table 1. They are determined for a cooling air temperature of 45 °C.

If a cooling medium temperature is below the specified values, temperature excesses may be increased accordingly, but not more than by 10 °C.

Table 1

Permissible temperature excesses for electrical machines at a cooling air temperature of 45 °C

Nos.	Parts of electrical machines	Class of insulating material														
		A			E			B			F			H		
		Measurement method (instrument)														
		Thermometer	Resistance method	Thermal detectors placed in a slot beetween coils	Thermometer	Resistance method	Thermal detectors placed in a slot beetween coils	Thermometer	Resistance method	Thermal detectors placed in a slot beetween coils	Thermometer	Resistance method	Thermal detectors placed in a slot beetween coils	Thermometer	Resistance method	Thermal detectors placed in a slot beetween coils
1	Windings of ac synchronous machines rated 5000 kVA and over or having a core length of 1 m and more	—	55	55	—	65	65	—	75	75	—	95	95	—	120	120
2	Windings of ac machines rated under 5000 kVA and having a core length under 1 m	45	55	—	60	70	—	65	75	—	80	95	—	100	120	—
3	Field windings of dc-excited dc and ac machines excepting those in items 5 to 8 of Table	45	55	—	60	70	—	65	75	—	80	95	—	100	120	—
4	Armature windings connected to a commutator	—	—	—	—	—	—	—	85	—	—	105	—	—	—	—
5	Field windings of dc-excited nonsalient pole machines	—	—	—	—	—	—	—	85	—	—	105	—	—	—	—
6	Single-row field windings with bare surfaces	60	60	—	75	75	—	85	85	—	105	105	—	130	130	—
7	Bar windings of asynchronous machine rotors	60	60	—	75	75	—	85	85	—	105	105	—	130	130	—
8	Field windings of low resistance with several layers and compensation windings	55	55	—	70	70	—	75	75	—	95	95	—	120	120	—
9	Insulated windings continuously closed on itself	55	—		70	—	—	75	—	—	95	—	—	120	120	—
10	Noninsulated windings continuously closed on itself	The excess of a temperature of these parts shall not reach the values which would cause a risk of damaging insulating and other adjacent materials														
11	Steel cores and other parts having no contact with windings															
12	Cores and other steel parts in contact with windings	55	—	70	—	—	—	75	—	—	95	—	—	120	120	—
13	Unprotected and protected commutators and slip rings	55	—	60	—	—	—	75	—	—	85	—	—	95	95	—

Notes: 1. For windings of ac machines for rated voltage over 11000 V, the limiting permissible excesses of temperature shall be reduced by 1,5 °C for each complete and incomplete 1000 V above 11000 V in measurements with a thermometer or by 1 °C when a thermal detector is used.

2. The limiting permissible excesses of a windings temperature specified in items 2 and 4 of Appendix, measured by the resistance method, may be increased by 5 °C for enclosed machines for voltage not more than 1500 V.

3. The specified class of insulating material as per item 13 of Table applies to the commutator or slip ring insulation, or else to the insulation of windings connected thereto if the insulation class of these latter is below that of the commutator or slip rings.

4. The resistance method is generally used for measuring the excess of a winding temperature. The use of a thermometer is allowed only in those cases when the above method cannot be applied due to certain reasons; the limiting permissible excesses of temperatures for these cases are specified in this Table.

5. If a thermometer indication is desirable additionally to the data received by the rsistance method, the temperature excess measured in the most heated accessible point shall not exceed 60 °C for insulation class A, 75 °C for insulation class E, 85 °C for class B, 105 °C for class F and 130 °C for class H.

6. The permissible temperature excesses for commutators and slip rings may exceed the values specified in item 13 of Table if the following conditions are met:

the temperature excess for insulating materials of commutators and slip rings and their related windings does not exceed the values specified in items 4 and 7 of the Table for materials of the relevant classes;

the temperature does not reach the values dangerous for solder joints.

If a cooling medium temperature is above the specified values, the temperature excess shall be accordingly reduced.

3. The temperature excess for transformers operating at rated loads and an environmental temperature +45 °C shall not exceed values specified in Table 2.

Table 2

Parts of a transformer	Measurements method of	Permissible temperature exceess, °C , for insulation classes				
		A	E	B	F	H
Windings	Resistance	55	65	75	95	120
Cores and other parts of a transformer	Temperature	The temperature excess shall not exceed the temperatures permissible for adjacent materials				

4. The permissible excesses of temperature for different parts of breakers relative to an environmental temperature +45° C shall no exceed values specified in Table 3.

Table 3

Nos.	Parts of a breaker			Permissible temperature excess, °C
1	Solid spring contacts	Of copper	In continuous duty	35
			In 8 h continuous running duty, intermittent and short-time duties	55
		Of silver or with silver inserts		See Footnote 1
		Of other materials or metal-ceramic agglomerates		Depending on the type of metal or metal-ceramic agglomerate[1]
2	Brush contacts			25
3	Busbar joints	Unprotected against oxidization in the point of contact		45
		Protected against oxidization in the point of contact	By a tinning or cadmium coating	55
			By silver coating	75
		Soldered or welded		75
4	Magnets, cores and the like			Like the insulation in contact with these parts
5	Manual controls		Of metal	10
			Of insulating material	20
6	Cases, shields or parts unprotected against an inadvertent touch			35
7	Rheostat cases protected against an inadvertent touch			200
8	Air-cooled rheostats in measurements at a distance of 25 mm			175

[1] The temperature may be exceeded up to such a value when a heated part does not cause the increase of an adjacent parts temperature above the temperatures permissible for them.

APPENDIX 3

DEGREE OF IRREGULARITY OF ELECTRICAL UNITS RUNNING

1. The degree of electrical units running irregularity per revolution, when driven by piston engines, shall not exceed the values given in the Table (also refer to 2.4, Part IX "Machinery" of Rules for the Classification Construction of Sea-Going Ships).

2. The degree of running irregularity per revolution for all loads including the rated load at the rated speed is calculated by the formula:

$$S = (\omega_{max} - \omega_{min})/\omega_m$$

where ω_{max} = maximum,
ω_{min} = minimum and
ω_m = mean speed respectively.

Table

Number of motor pulses per second	Degree of running irregularity for a motor with the number of cylinders	
	⩽2	>2
Under 10	1/75	1/150
From 10 to 20	1/75	Pulses per second/1500
Above 20	1/75	1/75

APPENDIX 4

RECOMMENDATIONS ON CHECKING MECHANICAL STRENGTH OF ELECTRICAL APPARATUS AND ELECTROMAGNETIC BRAKES

1. Distributing breakers are recommended to manufacture so that being electrically-unloaded they may withstand the on-off test for the number of cycles specified in Table 1.

2. Manoeuvering breakers are recommended to manufacture so that their mechanical strength may match the intermittent duty of operation and they may withstand the on-off test according to Table 2.

3. The mechanical strength of safety jacks with knife contacts shall be such that they may withstand the on-off test for at least 500 cycles (one cycle implies one insertion and one withdrawal of a cartridge fuse link from the jack). Following that test, no jam of the cartridge shall be observed, and the voltage drop across two-way make-before-break contacts shall not exceed the permissible one.

4. The mechanical strength of a brake is recommended to be such that the latter may withstand the test for at least 106 activations. The test shall not result in mechanical and electrical damages, as well as in the mechanical wear of parts preventing the reliable operation of the brake.

5. It is recommended that the operation stability of an electromagnetic brake mated with an appropriate drive be at least 10^5 activations.

Table 1

Rated current of a breaker, A	Adjustment and service provided in a design		Adjustment and service ignored in a design
	without adjustment and service	with adjustment and service[1]	
25 — 314	1000	20000	8000
315 — 1249	500	10000	4000
1250 — 2499	500	5000	—
over 2500	By agreement with the Register		

[1] The manufacturer shall determine which, and for which elements, service and adjustment are required after producing no less than the number of cycles specified in column 2 which will ensure the mechanical strength corresponding to the number of cycles in column 3.

Table 2

Operation class	Number of cycles per hour	Mechanical strength expressed in terms of the total number of cycles, 10^6
0	До 6	0,05
I	30	0,25
II	150	1,20
III	600	5,0
IV	1200	10,0

APPENDIX 5

RECOMMENDATIONS ON CHECKING SWITCHING STRENGTH, NORMAL AND SHORT-TIME SWITCHING CAPACITY OF APPARATUS

1. It is recommended that the switching strength (under load) of distributing and manoeuvering breaker contacts determined for the current and voltage corresponding to the normal switching capacity be at least not less than the mechanical strength of a product with nonremovable switching elements, specified in Tables 1 and 2 respectively of Appendix 4, or not less than 1/20 of that mechanical strength for products with removable switching elements. Tests therewith shall be carried out for work categories AC_3, DC_3 and DC_4 specified in Table 1 of this Appendix.

2. It is recommended that the switching strength of auxiliary contacts of contactors be not less than the mechanical strength of their main contacts. The switch-

Table 1

Recommended switching capacity of manoeuvering breakers

	Load type	Normal						Short-time					
		Switch-on			Switch-off			Switch-on			Switch-off		
	Alternating current	I/I_r	U/U_r	cos φ[1]	I/I_r	U/U_r	cos φ[1]	I/I_r	U/U_r	cos φ[1]	I/I_r	U/U_r	cos φ[1]
AC_1	Active or low-inductance load	1	1	0,95	1	1	0,95	—	—	—	—	—	—
AC_2	Start of phase-wound rotor motors, reverse-current braking	2,5	1	0,65	2,5	1	0,65	4	1,1	0,65	4	1,1	0,65
AC_3	Start of squirrel-cage motors, tripping of the motor while running	6	1[1]	0,35	1	0,17	0,35	10[3] 8[4]	1,1	0,35	8[3] 6[4]	1,1	0,35
AC_4	Start of squirrel-cage motors, pulse operation, change of rotation direction	6	1	0,35	6	1	0,35	12[3] 10[4]	1,1	0,35	10[3] 8[4]	1,1	0,35
	Direct current	I/I_r	U/U_r	cos φ/R	I/I_r	U/U_r	cos φ[1]	I/I_r	U/U_r	cos φ/R	I/I_r	U/U_r	cos φ[1]
	Active or low-inductance load	1	1	1	1	1	1	—	—	—	—	—	—
DC_1	Start of shunt-wound motors and their tripping while running	2,5	1	2	1	0,1	7,5	4	1,1	2,5	4	1,1	2,5
DC_2 DC_3	Start of shunt-wound motors, pulse operation, change of rotation direction	2,5	1	2	2,5	1	2	4	1,1	2,5	4	1,1	2,5
DC_4 DC_5	Start of series-wound motors and their tripping while running	2,5	1	7,5	1	0,3	10	4	1,1	15	4	1,1	15
	Start of series-wound motors, pulse operation, change of rotation direction	2,5	1	7,5	2,5	1	7,5	4	1,1	15	4	1,1	15

I_r = rated working current; U_r = rated working voltage;
I = making or breaking current; U = mains voltage.
[1] Tolerance: cosφ ± 0,05.
[2] Permitted: $U < U_r$.
[4] For $I_r > 100$ A.
[3] For $I_r \leqslant 100$ A.
[5] Tolerance: φ/R ± 15 %.

ing strength of auxiliary contacts shall be at least not less than 1/20 of the mechanical strength of main contacts if the auxiliary ones are readily replaceable.

3. It is recommended that the switching capacity of manoeuvering breakers be not less than that specified in Table 1.

4. It is recommended that the relative time of electrical contactors operation and the full time of one switching cycle be not less than those specified in Table 2.

5. It is recommended that the number of cycles in testing the short-time switching capacity of manoeuvering breakers be not less than that specified in Table 3.

Table 2

Class	Relative duty time, %	Duty cycle duration, s	Load duration, s
I	60	120	72
II	60	24	14,4
III	40	6	2,4
IV	40	3	1,2

Table 2

Breakers	Work category	Control voltage	Number of cycles	
			Switch-on	Switch-off
Manually-operated manoeuvering	AC_1, AC_2, DC_1, DC_2, DC_3, DC_4, DC_5	—	20	20
	AC_3, AC_4	—	100	20
Electromagnetic contactors	AC_1, AC_2, DC_1, DC_2, DC_3, DC_4, DC_5	U_r	20	20
	AC_3, AC_4	$0{,}85U_r$	50	—
		$1{,}1U_r$	50	
		U_r	—	20

APPENDIX 6

RECOMMENDATIONS ON CHECKING BREAKING CAPACITY OF CIRCUIT BREAKERS

1. It is recommended that the breaking capacity of circuit breakers during tests be checked by currents not less than those specified in Table 1.

2. The circuit breaker shall be tested for the proper cutoff of the rated breaking current at 110 % of the rated switching voltage.

3. If the breaking capacity in connecting to the terminals of movable and fixed contacts is different, the one shall be specified in documentation for both cases.

4. Dc circuit breakers shall have the rated making capacity equal to the rated breaking capacity of short-circuit current.

5. It shall be ascertained in tests that the rated making capacity of an ac circuit breaker is at least equal to the product of the rated breaking current specified in Table 1 by the relevant factor k in Table 2.

6. The circuit breaker shall properly switch on and off a test circuit having parameters corresponding to the rated breaking capacity with the following cycle: F – t – NF – t – NF where F = turn-off and NF = turn-on and – off of short-circuit current following one immediately after another, t = time interval of 15 s to 3 min.

7. Testing circuit breakers according to the switching cycle specified in item 6, the following results shall be obtained:

.1 no stationary arc shall appear across contacts and no arc overthrow is allowed between poles and earthed parts of the circuit breaker, or to the parts at the other voltage;

.2 arc outbreak shall be within the limits provided by a protection zone and not to threaten the service personnel;

.3 the circuit breaker shall not be damaged and shall be fit for operation under the normal working conditions after the replacement of auxiliary contacts;

.4 no current-carrying elements burning-off and contacts weld are allowed, and the circuit breaker shall open at a rated insertion force;

.5 the temperature reached by circuit breaker contacts during the heat test, carried out after the test for switching capacity, shall not cause damages to the adjacent insulation and the break of elasticity of metallic elements functioning as springs;

.6 no damages to the release and relay are allowed, and time charateristics of thermal releases (relays) checked following the short-circuit test shall remain within the tolerance limits.

Table 1

Rated continuous current, A	Rated breaking capacity, kA			
	Alternating current		Direct current	
	500 V, 50 Hz	cos φ	220V	φ/*R*, m/s
63	5	0,5	4	10
100	8	0,5	6	10
160	10	0,4	8	10
250	15	0,3	15	15
400	25	0,25	25	15
630	30	0,25	30	15
1000	40	0,25	_	15
1600	50	0,25	_	15
2500	60	0,2	_	15
4000	80	0,2	_	15

Table 2

Breaking current, kA	Cos φ	*k*
Under 10	0,5	1,7
10 to 20	0,3	2,0
20 to 50	0,25	2,1
above 50	0,2	2,2

APPENDIX 7

EVALUATION OF DEGREE OF SPARKING AT ELECTRICAL MACHINE COMMUTATORS

Sparking degree	Characteric of sparking degree	Condition of a commutator and brushes
1	No sparking (sparkless commutation)	Blackening on the commutator and traces of carbon deposit on brushes are lacking
1,25	Light sparking under the small part of a brush edge	Ditto
1,5	Light sparking under the large part of a brush edge	Blackening traces emerge on the commutator surface, which are readily wiped out with petrol, as well as carbon deposit traces on brushes
2	Sparking under the entire brush edge. Allowed in short-time load and overload kicks only	Blackening traces emerge on the commutator surface, which cannot be wiped out with petrol, as well as carbon deposit traces on brushes
3	Essential sparking under the entire brush edge with large-sized escaping sparks. Allowed only for the moment of direct (without rheostat steps) switch-on or reverse of machines if a commutator and brushes therewith remain in the condition suitable for further operation	Essential blackening on the commutator surface, which cannot be wiped out with petrol, as well as burning and failure of brushes
Note. The key indicator of commutation evaluation is the condition of a commutator and brushes.		

APPENDIX 8

INSULATION DISTANCES

Both the air and insulation material surface distances between alive parts of different potentials, or between alive parts and earthed metallic parts or an equipment frame shall be consistent with working voltages and operational conditions of equipment with due regard for the insulating materials used.

Where instructions on insulation distances are lacking in technical documentation, the data in the Table of this Appendix are recommended. The values in the Table are given for electrical equipment rated up to 1000 V.

The insulation distances other than those in approved standards or the Table, as well as the insulation distances for equipment rated over 1000 V are subject to special consideration by the Register in each case.

Table

Electrical equipment	Insulation distances	Insulation distances, in mm, for voltage, in V																			
		⩽ 60		61 — 250		251 — 500		501 — 750		751 — 1000		1001 — 1500		1501 — 2000		2001 — 3000		3001 — 5500		5501 — 7500	
		a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b
Switchgear, electrical machines, transformers	Between noninsulated busbars and earthed metallic parts, or between noninsulated busbars related to different poles or phases	6	8	8	14	14	20	30	—	30	—	40	—	50	—	60	—	90	—	105	—
	Between live parts other than busbar joints (not related to commutators)	3	5	5	7	8	10	10	14	14	20	20	28	28	36	36	50	55	80	75	105

Table — continued

Electrical equipment	Insulation distances	Insulation distances, in mm, for voltage, in V																			
		⩽ 60		61 — 250		251 — 500		501 — 750		751 — 1000		1001 — 1500		1501 — 2000		2001 — 3000		3001 — 5500		5501 — 7500	
		a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b
Electrical apparatus: wiring accessories of intercommunication, ship's control and monitoring devices	Between noninsulated busbars and earthed metallic parts, or between noninsulated busbars related to different poles or phases	6	8	8	14	14	20	30	—	30	—	40	—	50	—	60	—	90	90	—	105
	Between live parts (other than busbar joints)	—	—	—	—	—	—	10	14	14	20	20	28	28	36	36	50	50	75	75	105
Electrical cooking appliances, lighting fixtures, wiring accessories	Between live parts and earthed metallic parts	3	4	5	7	8	10	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Notes: a = air distance; b = insulation material surface distance. Distances in column "b" are related to the materials tolerant to surface-leakage currents.																					

APPENDIX 9

DEGREES OF PROTECTION OF ELECTRICAL EQUIPMENT

The degree of electrical equipment protection is denoted by the letters IP and two numerals: the first stands for the degree of equipment protection against ingress inward of solid foreign objects (refer to Table 1), the second, against penetration of water (refer to Table 2).

Table 1

First numeral designating a protection degree	Characterization of electrical equipment protection against ingress of solid foreign objects
0	Equipment protection against ingress inward of solid foreign objects is lacking
1	Equipment protection against ingress inward of solid foreign objects with diameters 52,5 mm and above
2	Equipment protection against ingress inward of solid foreign objects with diameters 12,5 mm and above
3	Equipment protection against ingress inward of solid foreign objects with diameters 2,5 mm and above
4	Equipment protection against ingress inward of solid foreign objects with diameters 1 mm and above
5	Equipment protection against harmful ingress of dust Dust ingress is not fully prevented, but the dust cannot penetrate into a case in the amount sufficient for damaging the equipment or upsetting its satisfactory operation
6	Full equipment protection against ingress of dust

Table 2

Second numeral designating a protection degree	Characteric of electrical equipment protection against ingress of water and other liquids
0	Protection is lacking
1	Protection against vertically-falling water condensate drops Water drops vertically-falling onto the case shall not have an adverse effect upon equipment
2	Protection against water drops Falling water drops shall not have an adverse effect upon equipment when a case is inclined at an angle of up to 15° to the vertical[1]
3	Protection against raining Raining at an angle equal to, or lesser than, 60° to the vertical shall not have an adverse effect upon equipment

Second numeral designating a protection degree	Characterization of electrical equipment protection against ingress of water and other liquids
4	Protection against splashing Water splashes from any direction shall not have an adverse effect upon equipment
5	Protection against water jets The water jet produced with a nozzle from any direction at certain conditions shall not have an adverse effect upon equipment
6	Protection under condtions on the ship's deck (including watertight deck equipment) When exposed to sea waves, water shall not penetrate in the hull under certain conditions
7	Protection against immersion in water Water shall not penetrate into the hull under the pressure and during the time specified
8	Protection during indefinitely extended immersion in water under a certain specified pressure[2]

[1] The designation of a given degree of protection may be supplemented with the index "C" (e.g. IP22C) which specifies stricter requirements for the angle of raindrops falling. The protection degree corresponding to the supplementary index is specified in national standards or specifications effective in the country.

[2] The electrical equipment having the enclosure fit for underwater operation by its design and insulation is considered to be equivalent, as to its protection, to protection degree 8.

The protective enclosure of electrical equipment rated under 1000 V is specified in Table 3.

Table 3

Protective enclosure of electrical equipment rated under 1000 V

Enclosure protecting against ingress inward of solid foreign objects	Protection degree (the first numeral)	Enclosure by water ingress protection								
		Unprotected	Drop-proof		Splash-proof		Waterproof		Immersible	
		Protection degree (the second numeral)								
		0	1	2	3	4	5	6	7	8
Unprotected	0	IP00	IP01	—	—	—	—	—	—	—
Protected against ingress of foreign objects	1	IP10	IP11	IP12	IP13	—	—	—	—	—
	2	IP20	IP21	IP22	IP23	—	—	—	—	—
	3	IP30	IP31	IP32	IP33	IP34	—	—	—	—
	4	IP40	IP41	IP42	IP43	IP44	—	—	—	—
	5	IP50	IP51	—	—	IP54	IP55	IP56	—	—
	6	IP60	—	—	—	—	IP65	IP66	IP67	IP68

Notes: 1. Electrical equipment having enclosure IP00 is termed open.
2. Electrical equipment having enclosures IP60, IP65, IP66, IP67 and IP68 is termed airtight.
3. The table contains preferrable protection degrees established by standards.
4. If the degree for one of the types of protection is of no importance, one of the numerals in the designation is replaced with symbol X.

APPENDIX 10

RECOMMENDATIONS ON CHECKING CABLE STUCTURE AND PHYSICAL PROPERTIES

1. Conductors.

All the conductors of cables and wires shall be made of annealed electrolytic copper with the electrical dc resistance of each single cable conductor referred to a temperature of 20 °C (Ω/km) not exceeding the value from the formula

$$R = 17{,}24k_1k_2k_3/N \cdot 0{,}7854d^2. \quad (1\text{-}1)$$

For round cross-section conductors comprising cylindrical wires of the same cross-section, or

$$R = 17{,}24k_1k_3/A \quad (1\text{-}2)$$

for sector conductors,

where N = number of wires in a conductor;
d = wire diameter, mm;
A = effective area of a conductor cross-section corresponding to that of a single-core wire with a single-wire conductor of

the same length made of the material having the same conductivity and resistance, mm^2;

k_1 = factor (refer to Table 1);

k_2 = 1 for a single-wire conductor;

k_2 = 1,02 for multiwire conductors with a wire diameter over 0,6 mm;

k_2 = 1,04 for multiwire conductors with a wire diameter not exceeding 0,6 mm;

k_3 = 1,0 for single-, double- and triple-core cables;

k_3 = 1,05 for flexible cables and cords with two or more conductors;

k_3 = 1,03 for multipairs telephone cables;

k_3 = 1,02 for other cables.

Table 1

k_1	Nominal diameter of conductor wires, mm		
	0,10 to 0,30	0,31 to 0,90	0,91 to 3,60
For tinned conductor wires:			
single-wire	—	1,05	1,04
multi-wire	1,07	1,04	1,03
For nontinned conductor wires:			
single-wire	—	1,03	1,03
multi-wire	1,04	1,02	1,02

2. Conductors insulation.

2.1 The types of materials for insulation of current-carrying cables and wires are given in Table 2. The use of other insulating materials is subject to special consideration by the Register in each case.

Table 2

Insulation designation	Types of insulating materials	Permissible working temperature, °C[1]
PVC/A	Standard polyvinylchloride	60
PVC/D	Heat-resistant polyvinylchloride	75
EPR	Ethylene-propylene rubber	85
XLPE	Cross-linked polyethylene	85
S95	Silicone rubber	95

[1] The temperature of a conductor for calculating the permissible continuous load of a cable.

2.2 The properties of particular insulating materials recommended are given in Table 3. The properties of silicone rubber and mineral insulation are subject to special consideration by the Register in each case.

2.3 A nominal radial thickness of rubber insulation shall be not less than that specified in Table 4.

The nominal radial thickness of insulation specified in Table 4 may be reduced within 10 %.

2.4 The least mean thicknesses of cables and wires insulation of polyvinylchloride for voltages 250 V and 750 V are recommended as per Table 5.

Table 3

Mechanical properties of insulating materials

Nos.	Properties of insulating materials	EPR	XLPE	S95	PVC
1	Mechanical properties prior to ageing				
1.1	Breaking strength, min, N/mm^2	4,2	12,5	5,0	12,5
1.2	Elongation at rupture, min, %	200	200	150	150
2	Mechanical properties after ageing in an air furnace:				
	temperature, °C (accuracy ±2 °C)	135	135	200	80
	duration, h	168	168	240	168
2.1	Breaking strength:				
	a) minimum value, N/mm^2	—	—	4,0	12,5
	b) maximum changes depending on the value prior to ageing, %	±30	±25	—	±20
2.2	Elongation at rupture:				
	a) minimum value, %	—	—	120	150
	b) maximum changes depending on the value prior to ageing, %	±30	±25	—	±20
3	Mechanical properties after ageing air-pressurized at 0,55 ±0,02 Mpa:				
	temperature, °C (accuracy ±1 °C)	127	—	—	—
	duration, h	40	—	—	—
3.1	Breaking strength:				
	maximum changes depending on the value prior to ageing, %	±20	—	—	—
3.2	Elongation at rupture				
	maximum changes depending on the value prior to ageing, %	±30	—	—	—

Table 4

Nominal area of a conductor cross-section, mm^2	Nominal radial thickness of insulation, mm
1; 1,5	1,0
2,5; 4; 6	1,2
10; 16	1,4
25; 35; 50; 70	1,6
95; 120	1,8
150	2,0
185	2,2
240	2,4
300	2,6
400	2,8
500	3,0
625	3,2

Table 5

Nominal area of a conductor cross-section, mm^2	Thickness of polyvinylchloride insulation, in mm, for voltage, V	
	250	750
0,75 — 1,5	0,7	0,9
2,5	0,8	0,9
4 — 6	0,8	1,0
10	0,9	1,1
16	1,0	1,2
25	1,1	1,3
35	1,2	1,3
50	—	1,4
70	—	1,6
95	—	1,7
120	—	1,8
150	—	1,9
185	—	2,0
240	—	2,2
300	—	2,4

2.5 The conductor insulation thickness specified in Table 5 may be reduced by 10 % of the nominal thickness plus 0,1 mm.

The PVC sheath thickness taken according to Table 6 may be reduced by 15 % of the nominal thickness plus 0,1 mm.

The metallic sheath thickness specified in Table 7 may be reduced by 10 % of the nominal thickness plus 0,1 mm.

The permissible reduction of the nominal radial thickness of the rubber sheath specified in Table 6 shall be within 20 %.

The radial thickness of a lead sheath shall correspond to that specified in Table 7.

3. Sheathing.

3.1 The nominal radial thickness of a rubber sheath shall be not less than that specified in Table 6.

Table 6

Diameter under sheathing, mm	Under 10	10 to 25	25 to 40	40 to 50	Above 50
Nominal radial thickness of a rubber sheath, mm	2,0	2,5	3,0	4,0	4,5

The thicknesses specified in Table 6 may be applicable to PVC sheathing.

A lead sheath shall contain the antimony addition to the extent of 0,4 % to 0,8 %.

The other alloy additions may also be used.

The recommended tolerances for sheathing thicknesses are specified in 2.5 of Appendix.

3.2 The properties of compositions for nonmetallic sheathing are recommended as per Table 8.

Table 7

Diameter under sheathing, mm	Radial thickness of a lead sheath, mm		
	Minimum	Nominal	Maximum
Under 16	1,0	1,15	1,2
16 — 30	1,1	1,25	1,35
30 — 36	1,2	1,4	1,51
36 — 40	1,3	1,5	1,62
40 — 46	1,4	1,6	1,73
46 — 50	1,5	1,7	1,84
50 — 56	1,6	1,8	1,94
56 — 60	1,8	2,05	2,21
60 — 65	2,0	2,3	2,48
Above 65	2,2	2,5	2,70

Table 8

Nos.	Basic material of a sheath	Polychloropropylene				Polyvinylchloride	
	Designation of sheath material[1]	SP1	SP2	SP3[2]	SP4	SV1	SV2
	Continuous permissible working temperature for a conductor, °C	60	80	60	80	60	80
1	Mechanical properties prior to ageing						
1.1	Breaking strength, min, N/mm^2	8,4	8,4	12,7	12,7	10,5	15,0
1.2	Elongation at rupture, min, %	250	250	300	300	100	125
2	Mechanical properties after ageing in a furnace:						
	testing time, h	168	168	168	168	120	240
	temperature, °C	80	100	80	100	100	100
2.1	Breaking strength in percentage of that prior to ageing:						
	minimum	70	70	70	70	85	80
	maximum	—	—	—	—	—	120
3	Mechanical properties after ageing oxygen-pressurized at 2,1 N/mm^2:						
	testing time, h	96	96	96	96	—	—
	test temperature, °C	70	80	70	80	—	—
3.1	Breaking strength in percentage of that prior to ageing, min	70	70	70	70	—	—
3.2	Elongation at rupture in percentage of that prior to ageing, min	70	70	70	70	—	—
4	Mechanical properties after immersion in hot oil:						
	testing time, h	24	24	24	24	—	—
	oil temperature, °C	100	100	100	100	—	—
4.1	Breaking strength, min, in percentage of that obtained on samples prior to hot oil testing	60	60	60	60	—	—
4.2	Elongation at rupture, min, in percentage of that obtained on samples prior to hot oil testing	60	60	60	60	—	—
5	Thermoplastic properties						
5.1	Test for deformation in heating on ageing-free samples:						
	preclimatization time, h	—	—	—	—	1	1
	testing time, h	—	—	—	—	1	1
	furnace temperature, °C	—	—	—	—	120	120
	load pressing a sample, g	—	—	—	—	350	400
	maximum permissible deformation, %	—	—	—	—	40	40

Table 8 — continued

Nos.	Basic material of a sheath	Polychloropropylene				Polyvinylchloride	
	Designation of sheath material[1]	SP1	SP2	SP3[2]	SP4	SV1	SV2
	Continuous permissible working temperature for a conductor, °C	60	80	60	80	60	80
5.2	Cold bend test in aged samples						
5.2.1	Ageing in furnace:						
	h	—	—	—	—	168	168
	°C	—	—	—	—	80	90
5.2.2	Sample cooling time and temperature prior to the bend test:						
	h	—	—	—	—	4	4
	°C	—	—	—	—	−20	−20
5.3	Thermal shock test, furnace temperature, °C	—	—	—	—	120±2	120±2
6	Additional ageing test for PVC compound:						
6.1	air temperature, °C	—	—	—	—	80	100
6.2	testing time, h	—	—	—	—	120	120
6.3	maximum mass loss (roughly), mg/cm^2	—	—	—	—	2,0	2,0

[1] All sheath compounds are allowed for fixed cables.
[2] Compound SP 3 is allowed for sheaths of portable cables intended for use under severe conditions.

4. Protective coatings.

The diameter and thickness, in mm, of steel wires and tapes for cables armoring are recommended as per Table 9.

5. Test of flame retardance.

5.1 General instructions.

The test of flame retardance is performed to determine endurance of insulating enclosures of cables and conductors exposed to flame. This test is not applicable when the flammability of electrical insulating materials is determined.

5.2 Test samples.

A test sample of 600±25 mm long is taken from finished cables or conductors for testing.

5.3 Test unit.

The test unit includes a metallic box with an open front side, a gas burner having a flame pipe with an inner diameter of 10 mm and a holder.

The metallic box is dimensioned as follows: height — 1200±25 mm, width — 300±25 mm, depth — 45 ±25 mm.

5.4 Calibration of test flame.

A flame is adjusted so that its total length in the vertical position is about 125 mm, and the length of a flame core cone is about 40 mm.

The free end of a copper wire dimensioned 100 mm long and 0,7 mm in diameter is horizontally inserted into the flame 50 mm above the burner outlet.

The flame temperature shall be such that the copper wire may melt down within 4 s to 6 s.

5.5 Test performance.

The test is carried out in a space with no draughts. The sample is suspended vertically in the middle of the metallic box and exposed to the test flame at an angle of 45° and a distance of 100 mm above the lower end so that the flame cone touches the sample.

The time of exposure to flame t, s is determined from the formula:

$$t = 60 + m/25$$

where m = sample mass, g.

5.6 Results estimation.

Cables and wires are considered fire-resistant and flame-retardant if the sample does not ignite or, if ignited, independetly dies out after exposure to the test flame, and fire traces do not reach the upper end of the sample.

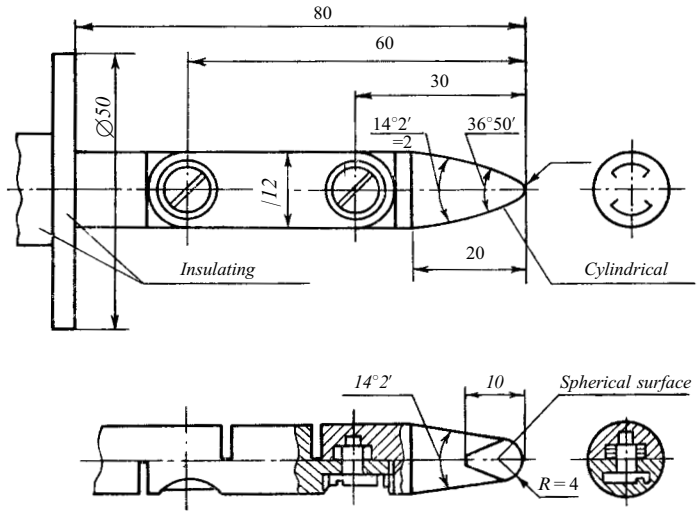
Table 9

Diameter of				Thickness of	
cable under armor		wire for braid	round wire	flat wire	tape
>	⩽				
—	10	0,2	1,2	1,0	—
10	20	0,3	1,5	1,2	—
20	25	0,3	2,0	1,4	—
25	30	0,4	2,0	1,4	—
30	45	0,4	2,5	1,8	0,5
45	60	0,4	2,5	1,8	0,8

APPENDIX 11

TEST PROBE

	Tolerances		
For angles	±5′	⩽ 25	±0,05 mm
For linear dimensions:		> 25	±0,2 mm



APPENDIX 12

PERMISSIBLE DEVIATIONS OF PARAMETERS IN MECHANICAL AND ENVIRONMENTAL TESTS

Parameter	Permissible deviation
Vibration frequency:	
⩽ 50	±2Hz
> 50	±3 %
Amplitude	±20 %
Acceleration under vibration	±20 %
Acceleration under shocks	±20 %
Temperature	±2 %
Relative humidity	±3 %

APPENDIX 13

ENVIRONMENTAL VERSIONS OF PRODUCTS ALLOWED FOR USE IN SEA-GOING SHIPS

Version	Designations[1]	
For ships designed for service in macroclimatic areas with boreal maritime climate[2]	M	M
For ships designed for service only in macroclimatic areas with tropical maritime climate[3]	TM	MT
For ocean-going ships	OM	MU
For all macroclimatic areas on land and at sea	B	B

[1] Designations: Russian letters are for Russia, the Latin ones are for some European countries.
[2] These areas include seas and oceans located north of latitude 30°N and south of latitude 30°S.
[3] These areas include seas and oceans located between latitude 30°N and latitude 30°S.

APPENDIX 14

RUSSIA-ADOPTED DESIGNATIONS OF PRODUCTS BY CLIMATIC CATEGORIES OF LOCATION AND ARRANGEMENT OF THESE PRODUCTS IN SHIPS (GIVEN ONLY THE FIRST KEY NUMERALS OF DESIGNATIONS)

Location category	Arrangement of electrical equipment
1	On open decks
2	In spaces where air temperature and humidity variations are unessentially different from those outdoors and access of outside air is available (e.g. in metallic spaces of superstructures and deckhouses having no thermal insulation, in spaces under the bulkhead deck having no thermal insulation and other spaces below); on open decks, but in areas beyond the reach of the direct exposure to solar radiation, atmospheric precipitation and seawater pouring or splashing; in enclosures of products having location category 1
3	In spaces with increased humidity (particularly wet) wherein the long-time presence of water or frequent condensation of moisture on bulkheads and deckheads is feasible
4	In spaces having thermal insulation and natural ventilation without artificially regulated environmental conditions or with prolonged breaks in regulation, wherein air temperature and humidity variations, wind and atmospheric precipitation effect are essentially less than outdoors, dew and the direct exposure to solar radiation are lacking
5	In spaces with artificially-regulated environmental conditions (heating, ventilation) including full or partial air-conditioning

APPENDIX 15

TEST OF ELECTRICAL INSULATING MATERIALS FOR INFLAMMABILITY

1. General instructions.

The flammability test applies to solid insulating materials used as holders of current-carrying parts or sheaths of electrical and electronic devices.

This test procedure is inapplicable to insulating enclosures and jackets of cables and coductors.

2. Test samples.

Sample dimensions: length – 200 mm, width – 35 mm, thickness – $3 \pm 1{,}5$ mm.

If the test is carried out on samples having other dimensions, a test technique shall be agreed with the Register.

If samples are made of material over 4,5 mm thick, the test is performed on the sample side with an intact extruded enclosure.

Prior to testing, the sample shall be normalized at the relative humidity of air 65 ± 3 % and a temperature of 20 ± 2 °C.

3. Test unit.

The test unit includes a filament loop and a mobile holder of the sample fitted with a scale for determination of a flame height and with a movable load for adjusting a compression pressure.

To make the loop, the filament of chrome-nickel and iron-chromium-aluminium alloys shall be used.

The configuration and dimensions of the filament loop shall be consistent with Fig. 1.

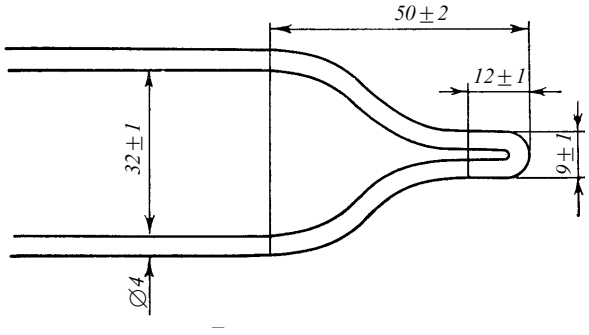


Fig. 1 Filament loop

The mobile holder of the sample shall be arranged so that the latter is retained against the filament loop at a right angle (refer to Figs. 2 and 3).

4. Test performance.

The filament loop is electrically heated up to the temperature corresponding to test parameters. This temperature shall be maintained at continuous power supply during at least 120 s prior to the test start.

The holder with the sample is pressed against the filament loop with a force of 1 N during the set time. If

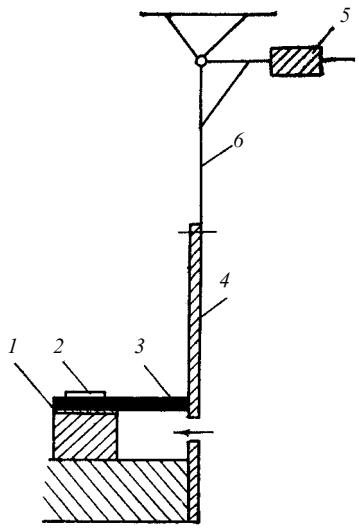


Fig. 2 Diagram of a test unit
1 = input lead; *2* = holder with clamps; *3* = filament loop; *4* = sample; *5* = mass; *6* = frame with a sample holder

insulating material therewith ignites, the flame height by the scale and burnout duration are determined. In this case, the time period from sample removal away from the loop till flame dying down shall be recorded.

5. Test conditions.

The parameters of insulating material tests are given in the Table.

6. Estimation of test results.

6.1 Insulating materials not ignited if loaded according to test group I or ignited, but have the burning duration within 30 s irrespective of a flame height, are considered flame-retardant and suitable for sheaths, but not for holders of current-carrying parts.

6.2 Insulating materials not ignited if loaded according to test group II or ignited, but at a flame height not exceeding 3 cm and have the burning duration 60 s and over, are considered flame-retardant and suitable for sheaths and holders of current-carrying parts.

6.3 The tests shall be performed with three samples.

If one of the samples subject to 6.1 or 6.2 cannot be classed with the flame-retardant ones, three new samples shall be tested.

An insulating material may be considered flame-retardant only when all the samples subject to 6.1 or 6.2 may be classed with the flame-retardant ones in the second test.

If more than one sample are considered nonflame-retardant subject to 6.1 or 6.2, the insulating material is considered nonflame-retardant.

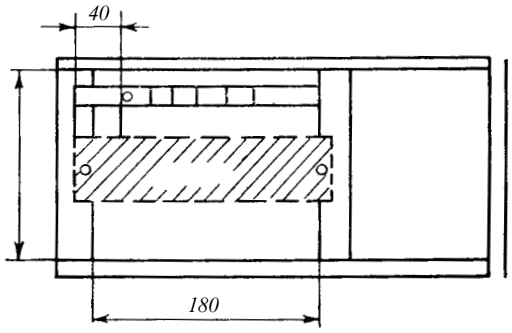


Fig. 3 Sample holder with a scale

Table

Parameters	Test group	
	I	II
Temperature, °C	650	960
Time of loop contact, s	60	30
Compression force, N	1	1

APPENDIX 16

REQUIREMENTS FOR TESTING OF A CARGO HOLD WATER LEVEL ALARM SYSTEM OF BULK CARRIERS AND SINGLE-HOLD CARGO SHIPS OTHER THAN BULK CARRIERS

1. A protective enclosure of bodies of detectors and other elements fitted in cargo holds, ballast tanks and dry spaces shall meet the IP68 requirements in accordance with IEC 60529.

2. The testing of detector/cable box bodies by water pressure shall be based on a pressure head. For detectors/cable boxes to be fitted in holds intended for the carriage of water ballast or in ballast tanks, the application head shall be the hold or tank depth and the hold period shall be 20 days. For detectors/cable boxes to be fitted in spaces intended to be dry, the application head shall be the depth of the space and the hold period shall be 24 hours.

3. Where a detector/cable box is fitted in a space adjacent to a cargo hold (e.g. lower stool, etc.) and the space is considered to be flooded under damage stability calculations, the detector/cable box shall meet the IP68 requirements for a water head equal to the hold depth for a period of 20 days or 24 hours whether or not the cargo hold is intended to be used as a ballast tank as specified above.

4. The functioning of the detector assembly with filtration arrangements shall be verified in the cargo/water mixture with immersion repeated 10 times without cleaning any filtration arrangements.

5. For test purposes, an agitated suspension of representative fine materials in seawater with a concentration of 50 % by weight shall be used.

6. The test container for the cargo/water mixture shall be dimensioned so that its height and volume are such that the sensor and filtration arrangements can be totally submerged repeated 10 times and tested by static and dynamic inclinations.

7. The sensor and filtration arrangements fitted, that shall be submerged, and arranged in the container as they would be installed in accordance with the installation instructions.

8. The pressure in the container for testing the complete detector shall be not more than 0,2 bar at the sensor and filtration arrangement. The pressure may be realised by pressurization or by using a container of sufficient height.

9. The cargo/water mixture is pumped into the test container and suitable agitation of the mixture is provided to keep the solids in suspension:

.1 The pumping of the cargo/water mixture into the test container shall not affect the functioning of the sensor and filter arrangements;

.2 The cargo/water mixture is pumped into the test container to a predetermined level that submerges the detector and the operation of the alarm is observed;

.3 The test container is then drained and the de-activation of the alarm condition is observed;

.4 The test container and sensor with the filter arrangement shall be allowed to dry without physical intervention.

The satisafactory alarm activation and de-activation at each of the ten consecutive tests demonstrate satisfactory testing.

10. The cargo/water mixture used for type testing shall be representative of the range of cargoes within the following groups and shall include the cargo with the smallest particles expected to be found from a typical representative sample:

.1 iron ore particles and seawater;

.2 coal particles and seawater;

.3 grain particles and seawater;

.4 aggregate (sand) particles and seawater.

11. The smallest and largest particle size together with the density of the dry mixture shall be ascertained and recorded. The particles shall be evenly distributed throughout the mixture. In general, testing with representative particles qualify all types of cargoes within the four groupings shown above.

12. The following provides guidance on the selection of particles for testing purposes:

.1 iron ore particles shall mainly consist of small loose screenings of iron ore and not lumps of ore (dust with particle size < 0,1 mm);

.2 coal particles shall mainly consist of small loose screenings of coal and not lumps of coal (dust with particle size < 0,1 mm);

.3 grain particles shall mainly consist of small loose grains of free flowing grain (grain having a size > 3 mm, such as wheat);

.4 aggregate particles shall mainly consist of small loose grains of free flowing sand and without lumps (dust with particle size < 0,1 mm).

11 REFRIGERATING EQUIPMENT

11.1 GENERAL

11.1.1 The provisions of this Section apply in technical supervision of the refrigerating equipment being part of the marine refrigerating plants (MRP) to be supervised by the Register according to the RS Nomenclature.

11.1.2 The Register shall define the scope, nature and methods of surveys as well as the standards and methods of testing machinery, heat exchangers, vessels, pipes and fittings, insulating materials and automatic devices of the MRP.

11.1.3 General regulations for the organisation of the technical supervision during the manufacture of the refrigerating equipment are set out in Part I "General Regulations for Technical Supervision", those concerning the technical documentation – in Part II "Technical Documentation".

11.1.4 Survey of the sets, compressors, pumps, fans, heat exchangers and vessels, automatic and safety devices, fittings and pipes as well as insulating materials shall be performed in accordance with the requirements of Rules for the Classification and Construction of Sea-Going Ships and also on the basis of the documentation and certificates on materials and their propertied approved by the Register.

11.1.5 When surveying finished products made of blanks (forgings, stampings, castings, rolled stock, etc.) a document confirming the compliance thereof with the approved technical documentation shall be submitted to the Surveyor to the Register.

11.1.6 Technical supervision during the manufacture of the refrigerating equipment shall be performed in accordance with the RS Nomenclature and Table 11.1.6. In case of stable production, based on the requirements of this Section, to specify the scope of supervision at various stages of the manufacture of the refrigerating equipment and with due account of the production process, the manufacturer shall draw up a list of items (refer to 12.2, Part I "General Regulations for Technical Supervision") which shall be reviewed and approved by the Register Regional Branch office which performs technical supervision at the enterprise concerned. Based on the experience gained in the technical supervision during construction and operation of the refrigerator ships, the Regional Branch office has the right to require appropriate amendments to be made in the List.

11.1.7 The components of articles related to the machinery of the MRP shall have documents stipulated by the RS Nomenclature and confirming the compliance with the technical documentation approved by the Register.

Table 11.1.6

Nos	Item of technical supervision	Checks			Tests				Inspection
		tech. documentation	components and assemblies[1]	welded joints, assembly work	hydraulic for strength	pneumatic leak	vacuum-tight[2]	bench	
1	Piston compressor:	+	+	+		+	+ +[3]	+	
1.1	bed plate, frame			+					
1.2	block-crankcase, cylinder block	+	+		+				
1.3	cylinder, cylinder liner	+	+		+				+
1.4	crankshaft	+	+						+ +[4]
1.5	connecting rod, rod	+	+						+ +
1.6	piston	+	+						+
1.7	crankshaft gland								+ +
1.8	covers of cylinders, crankcase, pump drive, etc.				+				
1.9	suction and discharge valves							+	+
1.10	piston rings and pins								+ +
1.11	bearing shells:								
	.1 main								+ +
	.2 connecting rod								+ +
1.12	gear wheels	+							+ +
1.13	capacity regulator								+ +
1.14	couplings	+							+
2	Rotary compressor:	+	+	+		+	+ +	+	
2.1	bed plate			+					
2.2	casing, cylinder, cover	+	+		+				+ +
2.3	vane rotor, rotor shaft	+	+						+
2.4	rotor shaft gland								+ +
2.5	discharge valve							+	+ +

Table 11.1.6 — continued

Nos	Item of technical supervision	Checks			Tests				Inspection
		tech. documentation	components and assemblies[1]	welded joints, assembly work	hydraulic for strength	pneumatic leak	vacuum-tight[2]	bench	
2.6	bearings								++
2.7	gear wheels	+							++
2.8	couplings	+							+
3	Screw compressor:	+	+	+		+	++	+	
3.1	bed plate			+					
3.2	casing, casing cover	+	+		+				++
3.3	screw rotor	+	+						+
3.4	rotor seals								++
3.5	journal and thrust bearings								++
3.6	gear wheels of synchronizing pair	+	+	++					+
3.7	step-up gear	+	+						+
3.8	capacity regulator				+				++
3.9	couplings	+							+
4	Turbo-compressor:	+	+	+		+	+	+	
4.1	bed plate			+					
4.2	casing	+	+		+				++
4.3	shaft	+	+						++
4.4	impellers	+	+	+					+
4.5	return-circuit rig	+	+	+					+
4.6	diffuser	+	+	+					+
4.7	blades	+	+						+
4.8	shaft seals	+	+	+					+
4.9	bearings			+					+
4.10	step-up gear wheels and pinions	+	+	+					
4.11	capacity regulator								++
4.12	couplings	+							+
5	Refrigerant pump:	+	+	+		+	++	+	
5.1	bed plate			+					
5.2	casing, cylinder, cover	+	+		+				++
5.3	shaft, rotor, rod	+	+						++
5.4	impeller, screw, piston, gears	+	+						++
5.5	shaft and rotor seal								++
5.6	bearings								++
5.7	built-in electric motor	+	+	++					++
6	Secondary refrigerant pump:	+	++	++				++	
6.1	bed plate			++					
6.2	casing, cover, branch piece	+	+		++				++
6.3	shaft	+	+						++
6.4	impeller	+	+						++
6.5	bearings								++
6.6	couplings	+							+
7	Cooling water pump:	+	++	++				++	
7.1	bed plate			++	++				
7.2	casing, cover, branch piece	+	++						++
7.3	shaft	+	++						++
7.4	impeller	+	++						++
7.5	bearings								++
7.6	couplings	+							++
8	Fan:	+	++	++					
8.1	bed plate			++					
8.2	casing	+	++						++
8.3	shaft	+	++						++
8.4	impeller	+	++						++
8.5	bearings								++
8.6	couplings	+							++
9	Explosive type fan:	+	+	+				+	
9.1	bed plate			+					
9.2	casing	+	+						+
9.3	shaft	+	+						++
9.4	impeller	+	+						+
9.5	bearings		+						++
9.6	couplings	+							+

Nos	Item of technical supervision	Checks			Tests				Inspection
		tech. documentation	components and assemblies[1]	welded joints, assembly work	hydraulic for strength	pneumatic leak	vacuum-tight[2]	bench	
10	MRP vessels and heat exchangers with refrigerant space volume of 0,1 m^3 and over:	+		+	+	+	+ +	+ +	
10.1	bed plate			+					
10.2	casing	+	+	+	+				
10.3	end plates	+	+		+				
10.4	headers	+	+		+				
10.5	covers	+	+		+				
10.6	tube plates	+	+						
10.7	tubes	+	+		+				
10.8	anchor ties	+	+						
10.9	level indicators	+	+		+				
11	MRP vessels and heat exchangers with refrigerant space volume less than 0,1 m^3	+		+ +	+	+	+ +	+ +	
11.1	bed plate			+ +					
11.2	casing	+	+ +	+ +	+ +				
11.3	end plates	+	+ +		+ +				
11.4	headers	+	+ +		+ +				
11.5	covers	+	+ +		+ +				
11.6	tube plates	+	+ +						
11.7	tubes	+	+ +		+ +				
11.8	level indicators	+	+ +		+ +				
12	Fittings and piping:								
12.1	safety devices and valves:	+	+ +	+ +	+	+	+ +	+	+ +
12.2	valves:								
	.1 shutoff and regulating	+	+ +	+ +	+	+	+ +	+ +	+ +
	.2 solenoid	+	+ +	+ +	+	+	+ +	+ +	+ +
	.3 motor	+	+ +	+ +	+	+	+ +	+ +	+ +
	.4 check	+	+ +	+ +	+	+	+ +	+ +	+ +
12.3	headers, tubes	+	+ +	+ +	+	+	+ +		
13	Automatic protective and alarm devices (APA):								
13.1	switches:								
	.1 pressure (suction and discharge)	+	+ +	+	+ +	+	+ +	+	+ +
	.2 pressure differential (lubrication monitoring)	+	+ +	+	+ +	+	+ +	+	+ +
	.3 float	+	+ +	+	+	+	+ +	+	+ +
	.4 flow rate	+	+ +	+ +	+ +			+ +	+ +
	.5 temperature, pressure (secondary refrigerant temperature, discharge temperature monitoring)	+	+ +	+		+	+ +	+	+ +
	.6 electromechanical, thermal, combined	_	+ +	+ +				+	+ +
13.2	gas analyzer (fixed)	+	+ +	+ +		+	+ +	+	+ +
13.3	APA actuators	+	+ +	+ +				+	+ +
13.4	APA amplifiers	+	+ +	+ +				+	+ +
13.5	automated APA fittings	+	+ +	+ +	+ +	+		+	+ +
14	Automatic APA control system devices:								
14.1	controls of:								
	.1 temperature	+	+ +	+ +				+ +	+ +
	.2 pressure	+	+ +	+ +	+ +	+ +	+ +	+ +	+ +
	.3 refrigerating capacity	+	+ +	+ +				+ +	+ +
	.4 level	+	+ +	+ +	+ +	+ +	+ +	+ +	+ +
	.5 humidity	+	+ +	+ +				+ +	+ +
14.2	valves of:								
	.1 temperature control	+	+ +	+ +	+ +	+ +	+ +	+ +	+ +
	.2 water control	+	+ +	+ +	+ +			+ +	+ +
14.3	APA amplifiers	+	+ +	+ +				+ +	+ +
14.4	APA actuators and automatic fittings	+	+ +	+ +	+ +	+ +	+ +	+ +	+ +
15	Insulation	+	+ +					+ +	

N o t e s: 1. Surveys marked + are conducted for classed and unclassed MRP.
2. Surveys marked ++ are conducted only for equipment and items of classed MRP.

[1] Surveys of components and assemblies are conducted to determine compliance with the requirements of the approved technical documentation with verification of brands, marking and accompanying documents on materials.

[2] Vacuum-tight tests are carried out only for equipment using Group I refrigerants.

11.2 TEST TYPES

11.2.1 Test programs for the refrigerating equipment including programs of acceptance tests during the functional inspection carried out by the manufacturer's technical control body shall be approved by the Register.

11.2.2 Tests of samples to be carried out to award Type Approval Certificate shall be combined with the periodical or type tests.

11.3 TECHNICAL SUPERVISION DURING MANUFACTURE OF COMPRESSORS

11.3.1 When compressors are presented to the Surveyor who performs the technical supervision, documentation approved by the Register shall be submitted, including: specifications on delivery of compressors; bench test program; control, regulation and protection diagram with an explanatory note, as well as drawing showing crankcase oil heating arrangements, safety valves, by-passes and device to facilitate starting and control of the compressor refrigerating capacity; set of working documentation.

Besides the technical documentation mentioned above, description and instruction manual as well as, at the Surveyor's request, other technical documentation shall be submitted.

11.3.2 During the manufacture of compressors, survey in accordance with the list shall be performed.

11.3.3 When surveying the compressors and checking their components and main assemblies, the relevant provisions of Section 5 and this Chapter shall be taken as a guide.

11.3.4 After assembling, the compressors shall be subjected to pneumatic leak and vacuum- tight tests. Where no defects are present, the compressors shall be accepted for bench tests.

11.3.5 Bench tests shall be carried out according to the program approved by the Register, which shall define the scope and procedure of the tests. The said tests shall include running-in and functional tests which shall be conducted only if the results of running-in are successful. Where defects are detected during the running-in and subsequent inspection, they shall be corrected and the compressor shall be subjected to repeat running-in the positive results of which shall permit the compressor to be subjected to check functional tests.

11.3.6 In case of stable production of compressors, the scope of the bench tests shall be defined by the Register for each enterprise depending on the procedures and techniques adopted and steady quality of manufacture.

11.3.7 When surveying the bench equipment and performing supervision during the bench tests, the Surveyor shall be governed by the requirements of 5.12.18. The bench equipment shall ensure operation of the compressor with performance of full refrigeration cycle or "vapour ring" cycle using the refrigerant and oil specified in the technical documentation, with maintenance of the rated parameters and environmental conditions, namely: pressure and temperature before the suction and after the discharge connections as well as the refrigerant boiling and condensation; intermediate pressure and temperature for the two- and multiple-stage compressors; cooling water temperature at +32 °C and ambient air temperature at +50 °C.

In case of stable production, the refrigeration capacity of serial compressors may be defined by comparison of their volumetric capacity with that of the prototype or pilot samples.

11.3.8 In case of the compressor tests conducted to award Type Approval Certificate, provision shall be made for determination of the refrigeration capacity under several conditions (not less than 5) of volumetric capacity, consumed power, idle run and oil carry-over.

Safety valves of each compressor stage shall be checked for operation and discharge capacity under several conditions with the discharge valve of the compressor closed.

In addition, the compressors with built-in electric motors shall be subjected to check of their starting characteristics, temperature and resistance of the winding insulation. In the process of periodic tests, the stability of the compressor production quality, durability and reliability of the compressor components, main parameters shall be assessed with subsequent comparison of the quality of products turned out at different times.

The duration of the tests shall be not less than 300 h, 30 % of which shall be spent for operation under maximum pressure differential and 30 % for operation at maximum rating.

11.3.9 Inspection of the compressors after bench tests shall be performed within scope given in Table 11.1.6, after type or periodic tests – with full dismantling of the running gear and measurement of the rubbing parts.

11.3.10 If, based on the compressor test results, a decision is taken as to the possibility of installing the compressor on board, the Surveyor shall put a brand and draw up a Report in accordance with Form 6.3.18 and issue the Register certificate.

In cases, specified in Section 6, Part I "General Regulations for Technical Supervision", the Report according to Form 6.3.18 serves as a basis for issuance of Type Approval Certificate.

11.3.11 In case of stable production, the compressor which passed the bench tests shall be branded and obtain the Register certificate.

11.4 TECHNICAL SUPERVISION DURING MANUFACTURE OF REFRIGERANT PUMPS

11.4.1 Prior to the manufacture of the refrigerant pumps, the documentation approved by the Register within the scope specified by the rules shall be submitted to the Surveyor performing the technical supervision.

11.4.2 In the process of the manufacture of the refrigerant pumps, the Surveyor shall carry out control checks and surveys according to the list. After being assembled, the shaft with discs (vanes) shall be balanced in accordance with the manufacturer's standards with subsequent presentation to the Surveyor for survey.

11.4.3 After being assembled, the pump shall be run in and tested on bench with the use of specified refrigerant according to the program approved by the Register.

The duration of the pump test on bench shall be sufficient to reveal the specified characteristics and reliability: in case of stable production – not less than 8 h and for tests mentioned in Note 4 to Table 11.4.6 – not less than 240 h.

After the tests the pumps shall be inspected within the scope given in Table 11.1.6.

11.4.4 The refrigerant pump which passed the bench tests under the Register technical supervision shall be branded and obtain the Register documents similarly to 11.3.10 and 11.3.11.

11.5 TECHNICAL SUPERVISION DURING MANUFACTURE OF SECONDARY REFRIGERANT AND COOLING WATER PUMPS

11.5.1 Technical supervision during the manufacture of the secondary refrigerant and cooling water pumps shall be performed in accordance with 5.8 and Table 11.1.6.

11.6 TECHNICAL SUPERVISION DURING MANUFACTURE OF FANS

11.6.1 Technical supervision during the manufacture of fans shall be performed in accordance with 5.10.8 and Table 11.1.6.

11.7 SUPERVISION DURING MANUFACTURE OF HEAT EXCHANGERS AND PRESSURE VESSELS FOR REFRIGERANT, SECONDARY REFRIGERANT AND/OR COOLING WATER

11.7.1 Technical supervision during the manufacture of heat exchangers and pressure vessels shall be performed in accordance with Section 9 and Table 11.1.6.

11.7.2 Heat exchangers and pressure vessels shall be presented for survey with the mounted regular fittings and devices specified by the technical documentation.

During the external examination in the process of survey, the following shall be checked: condition of the external surfaces, availability, compliance with the drawing data and condition of the fittings and instruments; mounting of the safety valves; availability of a data plate on the casing; length of the branch pieces; thickness of the insulation installed.

11.7.3 Bench tests of the prototype (pilot) samples of the refrigerant heat exchangers and pressure vessels, freezing units, ice-making units as well as the tests in case of stable production and to confirm Recognition Certificate for Manufacturer shall be carried out in accordance with the program and procedure approved by the Register. The bench equipment shall provide operation of the abovementioned apparatus with performance of full refrigeration cycle using the refrigerant stated in the technical documentation.

During the bench tests of the heat exchangers the heat transfer coefficient, heat exchange rate and pressure loss under different operating conditions shall be determined, and for the freezing units and ice-making units – also the capacity.

In the process of tests of the condensers the following shall be measured: water flow rate, its temperature at the inlet and outlet of the unit; pressure differential on the water side; condensation temperature and pressure; refrigerant temperature at the inlet and outlet of the condenser; mass of the refrigerant passing therethrough.

When testing evaporators, the following shall be determined: refrigeration capacity, heat transfer coefficient, heat exchange rate, pressure loss on the secondary refrigerant and refrigerant side.

The refrigeration capacity of the evaporator shall be determined either by the mass of the refrigerant evaporated or by the amount of heat released by the secondary refrigerant.

When testing air coolers, the refrigeration capacity under different conditions shall be determined from the change in air or refrigerant state. In the first case, the mass (volume and density) of the circulating air as well as its temperature and humidity at the outlet of the unit shall be measured. When determining the refrigeration capacity from the change in the refrigerant state, the mass of the evaporated liquid at circulation ratio $n > 1$ shall be determined only by calorimetric method and at the circulation ratio $n = 1$ it may be determined by the volumetric or constriction method.

The duration of the bench tests mentioned in Note 4 to Table 11.1.6 shall be not less than 300 h.

11.7.4 Where the results of surveys carried out according to Table 11.1.6 and this Chapter are positive, the pressure vessels, heat exchangers and units with the refrigerant space volume of 0,1 m^3 and over shall be branded and obtain the Register documents similarly to 11.3.10 and 11.3.11.

11.8 TECHNICAL SUPERVISION DURING MANUFACTURE OF REFRIGERATING PLANT FITTINGS

11.8.1 When surveying shutoff, regulating and safety fittings, the Surveyor shall be guided by Sections 8 and 10 and Table 11.1.6.

11.8.2 The fittings in assembly, after strength, leak and tightness tests shall be subjected to pneumatic leak test of closure.

11.8.3 Safety spring-loaded valves, after strength, leak and tightness tests shall be subjected to tests to verify their setting and tightness of closing; whilst so doing, they shall be set to the operation pressure not higher than 1,1 the design pressure and shall close at the pressure not less than 0,85 the design pressure adopted in accordance with 2.2.1, Part XII "Refrigerating Plants" of Rules for the Classification and Construction of Sea-Going Ships. The closing tightness shall be checked under the water by repeat rise of the pressure up to the design pressure after the valve is closed due to operation.

11.9 TECHNICAL SUPERVISION DURING MANUFACTURE OF REFRIGERATING PLANT INSTRUMENTS

11.9.1 Refrigerating plant fittings shall be tested according to the approved technical documentation.

11.9.2 Technical supervision during the manufacture and tests of the instruments of the protection and regulating automatic systems shall be performed according to Section 12 and Table 11.1.6.

11.9.3 Automatic protection, regulating and alarm systems of the automated machinery and units of the MRP shall be surveyed according to Sections 11 and 12, Part V "Technical Supervision during Construction of Ships".

11.10 TECHNICAL SUPERVISION DURING MANUFACTURE OF THERMAL INSULATING MATERIALS

11.10.1 Thermal insulating materials shall be manufactured and tested in accordance with the approved technical documentation.

11.10.2 When carrying out surveys stated in note to Table 11.1.6, the following properties of the thermal insulating materials shall be checked:

.1 thermal: heat conductivity coefficient, specific heat;

.2 humidity: hygroscopicity (steam adsorptive capacity), water absorption (capacity to absorb water) and steam diffusion coefficient;

.3 mechanical and structural: density, specific surface and volume of pores, radius of micropores and their proportion in volume, ultimate strength, impact strength, elasticity modulus[1], fluidity and compactness (shrinkage)[2].

11.11 HYDRAULIC TESTS FOR STRENGTH

11.11.1 Control over hydraulic tests of refrigerating equipment, individual assemblies and components shall be exercised by the Surveyor in accordance with Table 11.1.6. When performing supervision of the hydraulic tests, the Surveyor shall be guided by the requirements of Section 5 of this Part and Section 9, Part V "Technical Supervision during Construction of Ships" as well as by the provisions specified below.

11.11.2 The surfaces of the items subjected to the hydraulic tests shall have no protective coatings (nor shall be painted or tin-plated, etc.) and the openings intended for installation of the fittings and instruments shall be blanked off.

11.11.3 Items operating under pressure of the refrigerant and/or secondary refrigerant or cooling water shall be tested for strength by test pressure in accordance with the requirements of Rules for the Classification and Construction of Sea-Going Ships. In the tests the prototypes shall be exposed to this pressure during not less than 1 h, while the serial specimens – not less than 10 min.

11.11.4 The items shall be considered to have passed the tests if no pressure drop, cracks, tears, leak, drips, drops or visible residual deformations are found.

11.12 PNEUMATIC LEAK TESTS

11.12.1 Control over the pneumatic tests of the refrigerating equipment operating under the refrigerant pressure shall be exercised by the Surveyor in accordance with Table 11.1.6.

11.12.2 The items subjected to the pneumatic leak tests may be admitted to such tests only if the results of the hydraulic tests for strength are successful.

11.12.3 Pneumatic leak tests shall be carried out by test pressure equal to the design pressure provided the following conditions are complied with:

.1 there are two verified and sealed pressure gauges;

.2 test shall be carried out by dry air or nitrogen with the steam saturation temperature not more than 45 °C;

[1] To be determined for cellular insulating materials.
[2] To be determined for cellular, powder-like insulating materials.

.3 the temperature of water into which the items shall be completely immersed shall be not less than 12 °C for items of small volume and 12 °C for items of more than 0,1 m^3 in volume;

.4 no pumping-up during the time period when the item is exposed to the test pressure is permitted;

.5 the duration of the tests shall be not less than the stabilization time but not less than 15 min.

11.12.4 Heat exchangers and pressure vessels shall be considered to have passed the tests unless air or nitrogen leakage and pressure drop according to the pressure gauge during the tests are detected.

11.12.5 Testing of items without immersion due to large size or for other reasons shall be subject to special consideration by the Register in each case.

11.12.6 Where the refrigerating equipment is tested for leaks without being immersed into water, the duration of the tests shall be not less than 6 h, and in this case the total pressure drop during the tests due to adsorption and leak shall be not more than 1 % of the initial test pressure.

11.13 VACUUM-TIGHT TESTS

11.13.1 The control over the vacuum-tight tests of the freon refrigerating equipment operating at subatmospheric pressure shall be exercised by the Surveyor in accordance with Table 11.1.6 upon completion of the pneumatic leak tests.

11.13.2 Prior to tests, the items shall be dried. Thereupon they shall be vacuumized down to a residual pressure not exceeding 0,8 kPa.

11.13.3 The items shall be under vacuum during 6 h.

If the total pressure rise due to steam and gas desorption during the tests does not exceed 25 % of the initial residual pressure, the items shall be considered to have passed the tests.

Upon completion of the tests for tightness, gas conservation of the item shall be checked. Whilst so doing, positive pressure of the dry nitrogen, refrigerant or mixture thereof used for gas conservation of the interior spaces of the item shall be not less than 0,2 MPa at the ambient air temperature of 20 °C.

12 AUTOMATION EQUIPMENT

12.1 GENERAL

12.1.1 The provisions of this Section apply in technical supervision of the automation equipment listed in Section 15 "Automation" of the RS Nomenclature and in other sections of the Nomenclature as well as in this Section if such equipment forms part of the automation systems and devices.

12.1.2 The Section contains the requirements for technical supervision during the manufacture of the said supervised items at the enterprise.

12.1.3 General regulations for the organisation of the technical supervision during the manufacture of the supervised items are set out in Part I "General Regulations for Technical Supervision", those concerning the technical documentation – in Part II "Technical Documentation".

12.2 TECHNICAL DOCUMENTATION

12.2.1 Technical documentation on the automation equipment shall be approved within the scope specified in Part XV "Automation" of Rules for the Classification and Construction of Sea-Going Ships.

12.2.2 When reviewing the technical documentation on the automation equipment, it is necessary to identify the compliance of the design and performance characteristics of the products with the requirements of the relevant parts of Rules for the Classification and Construction of Sea-Going Ships, as well as with the shipboard service conditions according to the standards set forth in the Appendix to this Section.

12.3 SCOPE AND PROCEDURE OF SURVEYING THE AUTOMATION EQUIPMENT

12.3.1 The scope and types of tests of the automation equipment during the manufacture thereof shall correspond to Table 12.3.1.

Tests of the prototype in design office or in pilot production shall be conducted within the scope of the prototype tests, except for the reliability tests.

Prior to the tests of the automation equipment, it is necessary to check the availability of:

.1 documents on related parts confirming supervision by the Register during the manufacture thereof in accordance with the RS Nomenclature;

.2 set of the approved technical documentation on the equipment to be tested;

.3 approved test program;

Table 12.3.1

Test scope and types

Nos	Item of technical supervision	Prototype			Articles of stable production			
		Functional (refer to 12.4.1)	For compliance with shipboard conditions (refer to 12.4.2)	Special (refer to 12.4.5)	Verification of documents on articles (refer to 12.3.2.1)	Functional (refer to 12.4.1)	To confirm Recognition Certificate (refer to 12.4.4)	To confirm Type Approval Certificate (refer to 12.4.8)
1	**Integrated automation systems of machinery installations**	+	+	+	+	+	+	+
2	**Centralized alarm and monitoring systems including computer-based systems**	+	+	+	+	+	+	+
3	**Main machinery control systems:**							
3.1	Remote control systems of main internal combustion engines	+	+	+	+	+	+	+
3.2	Remote control systems of main machinery with CPP	+	+	+	+	+	+	+
3.3	Remote control systems of main steam turnine installations	+	+	+	+	+	+	+
3.4	Remote control systems of azimuth propulsion thrusters	+	+	+	+	+	+	+
3.5	Control systems of ship and MODU dynamic positioning systems	+	+	+	+	+	+	+
3.6	Control systems of azimuth podder electrical propulsion plant	+	+	+	+	+	+	+
3.7	Automated control systems of self-elevating MODU jacking mechanisms	+	+	+	+	+	+	+
3.8	Remote control and monitoring systems of semi-submersible MODU ballast systems	+	+	+	+	+	+	+
3.9	Remote control systems of azimuth and tunnel thrusters	+	+	+	+	+	+	+
3.10	Stabilization and hull-position control systems of high-speed craft	+	+	+	+	+	+	+
4	**Control systems of electric power plants:**							
4.1	Remote automated starting and stopping systems of diesel generators	+	+	+	+	+	+	+
4.2	Remote automated starting and stopping systems of turbo-generators	+	+	+	+	+	+	+
4.3	Remote automated starting and stopping systems of shaft generators (where coupling control system is provided)	+	+	+	+	+	+	+
5	**Control systems of boiler plants:**							
5.1	Automated control systems of main boiler plants	+	+	+	+	+	+	+
5.2	Ditto, auxiliary boiler plants	+	+	+	+	+	+	+
5.3	Ditto, waste-heat boiler plants	+	+	+	+	+	+	+
5.4	Ditto, water heating boilers	+	+	+	+	+	+	+
6	**Control systems of auxiliary machinery:**							
6.1	Automated control systems of compressors	+	+	+	+	+	+	+
6.2	Ditto, separators	+	+	+	+	+	+	+
6.3	Ditto, filters	+	+	+	+	+	+	+
6.4	Ditto, pumps (luboil, fuel oil, cooling, etc.)	+	+	+	+	+	+	+
6.5	Ditto, fuel preparation (temperature, viscosity)	+	+	+	+	+	+	+
7	**Remote control of ship's service systems:**							
7.1	Remote control of valves and pumps of ballast and bilge systems	+	+	+	+	+	+	+
7.2	Ditto, heel and trim systems of icebreakers and crane ships	+	+	+	+	+	+	+
7.3	Ditto, cargo systems of oil tankers	+	+	+	+	+	+	+
7.4	Ditto, cargo system of gas carriers	+	+	+	+	+	+	+
7.5	Ditto, cargo system of chemical carriers	+	+	+	+	+	+	+

Table 12.3.1 — continued

Nos	Item of technical supervision	Prototype			Articles of stable production			
		Functional (refer to 12.4.1)	For compliance with shipboard conditions (refer to 12.4.2)	Special (refer to 12.4.5)	Verification of documents on articles (refer to 12.3.2.1)	Functional (refer to 12.4.1)	To confirm Recognition Certificate (refer to 12.4.4)	To confirm Type Approval Certificate (refer to 12.4.8)
8	**Automation systems of deck machinery**	+	+	+	+	+	+	+
9	**Devices:**							
9.1	Regulating devices being part of control and monitoring systems referred to under Nos. 1 to 8	+	+	+	+	+	+	+
9.2	Monitoring (alarm and indication) devices being part of integrated and centralized control and monitoring systems referred to under Nos. 1 to 8	+	+	+	+	+	+	+
9.3	Safety devices being part of systems referred to under Nos. 1 to 8	+	+	+	+	+	+	+
9.4	Logging devices being part of systems referred to under Nos. 1 to 8	+	+	+	+	+	+	+
9.5	Crankcase oil mist detectors in internal combustion engines	+	+	+	+	+	+	+
9.6	Computers and programmable logic controllers	+	+	+	+	+	+	+
9.7	Electronic devices for control of working process in internal combustion engines	+	+	+	+	+	+	+
10	**Indirect regulators of:**							
10.1	level	+	+	+	—	+	+	+
10.2	pressure	+	+	+	—	+	+	+
10.3	temperature	+	+	+	—	+	+	+
10.4	viscosity	+	+	+	—	+	+	+
10.5	speed	+	+	+	—	+	+	+
11	**Sensors and signalling devices of:**							
11.1	level	+	+	+	—	+	+	+
11.2	pressure	+	+	+	—	+	+	+
11.3	temperature	+	+	+	—	+	+	+
11.4	flow	+	+	+	—	+	+	+
11.5	salinity	+	+	+	—	+	+	+
11.6	vibration	+	+	+	—	+	+	+
11.7	position	+	+	+	—	+	+	+
11.8	gas concentration	+	+	+	—	+	+	+
12	**Panels, cabinets and other enclosures for:**							
12.1	control systems	—	+	+	—	—	+	+
12.2	monitoring (alarm and indication) systems	—	+	+	—	—	+	+
12.3	recording system	—	+	+	—	—	+	+
13	**Remote instrumentation**	+	+	+	—	+	+	+

.4 full set of testing equipment with necessary documents confirming the characteristics thereof, Recognition Certificate or Report for Laboratory. Measuring instruments shall have an accuracy class not lower than 1,5;

.5 documents of competent authorities confirming positive results of special test types if they are stipulated in the test program (explosion proofness, noise immunity, etc.);

12.3.3 During the tests, the pneumatic components of the automation (analogue and discrete) shall be mounted and interconnected as this will be provided in the automation units.

12.3.4 The remotely controlled fittings shall be generally tested complete with the extreme position signalling devices (especially during vibration-resistance and shock-resistance tests).

12.3.5 Regulators, sensors and signalling devices shall be generally tested on beds with real working media.

12.3.6 Pneumatic and hydraulic pipelines of the automation systems shall be subjected to hydraulic tests to pressures according to Section 8.

12.3.7 Using the prototype or pilot sample the repairability of the automation and systems and devices shall be checked; the following shall be checked:

.1 simplicity and ease of component replacement, repair, maintenance and adjustment as well as the time needed to do this;

.2 replacement of the components (shall not be accompanied by complicated adjustments and fine

adjustments) of the automation equipment. When checking the repairability, attention shall be given to availability of numbers, instruction plates, tags and other indices designating the appropriate spare parts as well as their position in the automation system and in the diagrams.

12.3.8 Prior to testing, the automation systems and devices shall be run-in in order to expose internal defects therein, which according to the reliability theory reveal themselves within the first hours of operation, during the so called shake down period.

The run-in shall be performed at the enterprise manufacturing the systems and devices during 30 – 60 h on the shop bed while the system or device fulfils the main functions. The results of run-in (data on failures and delays in operation, etc.) shall be presented to the Surveyor. Where spare units are available, the tests shall be carried out both with the regular and spare units. The duration of testing the systems shall then be increased.

12.3.9 Tests of the prototypes of the automation systems (control, regulation, alarm and protection) shall be carried out at the manufacturer's complete with the sensors and actuators.

12.3.10 The prototype of the system manufactured at the manufacturer's shall be subjected to functional tests on the item automated (at the enterprise manufacturing the automated machinery). Where no positive results of such tests have been obtained, the said systems shall not be installed on board.

12.3.11 On agreement with the RS Branch Office performing technical supervision during the manufacture, for the automation systems some tests other than the functional tests conducted previously on the components and devices being part of this systems or the tests of the systems itself conducted previously may be taken into account, provided that those tests have been conducted according to the standards not lower than the Register standards.

12.3.12 Upon completion of the mechanical and environmental tests, any types of special tests and checks following which mechanical damages of individual components are likely to occur as well as when the normal operation during any tests is disturbed, the equipment shall be subjected to detailed examination.

12.3.13 Where the results of testing the individual samples of equipment are unsatisfactory, or negative results of shipboard operation of this equipment are obtained, supplementary tests may be required.

12.3.14 Upon completion of the tests of prototype (pilot) sample, the Register Report shall be drawn up in accordance with the requirements of Section 1. Where the results of the tests are positive, Type Approval Certificate shall be drawn up.

12.4 GUIDELINES ON PARTICULAR TEST TYPES

12.4.1 Functional tests.

12.4.1.1 Each sample at the manufacturer's shall be subjected to functional tests. The following shall be checked and tested prior to the functional tests:

.1 completeness;

.2 compliance of the structures with the technical documentation;

.3 manufacturer's marks and assembling;

.4 materials and spare parts;

.5 insulation resistance (according to 3.1 of Appendix for normal environmental conditions);

.6 electric strength of insulation;

.7 interchangeability;

.8 vibration resistance at one frequency (according to 3.6.2 of Appendix, only for stable production products) as well as other tests and checks specified in the technical documentation, but unrelated to the tests for compliance with shipboard service conditions (periodical tests).

12.4.1.2 Automation equipment shall be checked for functioning and proper performance under conditions specified by the technical documentation.

The tests shall be carried out under standard environmental conditions.

During the functional tests appropriate measurements shall be made and the following shall be checked:

.1 all characteristics for compliance with the requirements of the technical documentation (error, speed of response or sluggishness, responsivity, dynamic and static output characteristics, etc.) and automation algorithms, that is the whole scope, procedure and sequence of the control, regulation, monitoring and protection functions fulfilled by the system or device;

.2 automatic monitoring of the system state of health (if provided) by simulation of individual faults within the system, in sensors and test machinery by means of breaks, short-circuits, etc.;

.3 time and ease of the monitoring of the state of health, convenient arrangement of the test points for measurements, etc., if only routine monitoring is stipulated for the automation equipment. The time for checking state of health and identifying faults shall be minimum. The check of the state of health shall not require a large number of various precision instruments, complicated accessories, etc.;

.4 effects of short-circuits and breaks in the sensor and actuator circuits on the proper performance of same channels and the system as a whole by means of simulation of the short-circuits and breaks. When simulating short-circuits and breaks in some circuits, the performance of the adjacent circuits and channels shall not be affected, and, what is more important, the entire system shall not fail.

12.4.1.3 The interchangeability shall be checked by replacements of some sensors, units and assemblies by the spare ones. Upon replacement of a unit or sensor, malfunction shall not fall beyond the limits established by the technical documentation.

12.4.2 Pilot, prototype samples as well as the samples of the automation equipment presented to the Register for the first time shall be subjected to tests for compliance with the shipboard service conditions.

During these tests the following properties of the automation equipment shall be checked:

.1 resistance to the voltage and frequency fluctuation (supply pressure fluctuation for pneumatic and hydraulic systems), stability in operation at the limiting coefficients of non-linear distortions;

.2 resistance to the magnetic and electric interferences (electromagnetic compatibility – EMC);

.3 level of the radio interference generated;

.4 resistance to the motions and prolonged inclinations;

.5 vibration resistance;

.6 shock resistance;

.7 protection of the casing;

.8 heat stability;

.9 cold endurance;

.10 moisture resistance;

.11 corrosion resistance;

.12 resistance to the effects of hoarfrost and dew – for the automation equipment intended for installation on open decks;

.13 resistance to mould – for the equipment intended for continuous operation under tropical conditions (if all components being part of the system or device have stood such tests, the tests of the equipment in assembly may be dispensed with);

.14 reliability of the seals at the mounting site and reliability of the tightness when the immersed part of the sensor fails;

.15 tests of the hydraulic and pneumatic components and devices for maintenance of the proper performance at short-term 150 % overloads induced by increased pressure of the working medium.

The said tests shall be conducted according to the program approved by the Register and following the procedure set forth in Appendix to this Section.

On agreement with the Register, other methods of tests may be accepted.

The scope of the tests shall be determined with due account of the energy used and structural features of the automation equipment.

12.4.3 To confirm the compliance of the product with the approved technical documentation, in the process of stable production, the manufacturer shall carry out regular tests within the scope of the tests for compliance with the shipboard service conditions (refer to 12.4.2) according to the program approved by the Register. Prior to these tests, functional tests (refer to 12.4.1) shall be conducted. The schedules of tests shall be agreed with the RS Regional Branch office performing supervision at the enterprise. The above tests may be combined with the periodical tests required by the national standards.

12.4.4 To confirm the Recognition Certificate (refer to Part I "General Regulations for Technical Supervision"), the results of the tests referred to in 12.4.3 shall be presented to the Register. If need be, the Register shall take part in these tests.

12.4.5 Depending on the purpose and on board arrangement of some kinds of equipment, special tests shall be conducted:

for explosion proofness, noise immunity, solar radiation resistance, for absence of noise for the magnetic compass operation, etc. Special tests shall be conducted according to the program and procedure set forth in the technical documentation on the automation equipment.

The explosion proofness shall be checked and confirmed by a special competent body. A certificate shall be presented for each kind of such equipment.

12.4.6 Reliability characteristics of the automation components, devices and systems shall be confirmed by the reports of the reliability tests carried out by manufacturers.

12.4.7 Incoming inspection of the components shall be performed by the manufacturer of the automation systems and devices.

The results of such inspection shall be presented to the Surveyor at his request.

The incoming inspection service of the manufacturer's shall be checked by the Register during issuance and confirmation of the Recognition Certificate.

12.4.8 After modifications have been made in the design of the automation equipment, the samples shall be subjected to tests according to the program approved by the Register and under its supervision in order to confirm the Type Approval Certificate.

The above tests may be combined with the type tests of the equipment, required by the national standards.

APPENDIX

STANDARDS AND METHODS OF TESTING AUTOMATION EQUIPMENT

1. General.

1.1 This Appendix gives minimum requirements imposed on the tests of the automation equipment.

1.2 The automation equipment tested according to these requirements shall be considered as having passed the tests if it meets the conditions set out in the main definitions and the text of this Appendix.

2. Definitions and explanations.

2.1 Vibration resistance of equipment is the capability of the equipment to perform its functions under vibration conditions while maintaining the parameters within the prescribed limits.

2.2 Shock resistance of equipment is the capability of the equipment to perform its functions under conditions of shocks while maintaining the parameters within the prescribed limits.

2.3 Protection of equipment means a degree of protection of enclosed equipment against penetration of foreign solids as well as a degree of protection of enclosed equipment against penetration of water.

2.4 Heat stability of equipment is the capability of the equipment to perform its functions at the highest ambient air temperature which may be observed under service conditions while maintaining the parameters within the prescribed limits and being undamaged.

2.5 Cold endurance of equipment means the capability of the equipment to perform its functions at the lowest ambient air temperature which may be observed under service conditions while maintaining the parameters within the prescribed limits and being undamaged.

2.6 Corrosion resistance is the capability of the metal article to resist corrosion when exposed to salt solution.

2.7 Mould resistance is the capability of the articles to resist development of the fungus mould in fungi contaminated environment.

2.8 Normal environmental conditions are the conditions characterized by combination of the following atmosphere parameters:

.1 temperature 25 ± 10 °C;

.2 relative humidity 60 ± 30 %;

.3 atmospheric pressure 96 ± 10 kPa.

2.9 The standard environmental conditions are the conditions characterized by combination of the following parameters:

.1 temperature 20 ± 2 °C;

.2 relative humidity 65 ± 2 %;

.3 atmospheric pressure 96 ± 10 kPa.

Note. If it is impossible to maintain the standard environmental conditions at the beginning and in the end of the tests for heat stability, cold endurance, moisture resistance and mould resistance, it is permitted to change the parameters of the equipment under normal environmental conditions. However, the difference between the parameters in the beginning and in the end of the tests shall not, where possible, exceed the tolerance specified for the standard environmental conditions. The deviations from the standard values of the temperature and humidity defined by the test conditions shall be indicated in the Test Report.

3. Standards and methods of tests.

3.1 Insulation resistance measurement.

The insulation resistance during the tests on bench for each individual instrument or device circuit shall be not lower than the values given below:

Normal environmental	20
Relative humidity 20 ± 3 % at temperature 55 ± 2°C	5
Relative humidity 95 ± 3 % at temperature 40 ± 2°C	1

Measurement of the insulation resistance at elevated temperature and humidity may be combined with the tests for heat resistance and moisture resistance.

3.2 Test of insulation electric strength.

The electric insulation of the automation equipment shall stand up without any flashover, within 1 min, under normal environmental conditions, to the alternating sine voltage with a frequency of 50Hz or 60 Hz and with a value given below:

Rated, V	Test, V
Up to 65	$2U_r + 500$
From 66 up to 250	1500
From 251 up to 500	2000

For the automation equipment with semiconductor components the value of the test voltage shall be subject to special consideration by the Register in each case.

3.3 Test for deviation of power supply from rated values.

The deviations of the voltage and frequency from the rated values during the tests of the electric and electronic automation equipment shall comply with the values given in Table 3.3.

Table 3.3

Nos	Parameter	Deviations from rated values		
		long-term, %	short-term, %	time, s
1	Voltage	+6, −10	±20	1,5
2	Frequency	±5	±10	5,0

The components and devices supplied from accumulator batteries shall be tested with the voltage being deviated from the rated value by +30 % – 25 %.

Thrice-repeated interruption of the power supply for 30 s within 5 min shall not affect the proper performance of the automation equipment.

The pneumatic and hydraulic components and devices shall be tested at fluctuations of the working medium $\pm$20 % from the rated value.

3.4 Tests for electromagnetic compatibility (EMC).

3.4.1 Tests for interference level for other equipment.

During the tests the equipment shall operate under normal conditions and the position of controls affecting the interference level shall be such that the maximum level of interference generated by the equipment being tested could be established. If the equipment has several power modes, a mode generating the maximum interference level shall be identified, and it is just for this mode all the measurements shall be made.

3.4.1.1 Conductive interference.

For the equipment arranged on open deck and navigating bridge the levels of the generated radio interference voltage in the power supply and input/output circuits shall not exceed the following values within the frequency ranges given below:

10 – 150 kHz – 96 – 50 dBmV;

150 – 300 kHz – 60 – 50 dBmV;

350 kHz – 30 MHz – 50 dBmV.

For the equipment arranged in machinery and other enclosed spaces of the ship, the levels of the generated radio interference voltage in the power supply and input/output circuits shall not exceed the following values within the frequency ranges given below:

10 – 150 kHz – 120 – 69 dBmV;

150 – 500 kHz – 79 dBmV;

350 kHz – 30 MHz – 73 dBmV.

To measure the levels of interference voltage, use shall be made of the artificial mains network and quasi-peak measuring receiver. The transmission bandwidth of the receiver when measurements are made in the frequency range from 10 kHz to 159 kHz shall be 200 Hz and in the frequency range from 150 kHz to 30 MHz – 9 kHz.

The connecting cables between the electric power supply terminals of the tested equipment and the artificial mains network shall be screened and not exceed 0,8 m in length. If the tested equipment consists of several units with separate terminals for alternating and direct current, the power supply terminals with similar voltage rating may be connected in parallel.

When making measurements, all the measuring instruments and the equipment being tested shall be installed on an earthed plane and connected thereto. Where the use of an earthed plane is impossible, an artificial earthing shall be carried out by connecting to a metal frame or casing of the equipment being tested.

3.4.1.2 Radiated interference.

For the equipment arranged on open deck and navigating bridge the levels of the generated radio interference electromagnetic field at a distance of 3 m shall not exceed the following values in the frequency ranges given below:

0,15 – 0,3 MHz – 80 – 52 dBmV;

0,3 MHz – 30 MHz – 52 – 34 dBmV;

30– 2000 MHz – 54 dBmV,

except for the range 156 – 165 MHz where 24 dBmV shall be established.

For the equipment arranged in enclosed machinery and other spaces of the ship, the levels of the generated radio interference electromagnetic field at a distance of 3 m shall not exceed the following values in the frequency ranges given below:

0,15 – 30 MHz – 80 – 50 dBmV;

30 MHz – 100 MHz – 60 – 54 dBmV;

100– 2000 MHz – 54 dBmV

except for the range 156 – 165 MHz where 24 dBmV shall be established.

To make measurements, use shall be made of a quasi-peak measuring receiver. The transmission bandwidth of the receiver in the frequency range from 0,15 MHz to 30 MHz and from 156 MHz to 165 MHz shall be 9 kHz and in the frequency range from 30 MHz to 156 MHz and from 165 MHz to 1 GHz – 120 kHz.

The size of the measuring antenna in the direction to the equipment being tested shall not exceed 20 % of the distance thereto. At frequencies more than 80 MHz a possibility shall be provided of changing the height of the antenna centre position in relation to earth from 1 m to 4 m.

The test room shall have a metal earthed plane. The equipment to be tested shall be presented in full set with all the cables connecting devices and installed in the normal working position.

If the equipment to be tested consists of several units, the connecting cables between the basic and all other units shall have a maximum length stated in the manufacturer's specification. The existing inlets and outlets of the equipment to be tested shall be connected to the equivalents of usually used auxiliary equipment with the use of cables of maximum length specified by the manufacturer.

The surplus length of the cables shall be coiled and located at 30 – 40 cm (horizontally) from the connectors to which they are hooked up. If this is impracticable, the positioning of the surplus length of the cables shall meet the stated requirements as close as possible.

The measuring antenna shall be located at a distance of 3 m from the equipment to be tested. The antenna centre shall located above the earthed plane by at least 1,5 m. To determine the maximum interference level the antenna which measures the electric field strength shall be adjusted in the vertical extent only and be capable of

rotating to obtain horizontal and vertical polarization. The antenna itself shall remain parallel to the floor. In order to determine the maximum interference level, provision shall be made for movement of the antenna around the equipment to be tested or for rotation of the equipment itself located in the orthogonal plane of the antenna at its middle point level.

3.4.2 Resistance to external electromagnetic interference.

When conducting these tests, the equipment shall be presented in its normal working set and operate under normal conditions.

During the tests for the resistance to external electromagnetic interference the results shall be assessed against the functioning (performance) criteria related to the working conditions and functional purpose of the equipment being tested. These criteria shall be defined as follows:

functioning criterion A: the equipment being tested shall continue to operate for its designed purpose during and after the tests. No degradation of performance or loss of functions specified in the appropriate standard for equipment and technical documentation of the manufacturer shall be allowed;

functioning criterion B: the equipment being tested shall continue to operate for its designed purpose during and after the tests. No degradation of performance or loss of functions specified in the appropriate standard for equipment and technical documentation of the manufacturer shall be allowed. Nevertheless, degradation or loss of functions or performance which can be self-restored may be allowed during the tests, but no change in the mode set or operational data shall be allowed;

functioning criterion C: temporary degradation or loss of function or performance shall be allowed during the tests. Along with that, the self-restoring function is ensured or restoration of the disturbed function or performance may be provided in the end of the tests through the use of adjustments in accordance with the standard for equipment and technical documentation of the manufacturer.

3.4.2.1 Resistance to conductive low frequency interference.

These tests simulate effect of the interference generated, for example, by electronic consumers (thyristors, etc.) and introduced in the power supply circuits in the form of harmonic components. These tests shall not be applied to the equipment supplied solely by accumulators.

The equipment shall remain operable (functioning criterion A) when additional test voltages are imposed on its supply voltage:

for the electrical equipment supplied by direct current:

sine voltage the effective value of which is 10 % of the rated supply voltage in the frequency range from 50Hz to 10 kHz;

for the electrical equipment supplied by alternating current:

sine voltage the effective value of which changes depending on the frequency: 10 % of the effective value of the supply voltage in the frequency range from the rated supply voltage frequency to the 15-th harmonic; 10 – 1 % in the range from the 15-th to 100-th harmonic and 1 % in the range from the 100-th harmonic to 200-th harmonic.

3.4.2.2 Resistance to conductive radio frequency interference.

During the tests, the radio frequency voltages are generated, which arise in the power supply, control and signalling circuits due to operation of the electric power converters, echo sounders, shipboard radio transmitters on frequencies below 80 MHz.

The equipment being tested shall be installed on an insulated support located at a height of 0,1 m above the earthed surface. Cables connected to the equipment being tested shall be provided by suitable couplers and decouplers located at a distance of 0,1 – 0,3 m from the equipment being tested.

The tests shall be carried out with the use of a generator connected sequentially to each coupler and decoupler. The unused input terminals of the couplers and decouplers used for connection of the test generator shall be loaded by an equivalent with noninductive impedance equal to the characteristic impedance of the cable. The test generator shall be tuned for each circuit design of the coupler and decoupler; whilst so doing, the additional and tested equipment shall be disconnected and replaced by a noninductive resistors of suitable ratings (when the cable impedance is 50 Ohm additional resistances shall be 150 Ohm). The test generator shall be tuned in such a way as to provide a non-modulated voltage of the required level at the input terminals of the equipment being tested.

The equipment shall remain operable (functioning criterion A) at the following levels of the test signal:

effective voltage value of 3 V at the frequency varying in the range from 150 kHz to 80 MHz;

for the equipment arranged on open deck and navigating bridge the effective voltage value increases up to 10 V at points with frequencies: 2 MHz, 3 MHz, 4 MHz, 6,2 MHz, 8,2 MHz, 12,6 MHz, 16,5 MHz, 18,8 MHz, 22 MHz and 25 MHz.

The frequency variation rate shall not exceed $1{,}5 \times 10^{-3}$ decade/s (or 1 %/3s) in order to find the malfunctions of the equipment being tested.

The modulation frequency shall be 1000 Hz $\pm$ 10 % at the modulation depth 80 % $\pm$ 10 %. At the modulation frequency of the input signal being 1000 Hz the modulation frequency of the interference signal may be chosen to be 400 Hz.

3.4.2.3 Resistance to electromagnetic field.

During these tests, the test electromagnetic field is set up, which arises on board ships when radio

transmitters, e.g. shipboard fixed and portable VHF radio sets adjacent to the equipment operate on frequencies over 80 MHz.

The equipment being tested shall be installed in a suitable screened space or in an anechoic chamber the dimensions of which are commensurable with the equipment. The equipment being tested shall be installed in the uniform (homogenous) field zone and insulated from the floor by a dielectric base. The tests shall be carried out in all orientations (on all sides) of the equipment.

The frequency variation rate shall not exceed $1{,}5 \times 10^{-3}$ decade/s (or 1 %/3s). During the tests, the frequencies at which the equipment is most sensitive to the interference shall be particularly checked.

The equipment shall remain operable (operability criterion A) when arranged in a modulated electric field with the strength of 10 V/m and when the frequency varies in the range from 80 MHz to 2 GHz. The modulation frequency shall be 1000 Hz $\pm$10 % at the modulation depth of 80 % $\pm$10 %. When the modulation frequency of the input signal of the equipment being tested is 1000 Hz, the modulation frequency of the interference signal may be chosen to be 400 Hz.

3.4.2.4 Resistance to nanosecond pulse interference due to fast transient processes in the circuits of the a.c. supply sources, signal and control circuits.

During these tests, the fast low-energy transient processes generated by the equipment the switching-on of which is accompanied by sparking at contacts shall be simulated.

The equipment shall remain operable (operability criterion B) if pulse voltage with the following parameters is applied to the inlets of the supply sources:

rise time – 5 ns (at 10 % — 90 % amplitude level);

duration – 50 ns (at 50 % amplitude level);

amplitude 2kV – when applied through the coupler-decoupler to the a.c. supply circuits relative to the casing;

amplitude 1 kV – when applied through the capacitive coupling clamp to the signal, control low-voltage d.c. supply circuits;

pulse recurrence frequency – 5 kHz;

pulse burst duration – 16 ms;

burst recurrence period – 300 ms;

duration – 5 min for each positive and negative pulse polarity.

3.4.2.5 Resistance to microsecond pulse interference due to slow transient processes in the a.c. electric power supply circuits.

These tests simulate effects of the pulse voltages induced by switching on and out of the powerful inductive consumers.

The equipment shall remain operable (functioning criterion B) if a pulse voltage with the following parameters is applied to its supply circuits:

rise time – 1,2 ms (at 10 % - 90 % amplitude level);

duration – 50 ms (at 50 % amplitude level);

amplitude – 2 kV when applied through the coupler-decoupler between each circuit (line) and casing; 1 kV when applied through the coupler-decoupler between the circuits (lines);

recurrence frequency – 1 pulse per minute;

number of pulses – 5 pulses for each positive and negative pulse polarity.

3.4.2.6 Resistance to electrostatic discharges.

During these tests the discharges of the static electricity are simulated which can arise when a man is in contact with the casing of the equipment.

The tests shall be carried out with the use of an electrostatic discharge generator (discharging capacitance — 150 pF and discharge resistance – 330 Ohm to be connected to the discharge terminal). The test site shall be equipped with a wooden table of 0,8 m in height, installed on the earthing plane. A horizontal coupling plane with dimensions of 1,6 m $\times$ 0,8 m shall be placed on the table. The coupling planes shall be connected with the earthing plane by wires equipped with resistors of 470 kOhm at each end. The equipment and cables shall be isolated from the coupling plane by an insulating pad of 0,5 mm in thickness.

The discharges from the generator shall be applied to those points and surfaces of the equipment which are accessible for the personnel during normal operation. During the tests the generator shall be located normally to the surface and the discharge application points may be chosen so that 20 discharges per minute can be possible. Each chosen point shall be subjected to tests for 10 positive and 10 negative discharges with an interval of at least 1 s between the discharges in order to provide revealing any malfunctions of the equipment. In testing the preferable method is the contact discharge. If use of the contact method is impossible (where painted surfaces are available) air discharge shall be used.

In order to simulate discharges on the objects located or installed in the neighbourhood of the equipment, 10 positive and 10 negative contact discharges shall be applied to the horizontal coupling plane. The discharge application points shall be at 0,1 m away from the equipment being tested. The next 10 discharges shall be applied to the centre of the vertical coupling plane of $0{,}5 \times 0{,}5$ m in dimensions. These tests shall be carried out for all four sides of the equipment.

The equipment shall remain operable (functioning criterion B) at the voltage 6 kV for the contact discharge and 8 kV for the air contact.

3.5 Tests for resistance of the automation equipment to motions and prolonged inclinations.

3.5.1 Automation equipment shall stand the tests using the following procedure:

Sequence, standards and conditions of tests	Numerical value
.1 Installation of the equipment on bed, switching-on and measurement of parameters. Holding of the equipment under motions conditions when installed sequentially in two mutually perpendicular positions and measurements of parameters in each position, and whilst so doing:	
limiting inclination angle	30 °C
motions period	7 – 9 s
duration of tests	any which is sufficient for measuring parameters, but not less than 5 min in each position
.2 Conditioning of equipment sequentially in two mutually perpendicular positions at an angle of 15° to the horizontal and measurement of parameters . .	during any time sufficient for measuring parameters but not less than 3 min in each position
.3 Removal of equipment from bed, measurement of parameters, switching-out and examination.	

During the tests the equipment shall be in operable condition under normal environmental conditions. The equipment shall be installed on a special bed on regular shock-mounts and tested in two mutually perpendicular normal operating positions.

3.6 Vibration tests.

3.6.1 The tests shall be carried out under effect of the vibration in the frequency range from 2 to 100 Hz. The tests shall be conducted in three mutually perpendicular directions in relation to the item. The method of fastening of the items for tests shall be indicated in the technical documentation with due account of the possible positions of the items in service. If the technical documentation specifies different methods of fastening during operation of the item it shall be tested using the method of fastening which is the most dangerous. The vibration frequency range, amplitude, transition frequency, acceleration, test time shall comply with those given in Table 3.6.1.

Table 3.6.1

Frequency range, Hz	Amplitude, mm	Transition frequency, Hz	Acceleration, *g*	Time, h
for equipment of normal design				
2 — 100	±1,0	13,2	±0,7	
for equipment subject to enhanced vibrations				
2 — 100	±1,6	25,0	±4,0	

The tests shall be carried out on regular shock-mounts, if any.

The variation rate shall be sufficient for verifying and recording the necessary parameters, but not more than two octaves per minute. The time of search shall be sufficient to reveal resonance. When resonance frequencies are detected, the amplitude of which exceeds the normal one by two – five times, the tests shall be conducted on each resonance frequency during at least 1,5 h. The amplitude on the resonance frequency shall not exceed the rated amplitude by more then 5 times.

The equipment shall be considered to have passed the tests, if in the process of vibration effect it retains its parameters within the prescribed limits and remains undamaged.

3.6.2 Tests for resistance to the effect of vibration loads for the items of stable (serial) production shall be conducted on each item in order to reveal rough production defects at the acceleration ±4,0*g* for the items subject to enhanced vibration and 0,7*g* for the remaining equipment.

The tests shall be conducted on the frequency of 30 Hz during 30 min.

3.7 Shock tests.

The tests shall be carried out in operating condition under effect of shock load in each of the three mutually perpendicular directions in relation to the item, in turn.

The form of the shock pulse is recommended to be close to sine one. The acceleration value, shock duration, number of shocks in each position of the item as well as the shock frequency are given in Table 3.7.

Table 3.7

Acceleration	Shock duration, ms	Number of shocks in each position	Shock succession frequency, min
±5,0	10 — 15	20	40 — 80

The method of fastening the items for testing shall be indicated in the technical documentation with due account of the possible positions of the items in service. If the technical documentation on the items specifies different methods of fastening in service, the item shall be tested using the most dangerous method of fastening stated in the technical documentation.

The equipment shall be considered to have passed the tests if during and after the tests it meets the requirements set forth in the technical documentation for the test type concerned.

3.8 Tests of the degree of protection of the equipment.

The tests for checking the degree of protection against penetration of foreign solids and water into the enclosure shall be carried out in accordance with Section 10.

3.9 Tests of the equipment for heat stability.

Automation equipment shall have heat stability and stand the tests using the following procedure:

Sequence, conditions and standards of tests — Numerical value

.1 Installation of the equipment to heating chamber under standard environmental conditions (self-heating): duration, h . . . . . 0,2 – 2

.2 Measurement of parameters under standard environmental conditions . . . . . —

.3 Temperature elevation in the chamber up to the working temperature: temperature elevation rate, °C/min . . . 0,5 – 3; working temperature, °C. . . . . 55 + 2; relative humidity, %. . . . . 20±3

.4 Conditioning at the working temperature — duration, h. 10

.5 Measurement of parameters at the working temperature . . . . . —

.6 Temperature elevation in the chamber up to the limiting temperature: temperature elevation rate, °C/min . . . . 70±2; relative humidity, %. . . . . 20±3

.7 Conditioning of the equipment switched on at the limiting temperature – duration, h . . . .2 – 6

.8 Measurement of parameters at the limiting temperature . . . . . –

.9 Temperature drop in the chamber down to the standard temperature – temperature drop rate, °C/min . . . . . 0,5 – 3

.10 Conditioning of the equipment under standard environmental conditions – duration, h . . . . . 2 – 6

.11 Measurement of parameters under standard environmental conditions, switching-off and examination of the equipment . . . . . –

The tests shall be carried out at the temperature of 55 °C or at 70 °C.

The equipment shall be in operable condition throughout the test period.

Check of the equipment for proper functioning shall be performed in the last hour under normal environmental conditions.

For the equipment for which large values of the working temperatures are possible (the equipment installed directly on engines, boilers, etc.), the test program shall be subject to special consideration by the Register in each case.

3.10 Tests of the equipment for cold endurance.

The equipment shall be cold endurant and stand the tests using the following procedure:

Nos	Sequence, conditions and standard of tests	Numerical value for equipment intended for use	
		in internal spaces	on open deck
1	Installation of equipment to cold chamber, switching-on and conditioning under standard environmental conditions (self-heating) – duration, h	0,2 — 2	0,2 — 2
2	Measurement of parameters under standard environmental conditions	—	—
3	Temperature drop in the chamber down to working temperature:		
	temperature drop rate, °C/min	1 — 2	1 — 2
	working temperature,°C	−10±3	−30±3
4	Conditioning of the equipment at working temperature — duration, h	6	6
5	Measurement of parameters at working temperature and switching-off	—	—
6	Temperature drop in the chamber down to limiting temperature:		
	temperature drop rate, °C/min	1 — 2	1 — 2
	limiting temperature, °C	−50±3	−50±3
7	Conditioning of the equipment at limiting temperature duration, h	2	2
8	Temperature elevation in the chamber up to standard temperature — temperature elevation rate, °C/min	0,5 — 3	0,5 — 3
9	Conditioning of the equipment under standard environmental conditions – duration, h	3 — 4	3 — 4
10	Switching-on and conditioning of the equipment under standard environmental conditions (self-heating) – duration, h	0,2 — 2	0,2 — 2
11	Measurements of parameters under standard environmental conditions, switching-off and examination of the equipment	—	—

The cold endurance tests of the equipment in operable condition, the working medium of which allows no operation at subzero temperatures shall be carried out at 0 °C.

3.11 Tests of the equipment for resistance to moisture.

Automation equipment shall be resistant to moisture and stand the tests using the following procedure:

Sequence, conditions and standards of tests	Numerical value
.1 Installation of equipment to moisture chamber and conditioning under standard environmental conditions (self-heating) – duration, h	0,2 – 2
.2 Measurement of parameters under standard environmental conditions and switching-off	–
.3 Temperature elevation in chamber up to working temperature:	
elevation rate, °C/min	0,5 – 3
working temperature, °C	40 ± 2
.4 Conditioning of equipment at working temperature – duration, h	1,5 – 2
.5 Increase of relative humidity in chamber up to working humidity – working relative humidity, %	95 ± 3
.6 Conditioning of equipment at working temperature and relative humidity – duration, days	10
.7 Switching-on, measurement of parameters at working temperature and relative humidity (once a day) – duration, h	not more than 1
.8 Removal of equipment from chamber and conditioning under standard environmental conditions – duration, h	6 – 12
.9 Switching-on and conditioning of equipment under standard environmental conditions (self-heating) – duration, h	0,2 – 2
.10 Measurements of parameters under standard environmental conditions, switching-off and examination of equipment	-

Note. On agreement with the Register, a cyclic test method may be applied. This method contains two cycles of 24 h; the conditioning at the test temperature and humidity shall last in such case not less than 16 h. The tests shall be carried out at the temperature of 55 ± 2 °C and relative humidity of 95 ± 5 %.

The equipment of any design shall be tested in regular enclosures, except for the equipment having degree of protection against penetration of water being 4 and over, the covers of which during the tests in the chamber shall be open. The tests shall be conducted with the equipment being put periodically into operation.

3.12 Tests of the equipment for resistance to corrosion (resistance to sea fog).

The equipment intended for operation on open deck shall be resistant to corrosion and stand the tests using the procedure given in Table 3.12.

During the tests, spray of the solution from the atomizer or aerosol device as well as the drops of the condensate from the ceiling shall not fall on the equipment being tested.

3.13 Tests of the equipment for resistance to hoarfrost and dew.

Automation equipment intended for installation on open decks of sea-going ships shall stand the tests for resistance to hoarfrost and dew using the following procedure:

Table 3.12

Nos	Sequence, conditions and standards of tests	Numerical value
1	Insulation resistance measurements and functional testing	—
2	Installation of the equipment to the chamber and conditioning during cyclic atomizing salt solution (sea fog)[1]:	
	temperature in the chamber, °C	35 ± 2
	composition of t synthetic salt solution per 1 litre of distilled water to produce sea fog, g/l:	
	sodium chloride	27
	magnesium chloride	6
	calcium chloride	1
	potassium chloride	1
	dispersivity of sea fog (90 % of drops), μ	1 — 5
	water content of sea fog, g/m	2 — 3
	test duration, number of cycles[2]	4
	duration of solution atomization (in the beginning of each cycle), h	2
3	Removal of the equipment from the chamber, insulation resistance measurement, functional testing, h	4 — 6

[1] During the tests the equipment is in switched off state.

[2] Each cycle consists of the following stages: salt solution atomization, conditioning of the equipment in the chamber during 7 days, functional testing on the seventh day of the cycle.

Sequence, conditions and standards of tests	Numerical value
.1 Installation of equipment into cold chamber and conditioning in switched-off state:	
temperature, °C	— 20±5
duration, h	2
.2 Removal of equipment from chamber, switching-on and conditioning under normal environmental conditions. Immediately after switching-on and at 30—60 min intervals parameters of equipment shall be measured – duration of conditioning, h	3
.3 Switching-off and examination	–

3.14 Tests of the automation equipment for resistance to mould.

Automation equipment shall be resistant to mould and stand tests using the procedure given below.

Prior to the tests, the equipment shall be held at the temperature of 60±2 °C during 6 h and then placed for 1 – 6 h into standard environmental conditions for examination and measurement of parameters. The tests of the equipment shall be carried out in medium contaminated by fungus mould with no light and movement of air. The mould shall be water suspension consisting of a mixture of mould fungi the names of which are given in Table 3.14.

As a culture medium for growing the mould fungi, it is recommended to use brewing wort or synthetic medium "Chapek – Doxa".

Sterilized culture medium in Petri dishes together with the equipment disconnected from the supply sources shall be placed into test chamber and sprayed with water suspension through an atomizer with an orifice diameter not less than 1 mm per 1 m^3 of usable volume of the chamber. After spraying, a temperature of 20±5 °C and relative humidity of 95 – 98 % shall be settled in the test chamber.

The equipment shall be held under these conditions during 48 h. If after such holding time no growth of mould is observed in the Petri dishes it is necessary to spray again the dishes and equipment by viable suspension of mould fungi spores and to held them for the second time during 48 h. After mould growth is detected in the check dishes the temperature in the chamber shall be elevated up to 29±1 °C at the relative humidity of 95 – 98 % and the equipment shall be held under such conditions during 28 days. After the lapse of this time, the equipment shall be placed under standard environmental conditions for 24 h, whereupon examination and measurement of its parameters shall be made. The equipment shall be considered as resistant to mould, if when examined through a magnifier with 50X magnification no sites of fungus mould are detected or only isolated sprouted spores are seen.

Table 3.1

Nos	Spores	Strain	Typical cultures	Properties
1	Aspergillus niger	v.Tieghem	ATCC.6275	Grows copiously on many materials, resistant to copper salts
2	Aspergillus terreus	Thom	PQMD.82j	Affects plastics
3	Aureobasidium pullulans	(De Barry) Arnaud	ATCC.9348	Affects varnishes and paints
4	Paecilomyces varioti	Bainier	IAM.5001	Affects plastics and leather
5	Penicillium finiculosum	Thom	IAN.7013	Affects many materials, especially textiles
6	Penicillium ochrochlorom	Biourga	ATCC.9112	Resistant to copper salts
7	Scopulariopsia brevicuulis	(Sacc) Bain Var. glabra Thom	IAM.5146	Affects rubber
8	Trichoderma viride	Pers.ex.Er.	IAM.5061	Affects cellulose, textile and plastics

13 LIFE-SAVING APPLIANCES

13.1 GENERAL

13.1.1 The provisions of the present Section apply in performing technical supervision of life saving-appliances listed in the RS Nomenclature.

13.1.2 The Section contains the Register technical supervision requirements during manufacture of the mentioned items/products of supervision at the manufacturer's.

13.1.3 General provisions on arranging technical supervision during construction of life-saving appliances are set forth in Part I "General Regulations for Technical Supervision", and on technical documentation — in Part II "Technical Documentation".

13.1.4 If necessary, the Register may require to have its technical supervision during design and manufacture of life-saving appliances, including items/products of outfit and equipment not listed in the RS Nomenclature.

13.2 TECHNICAL SUPERVISION OF PROTOTYPES

13.2.1 The Register technical supervision during design and manufacture of prototypes (lots) of life-saving appliances, including items/products of outfit and equipment, shall be divided into the steps/stages as follows:

.1 examination and approval of the technical and working design;

.2 examination and approval of the program and test technologies/methods for prototypes;

.3 participation in tests of prototypes (first lots);

.4 examination and approval of the test program for life-saving appliances manufactured at the manufacturer's with serial production, and updated in accordance with test results of a prototype.

13.2.2 When examining technical documentation and surveying the prototypes of life-saving appliances, it is necessary that compliance with general technical requirements for these items/products prescribed in the relevant Parts of the Rules, should be verified in accordance with 13.1.1.

13.2.3 The scope of technical documentation to be submitted for the Register approval shall be in conformity with the requirements prescribed in 1.3, Part II "Life-Saving Appliances" of Rules for the Equipment of Sea-Going Ships.

13.3 TYPES OF TESTS

13.3.1 The test program to be performed by a technical control body of the manufacturer shall be approved by the Register.

13.3.2 Check tests of materials and products to be conducted by the Register so that to confirm the Recognition Certificate for Manufacturer or to confirm serial production and compliance of materials and products with approved technical documentation in cases, when it is not required to issue Recognition Certificates, may be coincident with the periodical tests of materials and products.

13.3.3 The Register tests of prototypes and tests required for issuing Type Approval Certificates (or Recognition Certificates for Manufacturers) may be coincident with the type tests of materials and products.

13.4 TECHNICAL SUPERVISION AT THE MANUFACTURER'S

13.4.1 All materials and complementing items required for manufacturing life-saving appliances shall be documented to confirm their compliance with the approved documentation. These documents shall be issued on the technical supervision forms under the RS Nomenclature.

13.4.2 Surveys of life-saving appliances by Surveyors at the manufacturer's in the course of different stages of production shall be conducted as indicated in the list of supervised items to be prepared by the manufacturer on the basis of the requirements of this Section (refer to Tables 13.4.2-1 to 13.4.2-5) and agreed with the RS Branch office (refer to paragraph 12.2, Part I "General Regulations for Technical Supervision").

As initiated by the RS Branch office, the list shall be updated by the manufacturer on the basis of survey findings of life-saving appliances of ships in service.

The tests of prototypes shall be completed under the program approved by the Register.

The number of specimens of prototype lots of production subject to tests shall be prescribed by the test program. The number of products to be inspected at the manufacturer's with serial production may be either increased or decreased at the Surveyor's discretion.

Table 13.4.2-1

Scope of surveys of lifeboats and rescue boats

Nos	Tests (Inspections)	Survey of Prototype	Survey at the Manufacturer's with Serial Production	Number of Products Inspected at the Manufacturer's with Serial Production, %
1	Cheching material quality	+	+	100
2	Inspection of dimensions and construction of lifeboats	+	+	100
3	Static strength test of hull of lifeboats to be launched by falls	+	+	Each tenth but 1 of the lot at least
4	Strength test of arrangements for launching and recovery	+	+	100
5	Hull tightness test of lifeboats	+	+	100
6	Determination of volumes of air lockers and compartments with buoyancy material	+	+	—
7	Tightness test of air lockers and compartments	+	+	100
8	Measurement of carrying capacity of lifeboats	+	—	—
9	Determination of lifeboat hull mass	+	+	Each tenth but 1 of the lot at least
10	Determination of lifeboat free board	+	—	—
11	Stability test of lifeboats (inclining test)	+	—	—
12	Flooding resistance of lifeboats	+	—	—
13	Impact test	+	—	—
14	Drop test	+	—	—
15	Security strength test of arrangements for launching and recovery	+	+	100
16	Test of protective cover of lifeboat, canopy erected	+	+	100
17	Inspection of seating and loading space aboard	+	—	—
18	Test of lifeboat's rigging	+	+	100
19	Test of mechanical propeller assembled and mounted	+	+	100
20	Mooring trials of motor lifeboats and hand-propelled lifeboats	+	+	100
21	Underway trials of motor lifeboats during at least 2 h	+	—	100
22	Speed determination of motor lifeboats and steering gear arrangement test	+	—	—
23	Speed determination of hand-and-power-propelled lifeboats	+	—	—
24	Fire tests of fire-protected lifeboats for tankers	+	—	—
25	Sea trials	+	—	—
26	Inspection of full complement and equipment of lifeboats	+	+	100
27	Painting and marking inspection of lifeboats	+	+	100
28	Inspection of rescue boats	+	+	100
29	Release mechanism test of lifeboats and rescue boats	+	+	100
30	Inspection of retro-reflective tapes fitted	+	+	100
31	Engine inversion test prior to its installation onboard	+	—	—
32	Submerged engine test	+	—	—
33	Engine-out-of-water test	+	—	—
34	Cold engine start test	+	—	—
35	Tests of self-righting, partially enclosed and totally enclosed lifeboats	+	—	—
36	Tests of lifeboats with a self-contained air support system	+	+	+
37	Tests of water spray system of fire-protected lifeboats	+	+	100
38	Watertight tests of enclosures of totally enclosed lifeboats	+	+	100
39	Electrical equipment test of lifeboats	+	+	100
40	Engine start test inboard totally enclosed lifeboat after it capsizes	+	+	100
41	Security inspection of safety belts aboard totally enclosed lifeboats	+	+	100
42	Tests of lifeboats and rescue boats to be launched by falls in the 10 % overload condition	+	+	100
43	Test of free-fall lifeboats with a load of 1,1 times the working load	+	+	100
44	Test of free-fall lifeboats to be launched from a height of 1,3 times its free-fall certification height	+	—	—
45	Test of free fall lifeboats to determine acceleration forces	+	—	—

Table 13.4.2-2

Scope of surveys of life rafts at different stages of manufacturing

Nos	Tests (Inspections)	Survey of Prototype	Survey at the Manufacturer's with Serial Production	Number of Products Inspected at the Manufacturer's with Serial Production, %
1	Checking material quality and adhesion of surface coatings	+	+	Each lot
2	Visual inspection and dimensional examination of life rafts	+	+	100
3	Drop tests and jump test of life rafts for strength	+	+	—
4	Strength test of launching-and-recovery arrangements of life rafts	+	+	100
5	Watertight test of metal life rafts	+	+	100
6	Watertight test of inflatable life rafts for containers	+	+	—
7	Watertight test of glass-reinforced plastic life rafts	+	+	100
8	Watertight and buoyancy tests of containers for equipment	+	+	2
9	Stability test	+	+	—
10	Buoyancy test of float-free life rafts	+	—	—
11	Loading and boarding space test of life rafts	+	—	—
12	Manoeuvrability tests and painter system strength (towing arrangements)	+	—	—
13	test	+	+	2
14	Flooding resistance and inspection of protective cover (canopy)	+	—	—
15	Test of capability of life rafts to be easily righted when in the inverted position	+	+	2
16	Inspection of proper package of life rafts in their containers and test of capability of gas inflation system to function properly	+	+	100
17	Inspection of full complement of equipment and outfit items	+	+	100
18	Inspection of the mass of life raft and cylinder	+	+	100
19	Painting and marking inspection of life rafts	+	+	100
20	Inspection of retro-reflective tapes fitting and securing	+	+	2
21	Test of hydrostatic release units	+	+	100
22	Test of davit-launched life rafts with 10 % overload	+	—	—
23	Manoeuvrability tests	+	+	2
24	Weak link strength test	+	—	—
25	Impact, drop and embarkation tests of davit-launched life rafts	+	—	—
26	Additional tests applicable to inflatable life rafts only	+	—	—
27	Additional tests applicable to automatic self-righting life rafts only	+	—	—
28	Submergence test of automatic self-righting life rafts and canopied reversible life rafts	+	+	1 % or 1 life raft
29	Wind velocity test	+	—	—

Note: The tests shall be completed in accordance with the applicable provisions of IMO Resolution MSC. 81(70).

Table 13.4.2-3

Scope of surveys of life buoys, lights and self-activating smoke signals

Nos	Tests (Inspections)	Survey of Prototype	Survey at the Manufacturer's with Serial Production	Number of Products Inspected at the Manufacturer's with Serial Production, %
1	Checking material quality	+	+	Each lot of life buoys
2	Dimensions	+	+	2 % of the lot, but 2 at least
3	Examination of internal structure (with coating broken up)	+	—	—
4	Visual inspection of painting, marking and positioning of retro-reflective tapes	+	+	100
5	Mass determination	+	+	10
6	Buoyancy test	+	—	—
7	Water absorption test	+	—	—
8	Temperature cycling test	+	—	—
9	Crude oil test	+	—	—
10	Drop strength test	+	—	—
11	Strength test	+	+	2 % of the lot, but 2 at least
12	Fire test of buoyant material	+	—	—
13	Fire test	+	—	—
14	Operational tests of life buoys fitted with lights and smoke signals	+	—	—
15	Tests of self-igniting lights	+	—	—
16	Tests of self-activating smoke signals	+	—	—

Note: The tests shall be completed in accordance with the applicable provisions of IMO Resolution MSC.81(70).

Table 13.4.2-4

Scope of surveys of life jackets

Nos	Tests (Inspections)	Survey of Prototype	Survey at the Manufacturer's with Serial Production	Number of Products Inspected at the Manufacturer's with Serial Production, %
1	Checking material quality	+	+	Each lot of life buoys
2	Dimensions inspection	+	+	2 % of the lot, but 2 at least
3	Examination of internal structure (with coating broken up)	+	—	—
4	Visual inspection of coating colour, inscriptions, markings, and fitting of retro-reflective tapes	+	+	100
5	Mass determination	+	+	10
6	Buoyant test	+	+	2 % the lot, but 2 at least
7	Water absorption test	+	—	—
8	Complement test	+	+	10
9	Temperature cycling test	+	—	2 % the lot, but 2 at least
10	Fire tests	+	—	—
11	Crude oil test	+	—	—
12	Drop test	+	+	2 % the lot, but 2 at least
13	Fire test of buoyant material	+	—	—
14	Test of life jackets correctly donned and comfortably worn	+	—	—
15	Strength test	+	+	2 % the lot, but 2 at least
16	Electric light and whistle tests	+	—	—
17	Buoyancy material test	+	—	—
18	Donning test	+	—	—
19	Tests in the water	+	—	—
20	Tests of life jackets for children	+	—	—
21	Test of inflatable life jackets	+	—	—

Note: The tests shall be completed in accordance with the applicable provisions of IMO Resolution MSC.81 (70).

Table 13.4.2-5

Scope of surveys of launching appliances of life craft

Nos	Tests (Inspections)	Test Load	Angle of Heel (Anti Heel)	Angle of Trim	Surveys of			
					Prototypes		At the Manufacturer's with Serial Production	
					Davit-Launched Boats	Davit-Launched Rafts	Davit-Launched Boats	Davit-Launched Rafts
1	Checking dimensions, construction and material quality	—	—	—	+	+	+	+
2	Strength test of:							
2.1	Launching appliance in assembly	$2{,}2p_w$	20°	10°	+	+	+	+
2.2	Padeyes for fastenings and lashings	$2{,}2p_w$	20°	10°	+	+	+	+
2.3	Fastening stoppers and horns of arms and other fastenings of davit arms	$1{,}2p_w$	20°	10°	+	—	+	—
3	Operational tests of launching appliances under the working load:							
3.1	Fastening stoppers of davit arms	$1{,}1p_w$	20°	10°	+	—	+	—
3.2	Turning out and launching of survival craft	$1{,}1p_w$*	20°	10°	+	+	+	+
3.3	Stress determination in fall runners when turning out and launching	p_w	20°	10°	+	+	—	—
3.4	Automatic release of davit arms	p_w	20°	10°	+	—	+	—
3.5	Lifting and recovery of boats	p_w	20°	10°	+	—	+	—
3.6	Stress determination in fall runners when recovering boats	p_w	20°	10°	+	—	—	—
3.7	Stress determination in fall runners when recovering davit arms	p_w	20°	10°	+	—	—	—
3.8	Raft launching by gravity and serviceability of davit release mechanism of raft launching and recovery appliances	p_w	20°	10°	—	+	—	+
3.9	Dynamic test of winch brakes	$1{,}1p_w$	0°	0°	+	+	+	+
3.10	Static test of winch brakes	$1{,}5p_w$	0°	0°	+	+	+	+

* P_w is applicable at the appropriate stage of operation.

Note: The tests shall be completed in accordance with the applicable provisions of IMO Resolution MSC 81(70).

13.4.3 Methods of tests (inspections) of life-saving appliances at the manufacturer's are prescribed in IMO Resolution MSC.81(70) "Revised Recommendation on Testing of Life-Saving Appliances".

13.4.4 The form of technical supervision of life-saving appliances and arrangements at the manufacturer's is provided in the RS Nomenclature.

13.4.5 Technical supervision during manufacture of engines for life boats is conducted in compliance with the requirements stated in Section 5, and additional requirements set forth in IMO Resolution MSC.81(70).

The scope of surveys and tests of immersion suits, anti-exposure suits, thermal protective aids, fast rescue boats, line-throwing appliances, lights indicating positions of life-saving appliances, marine evacuation systems, search lights for life boats and rescue boats is specified in accordance with the provisions of IMO Resolution MSC.81(70).

13.5 REQUIREMENTS FOR MANUFACTURERS AND CONTROL OF PRODUCTION

13.5.1 Prior to Agreement on Survey concluded or prior to performing any supervision activities at the request of the manufacturer without any agreement, the latter shall be surveyed by the Register.

13.5.2 During the survey the Register shall inspect the technical and material equipment of the manufacturer's, facilities and storage premises for initial manufacturing materials and production areas, its compliance with manufacturing technologies approved by the Register, procedures of issuing documents and availability of results of any tests and inspections conducted by the local laboratories and personnel of supervising bodies of the manufacturer's.

13.5.3 The premises and facilities of manufacturer's shall meet the necessary provisions required by standards, specifications and manufacturing technologies. Adequate instrumentation shall be used to monitor technological and climatic conditions.

13.5.4 When performing technical supervision during manufacture of life-saving appliances, the Register shall carry out regular surveys of the manufacturer's so that to ascertain that Recognition Certificate is applicable as well to other cases specified in Part I "General Regulations for Technical Supervision".

13.6 MARKING AND BRANDING OF LIFE-SAVING APPLIANCES

13.6.1 The procedure of marking, branding and stamping by the Register is described in the Instructions on Branding of Items Supervised by the Register in Part I "General Regulations for Technical Supervision".

14 SIGNAL MEANS

14.1 GENERAL

14.1.1 The provisions of the present Section apply in performing technical supervision of signal means subject to technical supervision by the Register under the RS Nomenclature.

14.1.2 The present Section specifies requirements for the Register technical supervision during manufacture and tests of signal means.

14.1.3 Definitions and explanations concerning the general terminology are given in Part III "Signal Means" of Rules for the Equipment of Sea-Going Ships.

14.1.4 General provisions concerning technical supervision of signal means are set forth in Part I "Surveys Regulations" of Rules for the Equipment of Sea-Going Ships" and in Part I "General Regulations for Technical Supervision" of the Rules.

14.1.5 The scope of surveys of signal means by the Register at the manufacturer's with serial production is set forth in Table 14.1.5.

14.2 TECHNICAL DOCUMENTATION

14.2.1 Signal means shall comply with Rules for the Equipment of Sea-Going Ships and be manufactured under the technical documentation approved by the Register.

14.2.2 General provisions relating to the procedure of examination and approval of technical documentation are set forth in Part II "Technical Documentation".

14.2.3 Technical documentation on manufacture of signal means shall include the following:

.1 product specifications describing light, sound, etc. characteristics of applied materials, welding and other joints, directions for processing technologies, assembling, methods of coatings, organization of control;

.2 assembly drawings and structural drawings of sections, units and component parts;

.3 program of approval testing;

.4 list of complementing items.

Table 14.1.5

Items of technical supervision	Inspection of documentation and complementing items	Visual inspection	Inspection of						Measure of insulation resistance	Inspection of basic frequencies range	Determination of sound pressure level
			Dimensions and masses	Strength of fastening of pendant light	Functioning	Interchange Ability	Waterproofness	Insulation electrical strength			
Navigation lights	+	+	+	+	+	+	+	+	+	—	—
Flashing lights	+	+	+	+	+	+	+	+	+	—	—
Sound signal means	+	+	+	—	+	+	—	—	+	+	+

14.3 TECHNICAL SUPERVISION DURING MANUFACTURE OF SIGNAL MEANS

14.3.1 Technical supervision during manufacture of signal means shall include the following:

.1 review of technical documentation;

.2 inspection of the quality control system accepted at the manufacturer's including input control;

.3 quality assurance of materials, semi-finished items, products, resources (where necessary);

.4 survey and tests of prototypes of signal means;

.5 survey and test of signal means at the manufacturer's with serial production;

.6 branding and issuing documents for manufactured signal means.

14.4 NAVIGATION LIGHTS AND FLASHING LIGHTS

14.4.1 The prototypes of lights are subject to tests under the program approved by the Register.

14.4.2 The tests of the prototypes of lights shall include:

.1 check of compliance of details and assembly units with the working documentation;

.2 check of dimensions and mass;

.3 operating/functioning tests;

.4 tests of lighting characteristics;

.5 vibration and impact shaking tests including strength tests of efficient securing of marine pendant lights;

.6 rain test and water-tightness tests;

.7 operating tests under the temperature cycling (high and low temperatures of ambient air) conditions;

.8 anticorrosion test;

.9 heat resistance test;

.10 seawater resistance test;

.11 operating tests under heeling and trimming conditions;

.12 insulation electrical strength tests of lights;

.13 insulation resistance of electric lights;

.14 operating and dimensional tests of lighting characteristics under variations of rated supply voltage and current frequency from standard values within those regulated by Rules for the Classification and Construction of Sea-Going Ships and Rules for the Equipment of Sea-Going Ships;

.15 electrical short circuit protection to prevent from getting into contact with current carrying parts;

.16 wind velocity tests of the oil lights;

.17 burning time tests of oil lights.

14.4.3 Check of the range of visibility of prototype lights shall be carried out during full scale underway tests.

14.4.4 Results of these tests may be considered satisfactory in case the tested lights are in complete conformity with the requirements of Rules for the Classification and Construction of Sea-Going Ships and Rules for the Equipment of Sea-Going Ships.

14.4.5 At the manufacturer's with serial production the lights shall be subject to acceptability tests under the program approved by the Register.

14.4.6 At the manufacturer's with serial production surveys and tests shall include the following inspections of:

.1 compliance of details and assembly items with the operating documentation;

.2 dimensions and mass;

.3 operating tests;

.4 interchangeability of details and units;

.5 reliability of security unit of marine pendant lights;

.6 waterproofeness;

.7 electrical strength and resistance of insulation.

14.4.7 Where survey and tests are satisfactory, the lights shall be branded by the Register, and appropriate Certificate shall be issued.

14.4.8 Markings of the light accepted by the Register shall include the following: the manufacturer's trade mark, identification and type of the light, its ordinal number, range of visibility and lamp power, date of manufacture and the Register brand mark.

14.4.9 The marking shall be applied on an anticorrosion metal plates permanently attached in readily accessible places in such a way that they can be easily found after installation on board the ship. Additionally, sector lights shall have axial marks.

14.5 SOUND SIGNAL MEANS

14.5.1 The prototypes of signal means shall be bench tested and marine full scale tested under the program approved by the Register.

14.5.2 Bench tests of the prototypes of sound signal means shall include the following:

.1 visual inspection;

.2 check of dimensions, mass as well as characteristics of the applied materials;

.3 operating tests under the vibration and impact shaking conditions;

.4 waterproof tests;

.5 operating tests under the temperature cycling (high and low temperatures of ambient air) conditions;

.6 operating tests under heeling and trimming conditions;

.7 anticorrosion test;

.8 heat resistance test;

.9 determination of the ranges of the basic parts;

.10 determination of the sound pressure levels;

.11 determination of insulation resistance;

.12 determination of insulation resistance of sound signal means;

.13 electrical short circuit protection to prevent from getting into contact with current carrying parts.

14.5.3 Marine full scale tests of the prototype signal means shall include the following: determination of the sound pressure levels, the range of audibility, the difference of the sound pressure level in horizontal plane, the durability and frequency of signal sounding, as well as check of possible manual actuation of signals with automatic cutting-off the automatic controls at the moment of manual actuation and also drainage of condensate.

14.5.4 Test results of prototype signal means shall be considered satisfactory where they are in full compliance with the requirements of Rules for the Equipment of Sea-Going Ships.

14.5.5 At the manufacturer's with serial production, the prototype signal means shall be subject to bench tests under the program approved by the Register.

14.5.6 At the manufacturer's with serial production surveys and bench tests of sound signal means shall include the following:

.1 visual inspection;

.2 check of dimensions and mass;

.3 check of interchangeability of details and units;

.4 determination of the ranges of basic parts;

.5 determination of the sound pressure levels;

.6 determination of insulation resistance;

.7 operating tests.

14.5.7 Upon satisfactory results of surveys and tests, the sound signal means shall be marked with the Register brand and, the appropriate type of Certificate is issued.

14.5.8 The markings of the sound signal means surveyed by the Register shall include the manufacturer's trade mark, ordinal number, assignment according to the ship's length in metres, date of manufacture and the Register brand mark.

14.6 PYROTECHNIC SIGNAL MEANS

14.6.1 The Register technical supervision during manufacture of pyrotechnic means shall include review of technical documentation therefor.

14.6.2 Prototype pyrotechnic signal means shall be bench tested and full scale tested under the program approved by the Register.

14.6.3 The bench tests of the prototype signal means shall include:

.1 visual inspection;

.2 check of dimensions and mass;

.3 determination of luminous intensity;

.4 determination of chromaticity;

.6 temperature tests;

.7 anticorrosion waterproof tests;

.8 pyrotechnic safety in operation tests;

.9 operating tests;

.10 transportability tests.

14.6.4 Full scale tests of prototype pyrotechnic signal means shall contain determination of the altitude, burning time, audibility range and attenuation altitude.

14.6.5 Test results of the prototype pyrotechnic signal means shall be considered satisfactory where they are in full compliance with the requirements of Rules for the Equipment of Sea-Going Ships.

14.6.6 The marking of pyrotechnic signal means shall include identification, purpose, date of manufacture, time of serviceability, identification and the number of technical documentation approved by the Register and the date of its approval.

14.6.7 Pyrotechnic signal means shall be provided with brief instructions applied in indelible paint on the product case.

14.7 SIGNAL SHAPES

14.7.1 The Register technical supervision during manufacture of signal shapes shall include review of technical documentation.

14.7.2 Prototype signal shapes complying with the requirements of Rules for the Equipment of Sea-Going Ships shall be kept at the manufacturer's until after any change has been introduced in the construction of signal shapes.

14.7.3 Marking of signal shapes shall contain a statement that a product has been manufactured in

conformity with the technical documentation approved by the Register.

14.8 TESTING LABORATORIES, BENCH TESTS

14.8.1 Testing laboratories carrying out tests in the course of manufacture of materials and products required by the Register Rules for the Equipment of Sea-Going Ships shall be recognized by the Register in accordance with Section 9, Part I "General Regulations for Technical Supervision". Recognition Certificate for Manufacture is subject to confirmation at least once in every two years.

14.8.2 The laboratories and equipment thereof required for the tests of signal means shall meet the requirements of the relevant standards. The tests shall be carried out by officials having an identification document issued by a competent body confirming their authorization for doing the tests. Prototypes of signal means shall be tested under the program approved by the Register. The program shall be prepared accounting for the provisions and requirements of the Management, the Register normative documents and approved documentations.

14.8.3 Bench tests requirements are set forth in Section 5 and in Appendices 1, 2 and 3.

APPENDIX 1

TESTS OF PROTOTYPE SIGNAL LIGHTS (TYPE TESTS)

1. External inspection.

This is expected to include a detailed visual inspection of lights, externally and internally, with the purpose of checking their compliance with the technical documentation.

The quality assurance of material shall be confirmed by Certificates issued by the manufacturer, as well as by the results of in-data control.

Lights in assembly and their details shall be subject to external inspection. Prior to the assembly of a product all the parts shall be thoroughly cleaned of dirt, conservation etc. Weld joints, unevenness shall be grinded, sharp edges shall be made blunt. The surfaces of interfaced parts as well as sealing surfaces shall have no chippings, scratches, marks or any other defects.

Full complement, adequate assembly, coatings quality, reliable fastening of parts and availability of markings shall be inspected. Special attention shall be paid to the condition and correct fitting of Fresnel lenses and cylinders. The inner and outer surfaces of the lenses shall be smooth, and the filter glass shall be free of flaws, foreign inclusions, blisters and notches, spallings, dullings, etc. The colouring of coloured lenses or coloured light filters shall be homogenously coloured throughout their entire surface.

The light filters shall be fixed in lanterns in such a way as to preclude their spontaneous shifting and falling, and also prevent the possibility of placing the red filter instead of the green one and vice versa.

2. Inspection of dimensions.

This inspection shall be conducted by measuring instrumentation, gauges, patterns manufactured spe-cially for this purpose, and providing for the required accuracy.

Overall and moulded dimensions along with the fixed vertical position of the sockets in relation to the fixed base of lanterns and also sector angles and positions of screen bent flanges of lanterns are subject to mandatory control. The correct position of the axial line placed on the case of lanterns shall be checked.

3. Functioning test.

This shall be conducted at the test stand or photometer bench with a fitted indicator lamp brought into circuit at the rated supply voltage. In this case in all sector lights the limits of the horizontal angular sectors shall be checked, including the cut-off within 5 degrees limits (except for sidelights in the forward direction), and the marks adequately applied on the fore and aft centerline (CL) shall be inspected as well. This inspection may be coincident with lighting characteristics tests (refer to paragraph 4). As to all-round-lights, their proper electric assembly shall be inspected. Additionally, in all the lights the proper positioning of incandescent lamp filament in relation to the vertical and horizontal axes of lens or cylinder shall be checked.

4. Luminous characteristics tests.

Luminous characteristics tests of lanterns in laboratory conditions (refer to paragraph 8) shall be carried out in accordance with the existing standards. In this case it is necessary that the requirements prescribed in 4.1 to 4.4 shall be met.

4.1 The curve of vertical light distribution at the rated supply voltage and 5 per cent reduced supply voltage shall ensure the following:

.1 luminous intensity not less than that prescribed in 3.1.7.1, Part III "Signal Means" of Rules for the Equipment of Sea-Going Ships within the angles in vertical sector from 5 degrees above to 5 degrees below the horizontal plane;

.2 not less than 60 % of the prescribed luminous intensity within the angles in vertical sector from 7,5 degrees above to 7,5 degrees below the horizontal plane, and for lights of sailing ships, not less than 50 % of the prescribed luminous intensity within the range of

visibility up to 25 degrees on either side from the horizontal plane.

4.2 The curve of vertical light distribution at the rated supply voltage and 5 % reduced supply voltage shall ensure the following:

.1 for all-round lights the minimal required luminous intensity shall be maintained over the arc of the horizon up to 360 degrees;

.2 for sternlights and masthead lights as well as for sidelights (within the sectors up to 22,5 degrees abaft) the minimum required luminous intensity shall be maintained over the arc of the horizon up to 5 degrees within the limits of the sectors prescribed for the appropriate light type;

.3 from 5 degrees within the prescribed sectors the intensity may decrease by 50 % up to the pre-scribed limits[1] of sectors; then it decreases gradually to reach practical cut-off at not more than 5 degrees outside the prescribed sectors;

.4 for sidelights the steady luminous intensity shall be maintained within the angular sector. In the forward direction, luminous intensities must decrease within the limits up to 3 degrees by means of afore inboard screens prescribed by Rules for the Equipment of Sea-Going Ships (refer to Appendix 1 to Section 14, Part V "Technical Supervision during Construction of Ships").

4.3 Within the prescribed angular sectors the horizontal luminous intensity shall not have sudden changes of luminous intensities: the maximum luminous intensity and the minimum luminous intensity ratio shall not exceed 1,5.

4.4 Luminous transmissivity and colour specification of lights shall be checked in accordance with the existing standard. In this case the coordinates x, y shall lie inside the zones of the diagram prescribed in Part III "Signal Means" of Rules for the Equipment of Sea-Going Ships.

4.5 Operational tests in the conditions of vibration and shaking shall be exercised under the norms and methods prescribed in Section 10.

4.6 Watertightness tests shall be carried out by water spraying (refer to 4.1, Appendix 2). During these tests the current-carrying parts in the electric lights, or chimney and other parts affecting the operation of the oil lanterns shall be prevented from getting into contact with water when such lights are being sprayed. Electric lights shall be of watertight design (IP56) and also shall comply with the requirements prescribed in Section 10.

4.7 The operational tests shall be conducted at variations of ambient temperature from + 45 to – 30 ºC, and lights intended for ships of ice category **Arc5** and above shall be adapted to operate at a negative temperature down to – 40 º C.

4.8 Anticorrosion and seawater resistance tests of lights shall be carried out under the norms and methods prescribed in Section 10. The product is considered to have passed the test if no traces of corrosion are found and insulation resistance on tcompletion of the test is not less than 1 MOm.

4.9 Thermal resistance test shall be performed under the norms and methods prescribed in Section 10.

4.10 Humidity resistance test shall be performed under the norms and methods prescribed in Section 10.

4.11 Operational tests in the conditions of heeling and trimming shall be performed under the norms and methods prescribed in Section 10.

4.12 When determining resistance of insulation electric chains of lights and when testing insulation electrical strength of lights the norms and methods shall be followed as prescribed in Section 10.

4.13 Operational check of lights with variations for long periods from the rated supply voltage and fre-quencies within the limits as specified by Rules for the Equipment of Sea-Going Ships suggests that lights shall provide the range of visibility required by the Rules. Such a check shall be coincident with luminous characteristics tests (refer to paragraph 4) and full-scale tests.

4.14 Wind velocity tests of oil lights shall be performed with wind velocity up to 30 m/sec.

4.15 Burning durability of oil lights shall be checked continuously during 16 h with burning lamp. In this case the lamp oil volume shall be such as to maintain that durable burning. In the course of testing the luminous intensity shall be determined regularly, but not less than once per 1 h.

APPENDIX 2

BENCH TESTS OF PROTOTYPE SOUND SIGNAL MEANS

1. External survey of sound signal means is expected to be conducted during external inspection with the purpose of ascertaining their conformity with the technical documentation approved.

Material quality intended for the product shall be certified by the Manufacturer's Certificate. Parts and the product itself shall undergo an external inspection with no application of magnifying devices. Prior to the assembly of

[1] It is an allowed/admitted reduction of luminous intensity (and not obligatory one) is meant.

the product, all the parts shall be thoroughly cleaned from rust, scale, conservation, etc. Weld joints, unevenness shall be grinded, sharp edges shall be made blunt. The surfaces of interfaced parts, as well as sealed surfaces shall have no chippings, scratches, marks or any other defects.

With agreement of the Register, the removal of surface defects not affecting the serviceability of signal means may be admitted.

2. The product design, dimensions, mass, surface unevenness, allowances, etc. shall comply with the requirements of the technical documentation.

Casting parts (or the product itself) shall be tested by striking in the hanging position by means of devices specified in the technical documentation so as to define (as per sounding tones) any cracks, cavities/pits, lamination, etc. If a part of the product (or the product itself) shall be strength or leak tried, it shall be subjected to hydrostatic P_{st} pressure tests in accordance with the requirements stated in the technical documentation. The structure is considered to have passed the test unless under constant pressure during the period required for inspection any drops, leakage, sweat, etc. are found.

3. Operational tests in vibration and shaking conditions shall be carried out under the norms and methods prescribed in Section 10.

4. Tests of sound signal means:

.1 for watertightness tests, the sound signal means similarly is positioned aboard like in service and during 5 min is water spray hosed, hole diameter 25 mm, distance 5 m, water pressure 0,8 Pa. Thereafter the sound signal means shall be dried, opened up and inspected. The product is considered to have passed the test unless there is water found out inside the case;

.2 for reliable operation:

at high and low temperatures of ambient air when testing in working conditions and temperature cycling up to + 55 ºC during 10 h and down to – 30 ºC during 6 h, and also in idling conditions at – 50 ºC during 2 h;

for heeling and trimming conditions. The sound signal means shall be tested in working conditions and normal climatic conditions and also in two inter-perpendicular normal operating positions. Heeling and trimming tests of signal means need not be conducted in case they have passed single component bench striking tests in three inter-perpendicular positions. In all cases of the tests the trim shall not be less than 10 degrees;

with rolling-and-pitching motion consequently in two inter-perpendicular positions with the ultimate heeling angle up to 45 degrees, trimming 10 degrees, heeling amplitude 7-9 s, duration not less than 5 min in each position;

with maintenance consequently in two inter-perpendicular positions, heeling angle up to 45 degrees, trimming 10 degrees, duration not less than 3 min in either position;

.3 for anticorrosion resistance under the norms and methods prescribed in Section 10. The product is considered to have passed the test if no traces of corrosion are found and insulation resistance on the completion of the test is not less than 1 MOm;

.4 for thermal resistance under the norms and methods prescribed in Section 10. In this case the heating temperature shall be checked after the signal means has operated for 30 min in the cycling as follows: 10 s as "switched on" and 5 s as "switched off".

5. Determination of ranges of fundamental frequencies and sound pressure level.

5.1 Acoustics tests of sound signal means in laboratory conditions shall be carried out at specially equipped bench. Locations of the products tested shall be adequately specified and correspond to their positioning in the conditions of free sound field. The instruments characteristics shall meet the requirements of Rules for the Equipment of Sea-Going Ships.

5.2 Sound pressure level shall be measured at the prescribed sound pressure level (on the forward axis) and at octave band levels with geometric average frequencies as follows: 63, 125, 250, 500, 1000 and 2000 Hz, and in the determination of frequencies in the bandwidth (3 or 6 %) in the particularly specified range 50 to 2000 Hz with the help of sound level meters, filters and analyzers.

The emission direction is estimated according to both the generally prescribed level and activated bands levels in the horizontal plane under all round characteristics.

5.3 When estimating the sound level intensity on the supporting radius equal to 3, 5 and 10 m the estimated results shall be reduced down to the 1 m supporting radius.

5.4 During the bench tests of the prototype signal means a signal means' full characteristics in accordance with those prescribed in 9.2 shall be received. In this case the general level and tonality of the product tested shall meet the requirements contained in the technical documentation approved by the Register.

The level of sound pressure level and frequencies range of a bell and gong shall be estimated as to the conformity and in the scope of the requirements prescribed in Rules for the Equipment of Sea-Going Ships.

6. The electric equipment of whistles shall be subjected to the measurement of insulation resistance, check of insulation electrical strength and prevention from getting into contact with current carrying parts (refer to Section 10). The extent of protection of closed type sound signal means, as well as sound signals means with starting valve electric-magnetic drive shall be in accordance with those prescribed in IP56.

Additionally, the sound signal means shall be tested in the full extent of people's prevention from getting into contact with parts under voltage or moving parts inside the hull.

7. The system of withdrawal of condensation shall be surveyed under the methods specified in the technical documentation for each whistle type.

APPENDIX 3

BENCH TESTS OF PROTOTYPE PYROTECHNIC SIGNAL MEANS

Bench tests shall include the following:

1. External inspection.

This is a visual survey of pyrotechnic means as to their conformity with the approved technical documentation.

2. Check of dimensions and mass.

Pyrotechnic signal means shall be measured by an universal gauge and thereupon weighted.

3. Determination of luminous intensity, light colour and burning time.

The luminous intensity shall be tested in a photographic camera.

A star shall be fixed on the stand vertically, with the igniter composition upward, and shall be burned by an electric coil switched on with rated supply voltage 24 to 36 V or with the help of safety fuse.

Air flow rate in the burning area shall be about 1 to The star's burning time measured by two timing devices with value divisions of 0,2 s shall be not less than that prescribed in Part III "Signal Means" of Rules for the Equipment of Sea-Going Ships.

When red light hand flares are to be tested, the length of colour wave shall be estimated which length is expected to be within 602 to 607 H/m, with flame saturation not less than 85 %.

4. Temperature cycling tests.

4.1 Pyrotechnic means shall be subjected to ambient temperature cycling – 30 ºC and + 65 ºC repeated 10 times in succession, and thereafter they shall function properly.

.1 endurance in the thermal chamber at temperatures of 65 ± 2 ºC during 8 h;

.2 specimens are withdrawn from the thermal chamber on the same day and maintained exposed in the ambient conditions until the next day;

.3 endurance in the freezing chamber at temperatures of -30 ± 2 °C during 8 h;

.4 specimens are withdrawn from the freezing chamber on the same day and maintained exposed in the ambient conditions until the next day.

4.2 Pyrotechnic means are endured at the freezing chamber during at least 48 h at temperatures of -30 ± 2 °C, and thereafter they shall function properly at these temperatures.

4.3 Pyrotechnic means are endured in the thermal chamber during not less than 48 h at 65 ± 2 ºC, and thereafter they shall function properly at these temperatures.

4.4 Pyrotechnic means are endured in the thermal chamber of 65 ± 2 ºC, and relative humidity 90 % during at least 96 h, and thereupon at temperatures of 20 to 25 ° C and relative humidity 65 % during 10 days, and thereafter they shall function efficiently.

5. Antycorrosion and moisture resistance tests.

Each pyrotechnic means shall function properly after the following:

.1 immersion in water during 24 h under 1 m;

.2 immersion in water during 5 min under 10 cm when a means of ignition is ready for use;

.3 influence of sprayed salt water (5 % solution of sodium chloride) at temperature of $\pm 35 \pm 3$ ºC during at least 100 h.

6. Safety of operation test.

6.1 Each pyrotechnic means shall be at first fired vertically, and thereafter horizontally from the altitude of 2 m down to a steel platform of 6 mm thick cemented into the concrete floor. On the completion of this test the pyrotechnic means shall operate properly.

6.2 Each pyrotechnic means shall be tried in operation in accordance with the manufacturer's instructions so as to ascertain that it is so designed as not to cause discomfort or injury to the person holding the casing, or to people nearby.

7. Tests of hand flares.

7.1 A hand flare shall be tried in operation with a burning period of at least 1 minute. Having burned for 30 s, it shall be immersed in water for 10 s under 100 mm, and thereafter it is to continue to be burning during at least 20 s.

7.2 A hand flare shall be tried in operation at a distance of 1,2 m above a testing square platform with its side equal to 1 m, containing 2 liters of heptane positioned above a layer of water. The test shall be conducted at a temperature within 20 to 25 ºC. On the complete combustion of hand flare the heptane shall not ignite due to the hand flare effect or materials therefrom.

8. Test of buoyant smoke signals.

8.1 After passing the test in accordance with the requirements prescribed in 4.1, a smoke buoyant signal shall operate properly in sea water with a temperature of -1 ºC, and the second one with a temperature of +30 ºC. After 1 min after beginning to emit smoke the buoyant smoke signal shall be completely submerged in water for at least 10 s. The smoke shall not stop emitting both during the submersion, and thereafter. Total time of smoke emission shall be equal to at least 3 min, and in the event of automatically operated buoyant smoke signal, at least 15 min.

8.2 A buoyant smoke signal shall operate in water under a hectane layer of 2 mm thick not causing ignition.

8.3 When the smoke is passing through the tube of 18 cm in diameter with the help of the blower providing air intake of 18,4 m^3/min, the light impairment (due to the smoke) at the outlet shall not exceed 30 %.

9. Transportability test.

Hand flares shall be tested for transportability while shaking at the bench with 60 impacts per minute during 30 min, and additionally throwing down from the altitude not less than 15 cm. The remaining pyrotechnic means shall be tested for transportability at the specially designed testing bench during 1 h and under special conditions. In the course of transportability tests some local damages to the surface coating of hand flares may be admitted.

APPENDIX 4

FULL SCALE SEA TESTS OF PROTOTYPE LANTERNS

Full scale sea tests of prototype lanterns shall contain the check of range and sectors of visibility of lanterns installed aboard. These tests shall be carried out under the program approved by the Register.

APPENDIX 5

FULL SCALE SEA TESTS OF PROTOTYPE SOUND SIGNAL MEANS

1. Prior to the full scale tests of prototype sound signal means, checking tests shall be carried out on the supporting radius of the prescribed sound pressure levels and octave band levels.

1.1 Full scale sea tests of prototype sound signal means shall be carried out in the water area adequately distant from the shore facilities which are likely to impair the sound propagation. The tests shall be performed at the day time in favourable weather conditions, that is, fair weather and wind force of not more than 3 m/s in the ship's heading direction. The background noise at the ship's posts in the direction of maximum sound intensity in the conditions of still air weather shall be not more than that specified in Rules for the Equipment of Sea-Going Ships.

1.2 Measurements of both the prescribed sound pressure level and the sound pressure in octave band levels shall be defined in the direction of maximum sound intensity in the specified sector and in appropriate distances. In this case the signal level shall be not less than 5 dB above the noise background. The measurements shall be performed at least three times.

1.3 When determining sound pressure levels, the subjective listening estimation by inspectors shall be conducted. In the course of listening nothing shall affect the sound signals listening subjectivity of inspectors. No doubling of sound signals is allowed. The listening procedure shall be performed at least three times.

2. The sound pressure level of a directional whistle shall not exceed 4 dB below the prescribed sound pressure level on the axis at any direction in the horizontal plane within ± 45 degrees of the axis (right ahead direction). The sound pressure level at any other direction in the horizontal plane shall be not more than 10 dB below the prescribed sound pressure level on the axis. Sound pressure levels shall be measured on the supporting radius over the arc at angles of 0º to 45º on either side accordingly, in all other directions in the horizontal plane the change of the sound pressure level as compared to the level on the main direction shall not exceed 10 dB.

3. Sound duration shall be determined by impulse noise meters in the direction of maximum sound intensity on the supporting radius. The probability of providing a short sound (about 1 s long) and long sound (4 to 6 s long) shall be tried at least three times.

The prescribed sound pressure level, at 1 m audibility range, shall not be below than that specified in the technical specifications for the whistle, and to change by more than 1 dB in case of a long signal. Clear sounding is defined by analyzing the sound signal in accordance with 5.2, Appendix 2.

Whistles shall be tested during 2 h in case of manual control, and during 12 h in case of auto-matic control; and their sounding characteristics shall remain within admitted limits.

APPENDIX 6

FULL SCALE PROTOTYPE TESTS OF PYROTECHNIC SIGNAL MEANS

1. The altitude and descent of pyrotechnic signal means shall be determined by devices specially designed for the purpose (for example, by a teodolite meter), the altitude of rockets extinguishing shall be at least 50 m. The rate of descent of rocket parachute flares shall be at least 5 m/s. A parachute rocket shall operate reliably when fired at an angle of 45 degrees.

2. The burning time shall be determined at full scale tests. The time of functioning shall be measured by timing devices with the scale graduation value of 0,2 s, and it shall be at least like that specified in Table 3.5, Part III "Signal Means" of Rules for the Equipment of Sea-Going Ships.

3. Determination of range of audibility.

The range of audibility of rockets or shells shall be determined over sea surface at wind force up to 1 and clear atmosphere and at background noise of at least 45 dB by devices specially designed for this purpose and approved by the Register.

4. The buoyant smoke signal means shall be tested in heavy seas of at least 300 mm high. It shall operate properly during at least 3 min.

5. Comfort and reliability in handling.

All the procedures to operate pyrotechnic signal means shall be performed in accordance with the Manufacturer's Operational Instructions and Regulations.

When conducting full scale tests of pyrotechnic signal means, special attention shall be drawn to the following:

.1 comfort, reliability and safety of application in any meteorological conditions (rain, wind);

.2 reliable ignition of hand flare;

.3 hand flare burning which shall burn uniformly under the conditions of wind, rain, and with no explosions and no slag in quantities impairing the burning process. The heating of hand flare handle shall not exceed 40 °C.

APPENDIX 7

SURVEYS AND TESTS OF LANTERNS AT THE MANUFACTURER'S WITH SERIAL PRODUCTION

Surveys and tests of lanterns shall include the following:

.1 external inspection (refer to item 1 of Appendix 1);

.2 check of dimensions and mass (refer to item 3 of Appendix 1);

.3 tests of functioning (refer to item 4 of Appendix 1);

.4 check of interchangeability of parts and units (possibility of rapid change of electric and oil lamps, possibility of inserting a lamp oil lantern with its chimney fitted);

.5 check of efficient securing and fitting of outboard basic and spare lanterns;

.6 watertightness tests (refer to item 4 of Appendix 1);

.7 check of insulation electrical strength of lanterns (refer to item 12 of Appendix 1);

.8 measurement of resistance of insulation of electric circuits of lanterns (refer to item 12 of Appendix 1).

APPENDIX 8

SURVEYS AND BENCH TESTS OF SOUND SIGNAL MEANS AT THE MANUFACTURER'S WITH SERIAL PRODUCTION

Surveys and bench tests of sound signal means shall include the following:

.1 external inspection, check of dimensions and mass, interchangeability of parts and units, etc.;

.2 check of prescribed level and levels of sound pressure of each product in octave band frequencies. Characteristics shall meet the requirements of the technical documentation approved by the Register. Admitted allowance is ± 1 dB;

.3 check of compliance of the range of fundamental frequencies (tonality) with that specified in the technical documentation by way of narrow band analysis of sound signals. Admitted allowance is ± 1 %;

.4 electric equipment of sound signal means shall be subjected to measurement of insulation resistance (refer to item 6 of Appendix 2).

15 RADIO EQUIPMENT

15.1 GENERAL

15.1.1 The provisions of this Section apply in technical supervision of the radio equipment specified in the RS Nomenclature.

15.1.2 The Section establishes the procedure, scope and methods of the Register supervision during manufacture of radio equipment at manufacturers'.

15.1.3 General provisions on the arrangement of technical supervision during manufacture of radio equipment for ships are set forth in Part I "General Regulations for Technical Supervision", on technical documentation, in Part II "Technical Documentation".

The radio equipment fitted in ships shall be of the approved type. Certificates on Form 6.5.30 (6.5.31) shall be issued on the basis of the effective Type Approval Certificate or, in exceptional cases (a one-time delivery, non-standard ship, etc.), by agreement with the Register relying on the survey conducted.

15.2 TECHNICAL DOCUMENTATION

15.2.1 Carrying out technical supervision during manufacture of radio equipment items at steady production, the following Register approved technical documents shall be received from the manufacturer:

.1 design technical documentation in the amount specified in 1.3, Part IV «Radio Equipment» of Rules for the Equipment of Sea-Going Ships;

.2 programs of product tests if not specified in documents in 15.2.1.1;

.3 notices on amendments of the documents required;

.4 list of technical supervised items (refer to 12.2, Part I "General Regulations for Technical Supervision").

15.2.2 The documents confirming the manufacture of the following items under the RS technical supervision shall be submitted: accessories, materials, units, blocks, etc. being part of the equipment to be surveyed.

15.2.3 In survey performance, the surveyor can demand from a manufacturer other (additionally to those specified in 15.2.1) technical documents pertinent for execution of his functions.

15.3 SCOPE OF SURVEYS AT ESTABLISHED PRODUCTION

15.3.1 Technical supervision during manufacture of radio equipment items at a manufacturer's with established production shall be carried out by surveying each finished product according to the List of Supervised Items (refer to 12.2, Part I "General Regulations for Technical Supervision") providing for:

.1 checking the documents confirming the RS supervision for accessories, materials and products; checking the documents of a quality control service and of competent bodies confirming the product conformity with the special requirements (explosion proofness, etc.);

.2 checking the completeness of equipment and technical documentation;

.3 external and internal inspections;

.4 checking product functioning;

.5 checking and electric testing the product to determine its performance;

.6 testing in the scope specified in effective documents on the product;

.7 checking spare parts;

.8 issuing for products the Register documents prescribed by the technical supervision mode established.

15.3.2 To surveying shall be submitted the final products that have passed all the checks and tests conducted by the technical control body of the manufacturer.

15.3.3 The survey shall be aimed at determining the product conformity with the requirements of Rules for the Equipment of Sea-Going Ships and the technical documentation for the given product as specified in 15.2.1.1 to 15.2.1.3.

15.3.4 The Surveyor can demand the performance of the relevant additional checks and tests of individual blocks, units, structures, accessories and other components being part of the product to be supervised if it is revealed during its complete survey that such components effect the product quality.

15.3.5 If during surveying the product the nonconformity is revealed with the requirements of the Register approved technical documentation, the product is considered to have failed the check and is returned for identifying the cause of rejection, defects rectifying and rechecking.

15.3.6 The Register rejected products may repeatedly be submitted for surveying after rectifying the defects and checking following the presentation of documents containing causes of nonconformities and measures taken for their elimination.

15.3.7 The repeated check of a previously rejected product is carried out in a full scope or, by agreement with the Register, for the items of product nonconformity with the technical documentation requirements.

15.4 GENERAL INSTRUCTIONS ON SURVEYING AT ESTABLISHED PRODUCTION

15.4.1 Depending on the production process used at the manufacturer's, to be submitted for surveying are indvidual specimens of fully completed products or of their batch.

15.4.2 The product survey shall be started with the verification of the approved technical documentation specified in 15.2.

In so doing the following shall be established:

.1 the set of documentation corresponds to that specified in 15.2.1;

.2 dates of documentation approval by the Register are still valid;

.3 all amendments, additions or exceptions given in drawings, diagrams, structures, technical conditions texts and other documentation are confirmed by the relevant notices agreed or approved in an established order.

15.4.3 The presence of metrological documents for devices, apparatus, testing equipment, and the like intended for checking and testing products during the survey shall be ascertained.

15.4.4 For two-way VHF radiotelephone apparatus, as well as for radar transponders and radio beacons, the presence of instructions for their activating by untrained personnel on the case of each kind of the equipment shall be checked.

15.4.5 The completeness shall be checked for the technical documentation compliance for all the product modifications specified, and to deal with units, blocks of central and peripheral devices and apparatus, control panels, etc. being individual cases.

15.4.6 In visual examination, the product conformity with the requirements of Rules for the Equipment of Sea-Going Ships and technical documentation shall be verified.

The following shall be checked:

.1 overall dimensions of each block or device;

.2 materials used for manufacturing frames, chassis, enclosures, covers, trays and other structural parts of the product case;

.3 quality of securing structural parts of a case and chassis (welding; bolt and screw joints);

.4 securing dependability and proper arrangement of means for securing products in specified positions (shock absorbers, feet, clamps, holes, etc.);

.5 proper arrangement of controls, measuring and indicating devices, signal lamps, and the like, presence of relevant guards for mechanical protection of controls;

.6 presence of the relevant signs or approved symbols for controls designation;

.7 presence of proper anti-corrosive coatings of equipment cases, as well as of coatings preventing the emergence of contact couples causing electrical corrosion; correspondence of cases to the protection degree required to prevent the ingress of water, foreign objects and touching;

.8 presence of marking that indicates the type, maker's number, year of manufacture, kind of current and supply voltage, safe distance of magnetic compass installation and other data pertinent for the particular kind of equipment;

.9 presence of earthing screws, bolts or strips of equipment cases, sufficiency of their quantity and their proper arrangement, condition of a contact surface;

.10 tightness of mechanical connections and dependability of the electrical ones of detachable covers, doors, manholes and fixed enclosures with product frames;

.11 dependability, smoothness, simplicity and convenience of maintaining all the opening and detachable

components of cases, of functioning of all the kinds of jointed, hinged and sliding arrangements for opening or extending individual blocks and devices from the case, as well as the presence of locks, stops, catches and the like arrangements to hold the moving units fixed in operating and opened positions;

.12 unobstructed access inside the product without special tools for removing single detachable and replaceable parts: fuses, printed circuit cards, etc.;

.13 functioning of controls: easy handling, precise positioning, a proper direction of movement with increasing or reducing the value of a regulated parameter, as well as convenience and safety of their use by the service personnel;

.14 cable and aerial entries, cable boxes and glands, connectors for supply cables and interdevice mounting, convenience of their arrangement and accessibility for periodical inspections;

.15 mass of portable equipment, e.g. of the portable two-way VHF radiotelephone apparatus of lifeboats and liferafts, and also of radar transponders, radio beacons, etc.

15.4.7 In the internal inspection, the conformity of a product with the requirements of rules, technical documentation regulating the requirements for internal (mechanical, electrical) wiring of the product shall be verified, namely:

.1 reliability of fastening internal units, parts, blocks, panels, cards, bundled cables and other components of internal wiring in their standard positions;

.2 presence of means to prevent the self-unscrewing of structural and contact threaded joints; absence of such fastenings loosened;

.3 mounting wire laying which prevents the contact with bare mounting circuits of opposite poles, phases and circuits;

.4 ways to group mounting wires in bundles, their packing and covering, laying and fastening inside the equipment to prevent wearing through by friction, bending and crumpling by moving parts of the equipment;

.5 fanning out of mounting wires for a contact joint with circuit components, ways to terminate mounting wires for contacts, quality of their soldering to lugs, racks, contact wires of resisitors, transistors, capacitors and other parts of equipment; inadmissibility of contact joints by the lap soldering ignoring the securing of the contact joint;

.6 presence and workmanship of earthing of shields, circuit sections to be shielded to prevent interaction, and the like, as well as of wires carrying high frequency and audio-frequency signals;

.7 presence of marking of all the circuit components according to the numbering used in a circuit diagram;

.8 tightness of fitting of all plug connectors, flat pin plugs, contactors, etc. in jacks;

.9 reliability of inductance coils windings securing on coil frames, securing of coil leads and taps on frames which prevent shifting of single turns or the entire winding;

.10 tightness of fitting of cores of inductance coils, transformers, chokes, and the like, as well as reliability of their earthing if specified in a circuit;

.11 workmanship of three-dimensional wiring in regard to arrangement of conducting wires (absence of their tangle and excessive lengths), use of nonflexible wires, absence of damages to insulation of wires and to their shielding, and of other shortcomings;

.12 workmanship of printed wiring: absence of damages to card surfaces, of incipient fractures of cards or damaged coatings, reliability of caulking contact wires of printed joint components by soldering;

.13 absence of potential arbitrary changes of internal wiring components positions relative to each other in inclinations, alterations, replacements of detachable components, door openings, etc.;

.14 presence of plug connectors for microphones, handsets, headphones, extension loudspeakers and other peripheral devices, as well as for disconnecting and regulating devices for integrated sound sources;

.15 observance of continuity of terminated high-frequency cable shielding with the clamp and the internal wiring of aerial circuits.

15.4.8 If positive results are obtained after the checks according to 15.4.2 to 15.4.8, the product to be surveyed shall be checked and tested in compliance with 15.3.1.4 to 15.3.1.6.These tests, measurements and checks shall be carried out according to the test programmes specified in 15.2.1.2 and are to provide for:

.1 measurement of input circuits insulation resistance in cold and heated conditions. Measurements shall be made after product testing for work duration;

.2 product supply switching on and off. This shall be performed at least 4 to 5 times to make sure that starting elements (tumblers, circuit breakers, start buttons, contactors and other switchgear) function properly and without failures, that pilot lamps and measuring devices are in working order, the pilot lamp colours are consistent with the requirements, and devices indicate the pertinent values of voltage and current;

.3 checking the high voltage interlock actuation in the opening of doors, removal of detachable covers and other closures;

.4 checking the residual voltage value at capacitors following the time required by Rules for the Equipment of Sea-Going Ships after switching off supply and opening-up etachable parts of the product case;

.5 checking the functioning of the device interlocking high voltage supply with removed detachable parts of the product case;

.6 checking the lighting of tuning scales of measuring devices, signal panels, displays, scopes, as well as of controls and inscriptions or symbols on control panels of products; in so doing, it is necessary to make sure that the lighting is sufficient and effective;

.7 checking the product functioning at permissible voltage and frequency variations in the ship's mains;

.8 checking control, alarm and monitoring systems including remote control panels for products;

.9 checking the functioning of cooling fans, if any;

.10 checking the duration of product operation at a nominal load;

.11 measuring the time needed for preparing the product for operation since the moment of manual, remote or automatic switching-on; measuring the time of automatic adjustment of proper parameters;

.12 checking the product vibration strength at one frequency. The procedure for tests performance is given in Appendix 1. In testing, it shall be ascertained that none of structural parts of the product or its component drop in resonance. The occurrence of the condition close to the resonance can be determined with the increase of the vibrations amplitude for separate parts, plates, panels and components more than two times that of a vibration testing machine. The inspection specified by the test procedure shall confirm that fastenings, positions of wiring components, main characteristics and parameters of the product are unaffected;

.13 checking the functioning of all controls:

knobs and buttons of frequency presetting, of high-, intermediate- and low-frequency amplifying, of adjusting transmitters stages, aerial circuits, of scopes brightness and the contrast range, etc. depending on the kind and purpose of the product. In checking, smooth regulation, reliability of switches positioning and the range of output parameters regulation shall be evidenced;

.14 presence of special colour marks of distress frequences setting on dials and controls.

15.5 SURVEYING SINGLE KINDS OF RADIO EQUIPMENT AT ESTABLISHED PRODUCTION

15.5.1 In addition to general inspections, checks, tests and measurements specified in 15.4, single kinds of radio equipment products shall be checked and tested regarding their design, characteristics and parameters associated with the purpose of the given kind of the radio equipment.

15.5.2 In the survey of transmitters being separate or combined radio transmitting devices or a part of radio stations, depending on their purpose, the following shall be checked:

.1 operation on fixed frequences, over separate bands and frequency spectra. In so doing, frequencies and bands shall be reliably and precisely fixed, frequency dialing using the frequency spectrum or other devices shall be reliable, without malfuctions, stuck buttons, etc.;

.2 operation using different classes of emission. Commutators of emission classes shall function properly and reliably hold the emission class. The actual emission shall be consistent with that meant by the inscription;

.3 operation for the standard artificial aerial at the rated and reduced power which shall comply with that in the technical documentation;

.4 operation of tuners over the given range of aerial parameters and the power delivered to a non-standard artificial aerial. The transmitter shall be readily tuned over all bands to all the aerials having specified parameters; in this case, the power values shall be within the limits specified in the technical documentation;

.5 functioning of an indicator for monitoring the aerial current;

.6 operability of transmitters in simulating the open-circuiting of an aerial or its fault to frame.

15.5.3 In the survey of receivers being the separate ones or part of radio stations, depending on their purpose, the following shall be checked:

.1 correspondence of a frequency range;

.2 accuracy of frequency setting;

.3 frequency drift within 15 min;

.4 sensitivity in the modes of receiving H3E, J3E, F1B or J2B (G3E, G2B for VHF) emissions, and of other kinds of operation specified in the technical documentation over all bands;

.5 reception of all the emission classes specified with automatically regulated amplification;

.6 loss of sensitivity of the adjacent channel, intermediate frequency, image channel and other parameters;

.7 limits of manual gain control on high, intermediate and low frerquencies;

.8 bandwidth of the intermediate frequency circuit;

.9 bandwidth of audio frequencies in all the modes of radiotelephone transmissions reception;

.10 presence and values of clipping in radiotelephone modes of operation;

.11 voltage levels at the output of intermediate and low frequencies.

15.5.4 In the survey of automatic matching aerial devices integrated in transmitters or fitted as separate units, the following shall be checked and tested:

.1 functioning of the matching device on a common aerial and the separate ones for a transmitter and receiver;

.2 functioning of the matching device over all the transmitter bands specified and on all the aerials specified, e.g. on 6 m and 10 m aerials, wire aerials, etc. Such checks may be carried out using an artificial aerial;

.3 measurement of time to tune and retune, when shifting to another frequency of a transmitter, the matching device which shall be within the range of 5 s to 15 s;

.4 presence and fuctioning of a visual indication of transmitter availability for operation, wrong tuning, etc.;

.5 availability in the matching device of an opportunity to connect a transmitting aerial, an aerial commutator, a receiving aerial; their earthing and isolation;

.6 determination of the minimum value of aerial insulation resistance wherein the matching device automatically prevents transmitter tuning and which shall not exceed 1MΩ;

.7 functioning of the manual tuning of the matching device.

15.5.5 In the survey of supply devices making parts of radio equipment products, both integrated in the common structure of the product or being separate units of those products, the following shall be checked and tested:

.1 presence of electric protection devices and their conformity with rated values of voltage and current;

.2 functioning of commutators of supply switching on and off;

.3 functioning of the visual indication of «ON – OFF» positions;

.4 presence of devices for measuring voltage and current, and their functioning on measuring (continuously, casually, selectively) the parameters under control;

.5 temperature of the most heated parts after lengthy functioning under load;

.6 power demanded from an electric power source;

.7 insulation resistance of input circuits, and protective and switching devices fitted therein;

.8 insulating strength of supply sources of up to 24 V, 220 V and 380 V when tested at a voltage of 500 V, 1000 V and 1500 V respectively, and absence therewith of breakdowns, new formations and discharges;

.9 operability of the radio equipment with the variation of a supply voltage by ± 10 % and a current frequency by ± 5 % from rated values;

absence of self excitation and generation of parasitic oscillations;

absence of ac potential components at the rectifiers output;

.10 operability of the radio equipment designed for battery supply at a voltage reduced by 25 % and increased by 30 % of the rated one respectively.

15.5.6 In the survey of transmitters, receivers, supply devices, automatic devices for generating alarm signals, automatic matching aerial devices, remote control panels and other units being part of the radio station set, in addition to the checks specified in 15.5.2 to 15.5.5, the following shall be checked:

.1 secure fastening of main blocks (transmitter, receiver, supply device, autoalarm), provision of screening and protection from mutual inerference;

.2 presence of an opportunity to control radio stations both directly and using a remote control panel, if available;

.3 communication both from the radio station location and via a remote control panel, if available;

.4 functioning of a device for an automatic transition to the listening watch frequency when placing a handset in its regular position;

.5 functioning of a device of an automatic aerial matching with output stages of transmitters;

.6 functioning of automatic devices for generating alarm signals;

.7 presence of a device for earthing and isolating of aerials connected to the radio station;

.8 measurements of a temperature of individual blocks within one case after a long continuous operation up to the steady temperature;

.9 absence of mutual adverse temperature, electric, mechanical, magnetic and other effects of individual blocks on one another;

.10 radio station functioning on simplex and duplex channels.

15.5.7 In the survey of command broadcasting equipment, the following shall be checked:

.1 priority of loudspeaking and command broadcasting in transmitting general radio broadcasting;

.2 remote start system;

.3 operability when supplied from a transitional emergency source of electricasl power, if any.

15.5.8 In the survey of the GMDSS VHF radio installation, the following shall be checked and tested:

.1 categories of calls using both telephony and digital selective calling (DSC), as well as the availability of communication in the telephony mode for the purposes of:

distress, urgency and safety;

ship operational requirements;

public correspondence;

.2 availability of:

DSC encoder facility;

DSC watchkeeping facility;

radiotelephone station;

.3 presence in the DSC facility of:

means to decode and encode DSC messages;

means necessary for composing DSC messages;

means for verifying the message prepared prior to its transmitting;

.4 availability of:

means to display the information contained in a received call in plain language;

means for the manual and, if provided, automatic entry of ship's position data;

means for the manual and, if provided, automatic entry of the time of ship's positioning;

sufficient memory capacity ensuring the storage of at least 20 distress messages in the DSC facility unless these are immediately printed out on receipt;

protection against the inadvertent use of the means for distress alert transmitting;

.5 availability of:

priority transmission of the DSC distress alert relative to any other operation of the facility;

data of self-identification in the DSC facility memory, absence of an opportunity to readily replace them;

.6 an opportunity to check the DSC facility without signal emission;

.7 presence of the fixed manually acknowledged audible and visual alarm activating after receiving the distress alert or urgency call, or the call of a distress category, as well as the others than these;

.8 in the survey of the radiotelephone station of the VHF radio installation, the following shall be checked and tested:

.8.1 operability:

in the band 156 to 174 MHz using G3E (radiotelephone channels) and G2B (DSC channel 70) type emissions with a frequency shift of 25 kHz;

within the frequency range 156,3 to 156,875 MHz on simplex channels;

within the frequency range 156,025 to 156,875 MHz for transmission and within the frequency range 160,625 – 162,025 MHz for reception on duplex channels;

.8.2 availability of at least five channels including channel 70 (156,525 MHz), channel 6 (156,3 MHz), channel 13 (1156,65 MHz) and channel 16 (156,8 MHz);

.8.3 the maximum deviation of frequency not exceeding ± 5 kHz at a depth of modulation 100 %;

.8.4 frequency modulation precorrection of 6 dB per octave;

.8.5 audio frequency bandwidth not exceeding 3000 Hz;

.8.6 operation on a vertically polarized aerial;

.8.7 rated power of a transmitter not less than 6 W and not more than 25 W;

.8.8 power reduction from 0,1 W to 1 W except for channel 70 (156,525 MHz);

.8.9 the mean power of any spurious emission due to modulation products at any other channel of the International Maritime Mobile Service not exceeding a limit of 10 μW, and the mean power of any other spurious emission at any discrete frequency of the International Maritime Mobile Service band not exceeding the limit of 2,5 μW;

.8.10 sensitivity of the receiver for a signal-to-noise ratio of 20 dB which shall be equal to or better than 2 μV EMF;

.8.11 availability of the radio station receiver output designed for a loudspeaker with power of at least 0,5 W and a hand set;

.8.12 automatic switching off the loudspeaker during duplex operation;

.8.13 change of channels within 5 s, and change from transmission to reception and vice versa within 0,3 s;

.8.14 manual volume control of the receiver;

.8.15 availability of a device providing on channel 16 the minimum power of 50 mW at the loud-speaker with the volume control in the zero position;

.8.16 presence of the noise killer, which can be switched off, on the face panel of the radio station, of an on/off switch for the whole VHF radio installation with a visual indication that the latter is on;

.8.17 presence of the visual indication of the carrier frequency emission;

.8.18 displaying the number of the channel tuned;

.8.19 sufficiency of the receiver bandwidth for receiving a signal with the maximum frequency deviation of ± 5 kHz in the high (intermediate) frequency at a level of 6 dB;

.8.20 non-linear distortion factor of the receiver which shall not exceed 7 %;

.8.21 adjacent channel selectivity of the receiver which shall be at least 75 dB;

.8.22 intermodulation selectivity of the receiver which shall be at least 70 dB;

.8.23 availability of a device switching the radio station to channel 16 when a handset is placed in its regular position (in the absence of a scan mode);

.8.24 automatic transition from simplex to duplex operation and vice versa in the transition to the corresponding channels;

.8.25 availability of muting of the receiver output in the transmitting mode during simplex operation;

.9 in the survey of the radiotelephone station having multichannel watch (scanning) facilities, the following shall be checked and tested:

.9.1 availability of:

two-channel control automatically scanning a priority channel and an additional channel;

channel 16 priority if selection of the priority channel is not provided;

clear indication of the number of both channels being scanned;

impossibility of transmitting in the scan mode;

automatic switching the transmitter and receiver to the additional channel when the scanning facility is switched off;

possibility of manual switching to the priority channel;

.9.2 scanning characteristics:

scanning the priority channel with a frequency of not less than once per 2 s;

holding the receiver on the priority channel during all the time of signal duration;

interrupting the signal reception on the additional channel for not longer than 150 ms while continuing the scan on the priority channel;

duration of each listening period on the additional channel which shall be at least 850 ms in the case when a signal is not received on the priority channel, but is received on the additional one;

indicating the channel on which a signal is being received.

15.5.9 In the survey of the GMDSS MF radio installation, the following shall be checked and tested:

.1 categories of calls using both radiotelephony and digital selective calling, as well as the availability of communication in the radiotelephony mode for the purposes of:

distress,urgency and safety;

ship operational requirements;

public correspondence;

.2 availability of:

transmitter/receiver including an aerial;

integral or remote control panel with a handset and an internal or external loudspeaker;

integral or separate DSC facility;

dedicated DSC watchkeeping facility to maintain a continuous watch on the frequency 2187,5 kHz;

.3 operability of the transmitter within the frequency range of 1605 – 4000 kHz with at least two operating frequencies: 2182 and 2187,5 kHz;

.4 emission classes J3E, H3E and J2B or F1B;

.5 availability of means to automatically prevent overmodulation;

.6 stability of a frequency within 10 Hz of the set one after the transmitter warm up;

.7 peak envelope power with normal modulation and emission classes J3E and H3E, or the mean power with emission class J2B or F1B which shall be at least 60 W;

.8 opportunity to reduce the output power down to 400 W or less if the mean output power exceeds 400 W;

.9 operability on the frequencies 2182 and 2187,5 kHz within a minute after switching on the radio installation;

.10 continuity of the transmitter operation at the rated power;

.11 providing the transmitter with the standard artificial aerial: $C = 300$ pF, $R = 4$ Ω;

.12 discrete or continuous tuning of the receiver in the freqency range of 1605 to 4000 kHz;

.13 receiver operation with emission classes J3E, H3H, J2B and F1B;

.14 frequency deviation of the receiver within 10 Hz of the frequency required;

.15 sensitivity of the receiver for emission classes J3E and F1B which shall be at least 6 μV at the receiver input for a signal-to-noise ratio of 20 dB;

.16 receiver power which shall be at least 2 W to a loudspeaker and at least 1 mW to a handset;

.17 presence of an additional output for DSC signals if the DSC facility is not integral;

.18 adjacent channel selectivity of the receiver which shall be at least 60 dB when tuning away an interference by ± 6 kHz;

selectivity on spurious channels which shall be at least 80 dB;

intermodulation selectivity relative to 1 μV which shall be at least 70 dB;

non-linear distortion factor which shall not exceed 7 %;

.19 availability of automatic gain control;

.20 decoding and encoding DSC formats and their composing, automatic erasing of those messages in 48 h after their reception;

.21 sufficiency of memory capacity for storage in the DSC facility of at least 20 distress alerts received when these are not immediately printed out, automatic erasing of those alerts in 48 h after their reception;

.22 opportunity to control the radio installation from an integral or remote control panel(-s) (priority shall be given to the control panel at the conning position);

.23 opportunity to prepare and transmit distress alerts and safety calls, and to provide communications related to ditress and safety from the conning position;

.24 immunity to inadvertent use of the means for transmitting distress alerts;

.25 operation of the radio installation control system:

switching on the DSC distress alert (prioritized regarding other kinds of operations);

acknowledgement of DSC distress alert reception;

DSC distress alert relay;

switching on the frequencies 2182 and 2187,5 kHz;

automatic selection of the emission class J3E (H3E) when switching to the frequency 2182 kHz;

automatic selection of the emission class J2B or F1B when switching to the frequency 2187,5 kHz;

.26 changing emission classes with one control;

.27 independence of receiver and transmitter frequency setting;

.28 opportunity to manually input the ship's position and the time of its determination;

.29 absence of unwanted emissions in use of controls;

.30 presence of indication in clear for understanding form for the DSC formats received and being entered;

.31 presence of the fixed manually-acknowledged audible and visual alarm indicating the receipt of a distress alert or an urgency call, or the call of a distress category; opportunity of checking the alarm;

.32 indication of transmission and reception frequencies;

.33 storage in the DSC facility memory of self-identification data, and lack of an opportunuty to readily change them;

.34 availability of means for checking the DSC facility without signal emission;

.35 protection against the inadvertent switching-off of a heating circuits breaker if the latter is needed for the normal operation of the radio installation;

.36 automatic delay of power supply to any part of the transmitter, if needed.

15.5.10 In the survey of the DSC MF/HF radio installation, the following shall be checked and tested:

.1 categories of calls using both radiotelephony and digital selective calling, as well as provision of radiocommunications in the mode of radiotelephony and NBDP for the purposes of:

distress, urgency and safety;

ship operational requirements;

public correspondence;

.2 availability of:

transmitter/receiver including an aerial;

integral or remote control panel(-s) with a handset and an internal or external loudspeaker;

integral or separate Narrow-Band Direct-Printing (NBDP) facility;

integral or separate DSC facility;

special receiver ensuring continuous watching over DSC calls on the frequencies 2187,5 and 8414,5 kHz, and at least on one of the distress and safety frequencies in the DSC system: 4207,5; 6312; 12577 or 16804,5 kHz;

.3 operation of the transmitter within the frequency range of 1605 kHz to 27,5 MHz; availability of at least 18 operating frequencies:

for radiotelephony – 2182; 4125; 6215; 8291; 12290 and 16420 kHz;

for NBDP – 2174,5; 4177,5; 6268; 8376,5; 12520 and 16695 kHz;

for DSC – 2187,5; 4207,5; 6312; 8414,5; 12577 and 16804,5 kHz;

.4 operation of the transmitter using emission classes J3E, H3E and J2B or F1B;

.5 availability of means automatically preventing overmodulation;

.6 stability of a frequency within 10 Hz of the set one after the transmitter warm up;

.7 peak envelope power with normal modulation and emission classes J3E and H3E, or the mean power with emission class J2B or F1B which shall be at least 60 W;

.8 opportunity to reduce the output power down to 400 W or less if the mean output power exceeds 400 W;

.9 operability on the frequencies 2182 and 2187,5 kHz within a minute after switching on the radio installation;

.10 continuity of the transmitter operation at the rated power;

.11 discrete or continuous tuning of the receiver in the frequency range of 1605 kHz to 27,5 MHz, or the combination of these, or use of the receiver tuned to the fixed frequencies numbered at least 18;

.12 receiver operation with emission classes J3E, H3H, J2B and F1B;

.13 stability of a frequency within 10 Hz of the set one after the receiver warm up;

.14 sensitivity of the receiver for emission classes J3E and F1B which shall be at least 6 μV at the receiver input for a signal-to-noise ratio of 20 dB;

.15 receiver power which shall be at least 2 W to a loudspeaker and at least 1 mW to a handset;

.16 presence of an additional output for DSC and NBDP signals if the DSC and NBDP facilities are not integral;

.17 adjacent-channel selectivity of the receiver which shall be at least 60 dB when tuning away an interference by ± 6 kHz;

selectivity on spurious channels which shall be at least 80 dB;

intermodulation selectivity relative to 1 μV which shall be at least 70 dB;

non-linear distortion factor which shall not exceed 7 %;

.18 availability of automatic gain control;

.19 decoding and encoding DSC formats and their composing;

.20 sufficiency of memory capacity for storage in the DSC facility of at least 20 distress alerts received when these are not immediately printed out;

.21 scanning all the DSC distress channels selected within not more than 2 s with the time of watching on each channel sufficient for detecting a sequence of dots preceding each DSC. End of scanning when dots transmitted at a speed of 100 Baud are detected;

.22 NBDP facility-ensured operation in the circular and selective modes on the single-frequency distress channels allocated for the NBDP;

.23 availability in the NBDP facility of:

means for decoding and encoding messages;

means for composing and checking the messages to be transmitted;

means for recording the messages received;

.24 availability of self-identification data in the NBDP facility and their protection against easy change;

.25 opportunity to control the radio installation from an integral or remote control panel(-s);

.26 priority of the control panel located at the conning position;

.27 opportunity to prepare and transmit distress alerts and safety calls, and to provide communications related to ditress and safety from the conning position;

.28 immunity to inadvertent use of the means for transmitting distress alerts;

.29 operation of the radio installation cotrol system:

switching on the DSC distress alert; the latter priority over all the other operations;

acknowledgement of DSC distress alert reception;

switching on the frequencies 2182 and 2187,5 kHz;

automatic selection of the emission class J3E (H3E) when switching to the frequency 2182 kHz;

DSC distress alert relay;

automatic selection of the emission class J2B or F1B when switching to the DSC and NBDP distress and safety frequencies;

changing emission classes with not more than one control;

opportunity to independently set receiver and transmitter frequencies;

manual input of the ship's position and the time of its determination;

.30 absence of unwanted emissions in use of controls;

.31 presence of indication in the form clearly understood for the DSC formats received and being entered;

.32 presence of an audible and visual alarm activating after the receipt of a distress alert or an ur-

gency call, or the call of a distress category; possibility to manually acknowledge the alarm;

.33 indication of transmission and reception frequencies;

.34 storage in the DSC facility memory of self-identification data, and lack of an opportunuty to readily change them;

.35 means for periodical checking the DSC facilities without signal emission;

.36 presence of protection against the inadvertent switching-off of a heating circuits breaker if the latter is needed for the normal operation of the radio installation;

.37 presence of an automatic delay of power supply to any part of the transmitter, if needed.

15.5.11 In the survey of the DSC INMARSAT ship earth station, the following shall be checked and tested:

.1 call categories (in the mode of direct-printing telegraphy);

.2 transmission and reception of distress piority calls;

.3 watching shore-to-ship distress alerts including those addressed to certain geographical areas;

.4 transmission and reception of general radiocommunications (in the mode of direct-printing telegraphy or telephony);

.5 absence of any external controls which can be used for changing the ship's station identity;

.6 an opportunity to transmit the distress alert from the conning position, as well as from any other place allocated for that purpose; protection against the inadvertent use of means for transmitting the distress alert;

.7 absence of a need to repeatedly manually force the equipment into the operating mode, of a loss of messages received and being stored in the memory in the case of the transition from one power supply to another or of any break in electric power supply within up to 60 s;

.8 conformity of the Enhanced Group Calling (EGC) system chracteristics with the requirements imposed upon the EGC equipment if included in the ship earth station;

.9 availability of a self-checking system, and automatic activating an audible and/or visual alarms in the case of:

satellite tracking loss by an aerial;

failure of ship earth station operability;

loss of power supply or starting a stand-by source of power.

15.5.12 In the survey of the NAVTEX service receiver, the following shall be checked and tested:

.1 availability of a receiver, signal processing device and printer;

.2 a possibility of receiving information on the areas covered by the service and on the types of messages excluded by an operator from reception;

.3 operability on the frequency 518 kHz and additional frequencies of the national NAVTEX service if provided;

.4 operability of the receiver, signal processing device and printer;

.5 storage of at least 30 message identities; automatic erasing the message identity from the memory of the equipment on expiry between the 60^{th} and 72^{nd} hour; automatic erasing the oldest message when the number of received messages exceeds the memory capacity;

.6 storage of correctly received messages only (i.e. the error ratio per character is lower than 4 %);

.7 activating an alarm when receiving search and rescue messages;

.8 keeping the information on the areas covered by the service and on the types of messages stored in the equipment memory within 6 h after the supply voltage failure;

.9 presence of at least 32 characters per line in operation of the printer;

.10 reflection of word division in the printed text with automatic line feed;

.11 paper feed after the fully printed message;

.12 printing an asterisk if the character received is distorted.

15.5.13 In the survey of the COSPAS-SARSAT satellite Emergency Position-Indicating Radio Beacon (EPIRB), the following shall be checked and tested:

.1 EPIRB operation on the frequency 406,025 MHz using G1B class of emission without using the satellite system;

.2 satellite EPIRB operation for a period of at least 48 h;

.3 presence of a device for storing the fixed portion of the distress alert using the non-volatile memory;

.4 presence in the EPIRB message of the ship station identity;

.5 EPIRB operation on the frequency 121,5 MHz (for homing) if provided;

.6 operation of the light beacon;

.7 availability of documents confirming the check of a releasing arrangement.

15.5.14 In the survey of the INMARSAT satellite Emergency Position-Indicating Radio Beacon (EPIRB), the following shall be checked and tested:

.1 EPIRB operation in the INMARSAT frequency band;

.2 provision of the EPIRB with the ship's position data for automatic input in the distress alert;

.3 an integral search and rescue radar transponder unless integral facilities for automatic position updating after activation are provided;

.4 the EPIRB without use of the satellite system;

.5 protection of any connection to the EPIRB against an accidental disconnection (e.g. for the purposes of data input or power supply);

.6 transmitting the distress alerting signal during 4 h or at least 48 h if integral facilities for automatic position updating are provided;

.7 operation of any other devices (e.g. of the search and rescue radar transponder, and a flashing light) during at least 48 h;

.8 presence of the ship station identity in the EPIRB message;

.9 availability of documents confirming the check of a releasing arrangement.

15.5.15 In the survey of the VHF EPIRB, the following shall be checked and tested:

.1 transmitting a VHF distress alert and a homing signal by means of a 9 GHz radar transponder;

.2 operation on board without emitting an alerting signal;

.3 continuous operation of the VHF EPIRB from an integral supply source during at least 48 h;

.4 operation on the DSC frequency 156,525 MHz;

.5 emission class G2B;

.6 frequency tolerance which shall not exceed 10×10^{-6};

.7 output power which shall be at least 100 mW;

.8 availability of documents confirming the check of a releasing arrangement.

15.5.16 In the survey of the radar transponder, the following shall be checked and tested:

.1 radar transponder operation;

.2 activation by unskilled personnel;

.3 presence of means to prevent inadvertent activation;

.4 presence of a visual and/or audible means to indicate normal operation, and activation by a radar;

.5 manual activation and deactivation;

.6 indication of a stand-by condition;

.7 drop from a height of 20 m into water without damage;

watertightness at a depth of 10 m during 5 min;

watertightness at a drastic temperature change by 45 °C during immersion;

buoyancy if not being an integral part of the survival craft;

a buoyant lanyard suitable for use as a tether;

presence of a smooth external surface to prevent damage to the survival craft;

.8 operation at the stand-by condition within 96 h and in the emission mode during 8 h being continuously interrogated by radar pulses;

.9 operability at a temperature from – 20 °C to + 55 °C (storage at a temperature from — 30 °C to + 65 °C);

.10 transponder operation at a distance of at least 5 nautical miles when interrogated by a radar of which the aerial is installed at a height of 15 m, and at a distance of at least 30 nautical miles when interrogated by an airborne radar with at least 10 kW pulse power at a height of 1000 m;

.11 availability of operating instructions and an expiry date of battery service;

.12 yellow/orange painting all over the surface.

15.5.17 In the survey of the two-way VHF radiotelephone apparatus, the following shall be checked and tested:

.1 a possibility to be operated by unskilled personnel wearing gloves, and a possibility to handle with one hand (except for channels change);

.2 withstanding drops onto a hard surface from a height of 1 m;

.3 watertightness at a depth of 1 m during 5 min;

.4 watertightness at a drastic temperature change by 45 °C during immersion;

.5 appliance for fastening to clothes;

.6 operation on the frequency 156,800 MHz (channel 16) and at least on one additional channel;

.7 emission class G3E;

.8 availability of an on/off switch provided with a visual indication that the radiotelephone is switched on;

.9 a manual volume control, squelch (mute) control and channel selection switch;

.10 determining channel 16 selection in all ambient light conditions;

.11 minimum output power of a transmitter 0,25 W;

.12 device for reducing power down to 1 W or less if the ouput power of the transmitter exceeds 1 W;

.13 senitivity of a receiver which shall be equal to or better than 2 μV emf for a SINAD ratio of 12 dB;

.14 operability at a temperature from — 20 °C to +55 °C and storage at a temperature from — 30 °C to +65 °C;

.15 operation during 8 h at the highest rated power with a duty cycle 1:9;

.16 availability of a brief operating instruction and an expiry date for the primary battery;

.17 availability for service in 5 s after switching on.

15.5.18 In the survey of the satellite radio communication facilities equipment, the following shall be checked:

.1 correspondence of technical parameters (range of frequencies and isotropic power, deviations of the carrier frequency of a transmitter, as well as of sensitivity and the noise temperature of a reception channel);

.2 priority of distress and safety transmissions;

.3 operation from a transitional emergency source of electrical power;

.4 operation in the direct printing telegraphy or telephony mode.

15.5.19 Additional checks and tests of radio equipment of other kinds excepting those listed in 15.5.2 to 15.5.18 are specified in examination of technical documentation including test programmes. In all cases, their scope shall be sufficient for assessing its fitness for use according to its purpose.

15.5.20 Following the performance of all the checks and tests specified in 15.3.4 and 15.5, a product is provided with a Register document established by a supervision form.

15.6 SCOPE OF PROTOTYPE AND/OR PILOT SPECIMEN SURVEYS

15.6.1 Technical supervision of development, manufacture and tests for prototypes and/or pilot specimens of radio equipment products shall be carried out by surveying which provides for:

.1 examination and approval of the technical design of the product being submitted as part of the documents specified in 1.3.4, Part IV "Radio Equipment" of Rules for the Equipment of Sea-Going Ships;

.2 review and approval of technical conditions (for a prototype);

.3 review and approval of programs and methods for bench tests and shipboard trials;

.4 performance of external and internal technical inspections of prototypes;

.5 performance of bench tests and shipboard trials;

.6 updating of technical documentation according to the results of prototype testing at steady production.

15.6.2 In the survey of the prototype, the following technical documents shall be submitted:

.1 approved technical design;

.2 approved program of bench tests;

.3 technical specification and operating instruction;

.4 documents confirming prototype readiness for surveying;

.5 documents confirming performance of periodical checks of measuring and test equipment by competent bodies;

.6 documents confirming positive results of special tests (e.g. of spark-proofness) conducted by competent bodies.

15.7 GENERAL INSTRUCTIONS ON SURVEYING PROTOTYPES AND/OR PILOT SPECIMENS

15.7.1 To assess operational reliability of prototypes and/or pilot specimens in continuous operation within the time specified in Rules for the Equipment of Sea-Going Ships, the following shall be checked:

.1 selection of components setting an operation mode;

.2 availability of devices for check measurements and malfunction diagnosis;

.3 availability of the necessary reserve on the time of continuous operation, as well as of spare parts.

15.7.2 The completeness of the product prototype shall be checked in accordance with 15.4.6.

15.7.3 In external and internal inspections supplementing those specified in 15.4.7 and 15.4.8, the following product charateristics and parameters shall be checked:

.1 maintainability:

free access to unit and block components for inspection and measurements;

automation of the process for detection of failures and malfunctions;

a possibility to replace removable components, parts or blocks in a simple and easy way without use of special devices and tools;

recovery of product parameters after replacing components, parts or blocks;

.2 availability of appliances to reliably secure the product: clamps welded to the product, brackets or bolts with use of shock-absorbers when needed;

.3 access to all alive parts (excepting aerial entries and earthing wires) only after the opening-up of a case, as well as;

absence of high voltage on insulated mounting wires relative to other wires or the product case;

availability of a device for automatic discharging of capacitors in high voltage circuits when the case is opened up;

.4 an opportunity to test the functioning of radio apparatus with the case opened up:

availability of high voltage protection;

an opportunity to close the case only after high voltage is switched off;

.5 arrangement of boards, blocks and devices with components having essential heat release, absence of their negative interaction or absence of their adverse effect on other radio equipment of the panel or set. The temperature of radio apparatus cases during operation under normal environ-mental conditions is not to exceed 50 °C;

.6 screening of high frequency devices, components and sections in order to eliminate or attenuate undesirable effects of some circuits on the functioning of the other ones, and to reduce dielectric losses, as well as:

strength of the electric connection of cable metal shielding with a case of apparatus;

reliability of mechanical securing of metal housings and cables on the case of apparatus;

.7 availability of earthing grips on all cases of radio apparatus; it is necessary therewith to make sure that the number of grips and their location are adequate to remove high-frequency voltage from the cases;

.8 availability of locking devices acting in both directions to prevent falling-out of unfixed folding and sliding frames of the product;

.9 presence on the product of clear inscriptions, coloured marks of distress frequencies, generally accepted symbols indicating their purpose and functioning of controls which shall be distinguishable at a distance of 700 mm at the normal acuity of vision and normal illuminance;

.10 arrangement of product controls, their proper and reliable fitting:

arrangement of controls on the faceplate of a case and remote control panel;

the most convenient use in relation to operational conditions;

design dependability and simplicity;

dominance of the main controls compared with the additional ones (the non-operative controls of operational means of radio communication may be placed on interior panels of apparatus);

protection of controls against mechanical damages when the face panel is put on the plane surface;

"up", "away from an operator" and "right" positions of control handles, turning of the handles clockwise and pressing of upper and right-hand buttons for correspondance to the positions "ON", "Start", "increase", etc;

"down", "to an operator" and "left" positions of control handles, turning of the handles counterclockwise and pressing of lower and left-hand buttons for correspondance to the positions "OFF", "Stop", "decrease", etc;

reliability of all controls (button switches, potentiometers, regulating elements) design preventing the spontaneous change of a set position;

readily accessible test terminals and fuses;

.11 adequate protection of internal parts against mechanical damages, ingress of water and dust depending on the radio equipment location, as well as:

dependability of a product case which shall be of a stamped, cast, welded or riveted design. Walls (panels) screwing or bolting is allowed only when specially agreed with the Register;

case proofness with air dust-protective filters;

tightness of panels, doors, joints, gaskets, etc. fit to the case;

.12 opening-up of apparatus, swing and slide-out frames, detachable panels and doors fitted to its case using no tools, as well as:

functioning of rotary locks, stop catches and etc. which prevent potential blocks or frames fallling-out from radio equipment cases;

securing devices of detachable or swing panels and frames of the product which ensure their reliable joint and precise fixing preventing damages to connectors when blocks are rearranged;

provision of threaded connections used in anchoring wires (wire harnesses) of the internal wiring with special means which prevent their getting loose and allow repeated nuts and screws loosening;

.13 ensuring the removal of electronic blocks and boards, the unmating of plug connections,

their proper connecting or switching on; in this case, the following shall also be checked:

structural measures to prevent potential improper connecting or switching on;

no voltage at projecting contacts of detachable connections when disconnected;

.14 ensuring the measures preventing the potential occurrence of damages to the radio equipment circuit and structure due to the wrong sequence of controls handling or the change of power source polarity; no fuse burning or automatic protection activating is therewith admitted;

.15 ensuring the conditions preventing earthing (earth fault) of the ship's mains and batteries in the radio equipment circuit;

.16 provision of MF and MF/HF radio transmitters with an artificial aerial.

15.8 SURVEYING PROTOTYPES AND/OR PILOT SPECIMENS OF SINGLE KINDS OF PRODUCTS

15.8.1 The prototype and/or pilot specimen of the single kind of a radio equipment product shall be surveyed in the full compliance with the requirements set forth in 15.3 to 15.7 and, additionally, in accordance with the requirements of this Chapter.

15.8.2 The prototypes of the transmitters mentioned in 15.5.2 shall be checked and tested for:

.1 frequency tolerance at any point of each range of the transmitter intended for operation within one or two side bands;

.2 the value of any spurious emission power being delivered to the aerial feeder of the transmitter operating within the frequency range of less than 30 MHz;

.3 the degree of carrier suppression for emission classes H3E, R3E and J3E which shall be less than the peak power of the transmitter by 6, 18 ± 2 and 40 dB respectively;

.4 the power of unwanted emissions supplied to a transmitting aerial on any spot frequency while operating at a full peak power using emission classes H3E, R3E and J3E;

.5 the modulation frequency of the transmitter operating on the emission class H2A which shall be 450 Hz to 1350 Hz;

.6 the audio-frequency bandwidth of transmitters operating on emission classes H3E, R3E and J3E which shall range from 350 Hz to 2700 Hz with amplitude tolerance not exceeding 6 dB;

.7 the depth of transmitters modulation;

.8 operation for standard artificial aerials of transmitters;

.9 the level of radio interference produced by the transmitter with a push-to-talk switch open; the level shall be within the set standards;

.10 other characteristics and parameters essential for the normal operation of the transmitter depending on its type and purpose as provided by Rules for the Equipment of Sea-Going Ships.

15.8.3 Surveying prototypes and/or pilot specimens of the receivers mentioned in 15.5.3, the following shall be checked and tested:

.1 availability of electric lighting (panel lighting);

.2 protection against mechanical damages;

.3 the value of backward radiation intensity;

.4 frequency tolerance under normal environmental conditions (that tolerance caused by all destabilizing

factors is determined during mechanical and environmental tests);

.5 protection against the high-frequency voltage induced, and thunderstorm protection;

.6 the level of low-frequency background at the receiver output;

.7 efficiency of screening and filtering;

.8 frequency drift due to voltage changes in the circuit;

.9 power taken off from the ship's mains or other source;

.10 other characteristics and parameters essential for the normal operation of the receiver depending on its type and purpose as provided by Rules for the Equipment of Sea-Going Ships.

15.8.4 Surveying portable two-way VHF radiotelephone apparatus, the following shall be checked and tested:

convenient single-handed operation of the apparatus, the device for its attachment to the clothing;

strength of the hull, its watertightness and resistance to seawater effect;

a possibility to quickly select a channel and its distinguishability;

a possibility to determine channel 16 in all ambient light conditions;

apparatus operability during 8 h.

15.8.5 Surveying prototypes and/or pilot specimens of radio stations mentioned in 15.5.6, the following shall be checked and tested:

.1 conformity of receiver and transmitter ranges, availability of the necessary channels on fixed frequencies for duplex and simplex communication, with the requirements of Rules for the Equipment of Sea-Going Ships and with dedicated frequencies;

.2 conformity of the following electrical characteristics of a transfer channel with the requirements of Rules for the Equipment of Sea-Going Ships:

output peak power to the artificial aerial required on distress and call frequencies;

output peak power to non-standard artificial aerials at various sections of the range used;

irregularity of a frequency-modulation characteristic;

a mode of reduced power;

frequency deviation under normal environmental conditions with due regard for the destabilizing factors effect;

availability of devices for periodic frequency correction;

attenuation of a carrier, low side band, unwanted emissions regarding the peak power;

an emission bandwidth at various types of emissions.

15.9 SINGLE KINDS OF PROTOTYPE AND/OR PILOT SPECIMEN TESTS

15.9.1 Prototypes and/or pilot specimens of a product, additionally to the specified in 15.7 and 15.8, shall be tested for product stability as to the effects of mechanical and environmental factors in the scope and with use of the techniques given in Appendix 1.

15.9.2 Bench tests shall be carried out according to the Register approved program taking into account the requirements for the tests and their procedure set forth in Appendix 1, or the requirements and test procedures provided by other Register approved technical normative documents provided that the level of such tests is not inferior to that in Appendix 1.

15.9.3 The bench tests shall confirm that the product can endure:

.1 vibrations, shocks, inclinations and wind loads;

.2 raised and lowered temperatures, increased humidity, water drops, splashes and jets, hoarfrost and dew, fungous mould attacks and other effects according to test standards.

15.9.4 When required by the Register, the radio equipment pilot specimens may be subjected to operational tests on board a ship if, according to the definition of a pilot specimen given in Section 1, Part I "General Regulations for Technical Supervision", they are of radically new design and were not previously used on board a ship, or cannot be adequately checked on the test bed as specified in 15.9.7. As this takes place, such specimens shall not generally be used as standard products required by Rules for the Equipment of Sea-Going Ships.

15.9.5 During testing on board a ship, the following shall be checked:

.1 transmitters functioning with ship's actual aerials – for a distance of communication with ship and coast radio stations on the frequencies of all ranges and using all the types of emission;

.2 quality of receiver reception – across all the ranges in simplex and duplex exchanges using all the types of emission;

absence of man-made interference from electrical and other ship's equipment and of radio interference due to operation of the ship's proper transmitters, radars and radio stations;

.3 radio stations for all the purposes – for functioning as per 15.9.5.1 and 15.9.5.2, as well as for operation being supplied from the complete sources of energy including the emergency and stand-by ones (if provided);

.4 a radio beacon – for tightness, as well as for the service life of a source of energy;

.5 command broadcast apparatus operating at its most and at the minimum volume in ship's spaces, corridors and on decks;

arrangement of the main broadcasting (deck, service, passenger) lines;

.6 equipment of satellite radio communication facilities – for operability of a self-testing system and for automatic activation of an audio and/or visual alarm when an aerial fails to track the satellite;

the alarm of supply loss or switching-on of the emergency source of electrical power.

15.9.6 When required by the Register, prototypes may be subjected to tests on board a ship for those characteristics and parameters which could not be completely or adequately confirmed in bench tests.

15.9.7 At the Surveyor's discretion, the tests on board the ship for the radio equipment product prototypes supervised by the Register since the stage of steady production may be ignored if their design and the electrical characteristics of the prototype are basically the same and correspond to the known prototypes effectively used in ships.

15.10 REGISTER DOCUMENTATION

15.10.1 With the positive results of radio equipment products surveys at steady production, as specified in 15.3 to 15.5, documents according to Section 3, Part I "General Regulations for Technical Supervision" are executed for each product (or batch).

15.10.2 Following the surveys of the prototype and/or test specimens, as specified in 15.6 to 15.9, the report on an established form is drawn up which contains the results of checks and tests performed and the conclusion on the possibility to carry out tests on board the ship, as specified in 15.9.5, and the recommendations on further manufacturing the products.

15.10.3 With the positive results of radio equipment product prototypes surveys, as specified in 15.6 to 15.9, and the tests (if planned) on board the ship carried out, Type Approval Certificate shall be issued for the products according to Section 6, Part I "General Regulations for Technical Supervision".

APPENDIX 1

STANDARDS AND METHODS OF RADIO EQUIPMENT TESTING

1 General.

1.1 This Appendix contains the minimum requirements imposed upon bench tests of sea-going ships radio equipment.

1.2 The equipment tested according to these requirements is considered to have passed the test if it meets the conditions specified in Appendix 1. The scope of bench tests at various production stages is given in Table 1.2.

2 Definitions and explanations.

2.1 Vibration resistance of equipment means a capability of equipment to function under conditions of vibration with its parameters remaining within the set limits.

2.2 Shock resistance of equipment means a capability of equipment to withstand a destroying action of impacts with its parameters remaining within the set limits following the impacts effect.

2.3 Wind resistance of equipment means a capability of equipment to withstand a destroying action of the maximum wind force, which is likely to occur in operational conditions, with its parameters remaining within the set limits following the wind effect.

2.4 Heat stability of equipment means a capability of equipment to function at the highest ambient air temperature, which is likely to occur in operational conditions, sustaining no damages and with its parameters remaining within the set limits.

2.5 Cold endurance of equipment means a capability of equipment to function at the lowest ambient air temperature, which is likely to occur in operational conditions, sustaining no damages and with its parameters remaining within the set limits.

2.6 Humidity resistance of equipment means a capability of equipment to function under the highest relative humidity conditions, which are likely to occur in service, sustaining no damages and corrosion, and with its parameters remaining within the set limits.

2.7 Corrosion resistance means a capability of metal products to withstand corrosion when attacked by a salt solution.

2.8 Fungus resistance means a product capability to withstand the growth of fungus mold in the environment infected with mold fungi.

Table 1.2

Nos.	Equipment propertieis to be checked in testing	Equipment for installation in ships		
		in internal spaces	on open deck	portable
1.	Protection	++	++	++
2.	Vibration resistance and resonance	++	++	++
3.	Vibration resistance on one frequency	+++	+++	+++
4.	Shock resistance[1]	+	+	+
5.	Resistance to motions	+	+	+
6.	Wind resistance[1]	—	+	+
7.	Heat stability	++	++	++
8.	Cold endurance	++	++	++
9.	Resistance to hoarfrost and dew[1,2]	—	+	+
10.	Humidity resistance	++	++	++
11.	Corrosion resistance	+	+	+
12.	Fungus resistance	—	+	+
13.	Resistance to temperature changes	—	—	++
14.	Solar radiation resistance	—	—	+
15.	Oil resistance	—	—	+
16.	Electromagnetic compatibility (EMC)	++	++	++
17	Magnetic compass safe distance	++	++	++
18	Electromagnetic radiofrequency radiation	++	++	++
19	Emission from visual display unit (VDU)	++	++	++
20	X-radiation level	++	++	++
21	Acoustic noise level	++	—	++

Symbols:
"+" = pilot specimen testing;
"++" = pilot specimen and prototype testing;
"+++" = tests of pilot specimen and prototype products at steady production.

[1] Depending on the kind of equipment, its location and the ship's sea area, mechanical tests for shock resistance on a shock table and for wind resistance, as well as environmental tests for hoarfrost, dew and fungus resistance may be subject to special consideration by the Register.

[2] If all the types and kinds of accessories, components and materials being part of equipment have passed the tests for fungus resistance, the tests for the latter of the equipment as a unit can be omitted.

2.9 Normal environmental conditions are the conditions featuring the combination of the following ambient air parameters:

temperature 25 ±10 °C;

relative humidity 20 to 75 %.

2.10 Standard environmental conditions are the conditions featuring the combination of the following ambient air parameters:

temperature 20 ±1 °C;

relative humidity 65 ±2 %.

2.11 Protection of equipment means a degree of personnel protection against touching live parts inside an enclosure, a degree of protection of the equipment integrated in the enclosure against the penetration of solid foreign objects, and also a degree of protection of the equipment inside the enclosure against the ingress of water.

2.12 Radiated emissions mean the emissions radiated by an equipment enclosure (except for the direct radiation of aerial devices of the equipment).

2.13 Conducted emissions mean the emissions produced by equipment at terminals connecting the supply network.

Note. When standard environmental conditions cannot be maintained at the beginning and end of equipment tests for heat stability, cold endurance, humidity resistance and fungus resistance, equipment parameters may be measured under normal environmental conditions. However the difference between ambient air parameters at the beginning and end of tests, where possible, shall not exceed the tolerances specified for the standard environmental conditions.The deviations from the standard values of temperature and humidity due to test conditions shall be specified in a test report.

3. Mechanical tests of equipment.

3.1 Tests of equipment for vibration resistance and resonance.

The equipment of sea-going ships shall display vibration resistance and pass tests according to the following procedure:

Table 3.1

Nos.	Sequence, conditions and standards of tests	Value
1.	Installation of equipment on a vibration table, starting and measuring parameters	—
2.	Holding equipment under vibration conditions within the set frequency range in three mutually perpendicular directions relative to a product:	
	frequency range of vibrations of the table platform, Hz	2 — 100
	amplitude for frequencies from 2 Hz to 13,2 Hz, mm	±1
	acceleration for frequencies from 13,2 Hz to 100 Hz, m/s²	7
3.	Measuring parameters during tests	—
4.	Removal of equipment from the table, measurement of parameters, turn-off and inspection	—

The equipment shall be installed on the table in the normal operational position on standard shock absorbers, if any. During testing the equipment shall be operating under the normal environmental conditions.

The rate of frequency change shall be sufficient to detect the presence of resonance in single parts of the equipment, as well as to check and record the pertinent parameters, but not more than two octaves per minute. Passage over the full frequency range shall take not less than 30 min.

In vibration testing, the resonance frequencies on which product parameters deteriorate shall be hunted for. If the resonances with an amplitude two and more times that of the nominal amplitude of the table platform vibrations are detected, a prolonged test on each resonance frequency during 2 h shall be performed.

If no resonances are detected, the prolonged test shall be performed on a frequency of 30 Hz in accordance with 3.2. The equipment is considered to have passed the tests if it has the same parameters and sustains no damages during tests and after their completion.

3.2 Tests of equipment for vibration resistance on one frequency.

Tests of equipment for vibration resistance on one frequency are carried out for detecting gross manufacturing defects that may be tolerable in a production process. The tests shall be carried out according to the following procedure:

Table 3.2

Nos.	Sequence, conditions and standards of tests	Value
1.	Installation of equipment on a vibration table, starting and measuring parameters	—
2.	Holding equipment under vibration conditions on one frequency in three mutually perpendicular positions:	
	vibration frequency of the vibration table platform, Hz	30
	acceleration, m/s^2	7
	duration, h	2[1]
3.	Measuring parameters during tests	—
4.	Removal of equipment from the table, measurement of parameters, turn-off and inspection	—

Note. The equipment shall be installed on the table without shock absorbers. During testing the equipment shall be operating under normal environmental conditions.

The equipment is considered to have passed the tests if it has the same parameters and sustains no damages during tests and after their completion.

[1] The time for testing production models at steady production may be reduced to 30 min and the test may be performed in one normal working position.

3.3 Tests of equipment for shock resistance.

The equipment of sea-going ships shall display shock resistance and pass tests according to the following procedure:

Table 3.3

Nos.	Sequence, conditions and standards of tests	Value
1.	Installation of equipment on a shock table, starting, measuring parameters and turn-off	—
2.	Holding equipment on the shock table under bumping conditions sequentially in three mutually perpendicular positions:	
	shock frequency of the shock table platform, shock/min	40 — 80
	acceleration, m/s^2	100

Table 3.3 — continued

Nos.	Sequence, conditions and standards of tests	Value
	duration of a shock pulse, ms	10 — 15
	total number of shocks	min 1000
3.	Removal of equipment from the table, starting, measurement of parameters, turn-off and inspection	—
4.	Shock resistance testing by a drop:	
	onto a hard surface from a height, m	1
	total number of drops	6
	into the water from a height, m	20
	total number of drops	3
5.	Starting the equipment after tests, measuring parameters, turn-off and inspection	—

[1] Tests are carried out for two-way VHF radiotelephone apparatus only.

[2] Tests are carried out for VHF and satellite emergency radio beacons and radar transponders only.

In testing, the equipment shall be inoperative. Depending on the type of the shock table, the equipment tests shall be carried out according to one of the following ways:

alternately in three mutually perpendicular positions on a single – component table;

in two mutually perpendicular positions on a two – component table;

in a normal working position on a three – component table. The minimum number of shocks may be reduced by 1/3 when the two – component table is used, and by 2/3, for the three – component table.

The tests on the shock table shall be generally conducted on standard shock absorbers, if any. However, testing the inclined equipment, the standard shock absorbers may be replaced by rubber or other means selected so as to provide the same static deflection as the standard shock absorbers.

The two – way VHF radiotelephone apparatus shall withstand additional shock resistance tests conducted by its drop onto a hard surface from a height of 1 m.

In these tests, the effect of equipment free fall onto a ship's deck is simulated.

The test surface shall be of solid hard wood of at least 150 mm thick and of at least 30 kg in mass. The height of the lowest point of equipment relative to the test surface at the instant of the drop shall be 1000 ± 10 mm.

Six drops shall be provided in tests: one drop for each side of the equipment. Following the tests, measurements of parameters and the inspection of the equipment for the presence of external damages shall be performed.

Emergency radio beacons and radar transponders shall withstand additional shock resistance tests being dropped into the water from a height of 20 m.

In these tests, the effect of free fall of the equipment from a ship's deck into the water is simulated.

The height of the lowest point of equipment relative to the water surface at the instant of the drop shall be 20 ± 1 m.

Three drops shall be made during tests. Each one shall be performed from the different initial position of equipment. Following the tests, measurements of parameters and the inspection of the equipment for the presence of external damages and for the break of leakproofness shall be performed.

The equipment is considered to have passed the tests if it retains its parameters, strength and tightness after tests completion.

3.4 Tests of equipment for resistance to motions and prolonged inclinations.

The equipment of sea-going ships shall display resistance to motions and prolonged inclinations and pass tests according to the following procedure:

Table 3.4

Nos.	Sequence, conditions and standards of tests	Value
1.	Installation of equipment on a stand, starting and measuring parameters	—
2.	Holding equipment in motions conditions sequentially in two mutually perpendicular positions and measuring parameters in each position:	
	limiting angle of inclination to the vertical, deg	45
	motions period, s	7...9
	duration of tests in each position, min	min 5
3.	Holding equipment sequentially in two mutually perpendicular inclined positions and measuring parameters in each position:	
	angle of inclination to the horizontal, deg	45
	duration of tests in each position, min	min 3
4	Removal of equipment from the stand, measurement of parameters, turn-off and inspection	—

In testing, the equipment shall be operative under normal environmental conditions. The equipment shall be installed on a special stand using standard shock absorbers and shall be tested in two mutually perpendicular normal working positions.

The equipment is considered to have passed the tests if it retains its parameters and sustains no damages during tests and after their completion.

The tests of equipment for motions and prolonged inclinations resistance may be omitted if the equipment has passed shock resistance tests on the single component shock table in three mutually perpendicular positions.

3.5 Tests of equipment for wind resistance.

The equipment and all the aerials designed for operation on ship's open decks shall display wind resistance and pass tests according to the following procedure:

Table 3.5

Nos.	Sequence, conditions and standards of tests	Value
1.	Installation of equipment on a stand in a normal working position, starting, measurements of parameters and turn-off	—
2.	Air blowing of the equipment alternately from eight horizontal directions in every 45 s at a certain speed:	
	speed of air flow, m/s	60[1]
	duration of tests at each of eight air flow directions, min	5
3.	Termination of air supply, starting, measurements of parameters, turn-off and inspection	—

[1] An air flow speed for aerials of the two-way VHF radiotelephone apparatus is 29 m/s, for emergency radio beacons, 51 m/s (100 kn).

In testing, the equipment shall be inopertive.

The equipment is considered to have passed the tests if it retains its parameters and sustains no damages after tests completion.

4 Environmental tests of equipment.

4.1 Tests of equipment for heat stability.

The equipment of sea-going ships shall have heat stability and pass tests according to the following procedure:

Table 4.1

Nos.	Sequence, conditions and standards of tests	Value for equipment designed for operation		
		in internal spaces	on open deck	portable
1.	Installation of equipment in a heating chamber, starting and holding under standard environmental conditions, h	0,2 — 2	0,2 — 2	0,2 — 2
2.	Measurements of parameters under standard environmental conditions	—	—	—
3.	Temperature rise in the chamber up to the working one:			
	rate of temperature rise, °C/min	0,5 — 3	0,5 — 3	0,5 — 3
	working temperature, °C	55 ± 3	55 ± 3	55 ± 3
	relative humidity, %	$\leqslant 20$	$\leqslant 20$	$\leqslant 20$
4.	Holding the equipment at the working temperature, h	10 — 16	10 — 16	10 — 16
5.	Measurements of parameters at the working temperarature and turn-off	—	—	—
6.	Temperature rise in the chamber up to the limiting temperature:			
	rate of temperature rise, °C/min	0,5 — 3	0,5 — 3	0,5 — 3
	working temperature, °C	70 ± 3	70 ± 3	70 ± 3
	relative humidity, %	$\leqslant 20$	$\leqslant 20$	$\leqslant 20$
7.	Holding the equipment at the limiting temperature, h	10 — 16	10 — 16	10 — 16

Table 4.1 — continued

Nos.	Sequence, conditions and standards of tests	Value for equipment designed for operation		
		in internal spaces	on open deck	portable
8.	Rate of decrease of temperature in the chamber down to the standard one, °C/min	0,5 — 3	0,5 — 3	0,5 — 3
9.	Holding the equipment under standard environmental conditions, h	2 — 6	2 — 6	2 — 6
10.	Starting and holding the equipment under standard environmental conditions, h	0,2 — 2	0,2 — 2	0,2 — 2
11.	Measurements of parameters under standard environmental conditions, equipment turn-off and inspection	—	—	—

The equipment is considered to have passed the tests if it retains its parameters and sustains no damages during tests and after their completion.

4.2 Tests of equipment for cold endurance.

The equipment of sea-going ships shall display cold endurance and pass tests according to the following procedure:

Table 4.2

Nos.	Sequence, conditions and standards of tests	Value for equipment designed for operation		
		in internal spaces	on open deck	portable
1.	Installation of equipment in a cooling chamber, starting and holding under standard environmental conditions, h	0,2 — 2	0,2 — 2	0,2 — 2
2.	Measurements of parameters under standard environmental conditions and turn-off	—	—	—
3.	Temperature decrease in the chamber down to the working one:			
	rate of temperature decrease, °C/min	1 — 2	1 — 2	1 — 2
	working temperature, °C	-15 ± 3	-40 ± 3	-20 ± 3
4.	Holding the equipment at the working temperature, h	10 — 16	10 — 16	10 — 16
5.	Starting, measurements of parameters at the working temperarature and turn-off	—	—	—
6.	Temperature decrease in the chamber down to the limiting one:			
	rate of temperature decrease, °C/min	1 — 2	1 — 2	1 — 2
	limiting temperature, °C	-60 ± 3	-60 ± 3	-30 ± 3
7.	Holding the equipment at the limiting temperature, h	2	2	10 — 16
8.	Rate of temperature rise in the chamber up to a standard temperature, °C/min	0,5 — 3	0,5 — 3	0,5 — 3

Table 4.2 — continued

Nos.	Sequence, conditions and standards of tests	Value for equipment designed for operation		
		in internal spaces	on open deck	portable
9.	Holding the equipment under standard environmental conditions, h	3 — 4	3 — 4	3 — 4
10.	Starting and holding the equipment under standard environmental conditions, h	0,2 — 2	0,2 — 2	0,2 — 2
11.	Measurements of parameters under standard environmental conditions, equipment turn-off and inspection	—	—	—

The equipment is considered to have passed the tests if it retains its parameters and sustains no damages during tests and after their completion.

4.3 Tests of equipment for hoarfrost and dew resistance.

All the equipment designed for installation on open decks of sea-going ships shall pass tests for hoarfrost and dew resistance according to the following procedure:

Table 4.3

Nos.	Sequence, conditions and standards of tests	Value
1.	Installation of equipment in a cooling chamber, starting and holding:	
	temperature, °C	-20 ± 5
	duration, h	2
2.	Removal of equipment from the chamber, starting and holding under normal environmental conditions; in so doing, equipment parameters are measured immediately after starting and every 30 – 60 min:	
	holding duration, h	3
3.	Turn-off and inspection	—

The equipment is considered to have passed the tests if it retains its parameters within the set limits and sustains no damages.

4.4 Tests of equipment for humidity resistance.

The equipment of sea-going ships shall display humidity resistance and pass tests according to the following procedure:

Table 4.4

Nos.	Sequence, conditions and standards of tests	Value for equipment designed for use in internal spaces and on open deck
1.	Installation of equipment in a humidity cabinet, starting and holding under standard environmental conditions, h	0,2 — 2
2.	Measurements of parameters under standard environmental conditions and turn-off	—
3.	Raising relative humidity in the cabinet up to an operating one: operating relative humidity, %	95 ± 3
4.	Raising a temperature in the cabinet up to the working one: operating temperature, °C	40 ± 2
5.	Holding the equipment at operating values of temperature and relative humidity, h	10 — 6
6.	Starting, measurements of parameters at operating values of temperature and relative humidity, h	2
7.	Decreasing the temperature and humidity in the cabinet down to those for standard environmental conditions, h	1
8.	Measurements of parameters under standard environmental conditions, equipment turn-off and inspection	—

The equipment is considered to have passed the tests if it retains its parameters and sustains no damages during tests and after their completion.

4.5 Tests of equipment for corrosion resistance.

Metal parts of equipment for sea-going ships shall be corrosion-resistant and pass tests according to the following procedure:

Table 4.5

Nos.	Sequence, conditions and standards of tests	Value
1.	Inspection of equipment and its installation into a chamber	—
2.	Holding the equipment in the chamber at cyclic spraying of salt solution (sea fog): temperature in chamber, °C	25 ± 10
	solution composition, parts by weight: NaCl	5 ± 1
	distilled water	95
	duration of solution spraying, h	2
3.	Holding the equipment in the chamber: temperature in chamber, °C	40 ± 2
	relative humidity in chamber, %	90 — 95
	holding duration, days	7
4.	Recurrence of operations in items 2 and 3, total number	4
5.	Removal of equipment from the chamber and inspection	—

In testing, the equipment shall be inoperative. The equipment is considered to have passed the tests if it retains its parameters and sustains no damages after tests completion.

4.6 Tests of equipment for fungus resistance.

The equipment of sea-going ships shall display fungus resistance and pass tests according to the following procedure.

Prior to testing, the equipment shall be held at a temperature of 60 ± 2 °C during 6 h and then kept under standard environmental conditions during 1 to 6 h for inspection and measurements of parameters. Equipment tests shall be carried out in the environment infected with fungus mold in the absence of lighting and air movement. The mold makes up a suspension composing of the mixture of mold fungus spores of which the names are given in Table 4.6. The wort or Chapek – Dox's synthetic medium is recommended for use as a nutrient solution to grow mold fungi.

The sterilized nutrient solution in Petri dishes along with the equipment disconnected from power sources is placed into a test chamber and sprayed, using a pulverizer with an outlet diameter of at least 1 mm, with the suspension of mold fungus spores on the basis of 50 ml of the suspension for 1 m^3 of the chamber payload volume. Following the spraying, a temperature of 20 ± 5 °C and relative humidity of 95 to 98 % are set in the test chamber.

The equipment is held in these conditions during 48 h. If no mold growth thereafter is observed in check Petri dishes, the repeated spraying of the dishes and equipment with a viable suspension of mold fungus spores and repeated holding during 48 h shall be carried out. If mold growth is observed in the check dishes, a temperature in the chamber is raised up to 29 ± 1 °C at relative humidity of 95 to 98 % and the equipment is hold under such conditions during 28 days. Thereafter the equipment is kept under standard environmental conditions for 24 h followed by inspection and measurements of parameters.

Table 4.6

Nos.	Spore	Strain	Typical culture	Properties
1.	Aspergillus niger	v. Tieghem	ATCC. 6275	Grows on many materials, resistant to copper salts
2.	Aspergillus terreus	Thom	PQMD. 82j	Affects plastics
3.	Aureobasidium pullulans	(DE Barry) Arnaud	ATCC. 9348	Affects paints and varnishes
4.	Paecilomyces varioti	Bainier	JAM. 5001	Affects plastics and leather
5.	Penicillium funicu-losum	Thom	JAM. 7013	Affects many materials,
6.	Penicillium ochrochloron	Biourge	ATCC. 9112	Textile materials in particular Resistant to copper salts
7.	Scopulariopsis brevicaulis	(Sacc) Bain Var. GIabra	JAM. 5146	Affects rubber
8.	Trichoderma viride	Thom Pers. Ex Fr.	JAM. 5061	Affects cellulose, textile, plastics

The equipment is considered mold resistant if no fungus mold focuses, or single germinating spores only are seen on it with a 50X magnifying glass.

4.7 Tests of equipment for resistance to temperature changes.

The tests for the effect of temperature changes define a capability of portable equipment to properly operate after a sudden immersion into water being previously at a high temperature. The equipment shall pass tests according to the following procedure.

The equipment to be tested is placed in a chamber having a temperature of 70 ± 3 °C for 1 h. Thereupon it is immersed into the water having a temperature of 25 ± 3 °C to a depth of 100 ± 5 mm for 1 h. Following the tests, the equipment shall be checked for the presence of moisture and damages, whereupon measurements of parameters are carried out under normal environmental conditions in accordance with the manufacturer's instructions.

4.8 Tests of equipment for solar radiation resistance.

To be tested is the portable equipment designed for operation on an open deck and which will fully or partially be exposed to solar radiation while in service. The tests are performed according to the following procedure.

The equipment is exposed during 80 h to continuous irradiation from the source simulating solar radiation. The irradiation intensity is to provide the total heat –flux density (1120 ± 10 %) W/m^2 with spectral power distributed according to Table 4.8.

Table 4.8

Spectral region	Ultra-violet B	Ultra-violet A	Visible spectrum			Infrared
Range width, μm	0,28 — 0,32	0,32 — 0,4	0,4 —0,52	0,52 — 0,64	0,64 —0,78	0,78 — 3,0
Radiation intensity, W/m^2	5	63	200	186	174	492
Tolerance, %	±35	±25	±10	±10	±10	±20

After testing, equipment parameters are measured with the following turn-off and inspection of the equipment. No signs of equipment damages (designation strips inclusive) shall be detected.

4.9 Tests of equipment for oil resistance.

The test applies to portable equipment only and is performed according to the following procedure.

The equipment to be tested is immersed into the mineral oil having a temperature of 19 ± 5 °C for 3 h.

The oil parameters:

aniline point = 120 ± 5 °C ;

flash point = min 240 °C;

viscosity = 10 – 25 cSt at t = 99 °C.

The following types of oil can be used for this purpose:

A5TM oil No. 1;

A5TM oil No. 5;

ISO oil No. 1.

After testing, the equipment is cleaned of oil, its parameters are measured with the following turn-off and inspection of the equipment.

The results are considered satisfactory if technical characteristics are consistent with the initial ones, and no indications of mechanical damages, cracking, swelling and dissolution are detected on the very equipment.

5. Tests for equipment protection.

The tests for equipment protection are defined by a degree of equipment enclosure protection. The degree of equipment protection is denoted by letters IP and two characteristic numerals: the first characteristic numeral defines the degree of equipment protection against access to dangerous parts inside the equipment enclosure, as well as against penetration inward of foreign hard objects;

the second characteristic numeral defines the degree of equipment protection against ingress of water.

A certain degree of protection denoted by the first characteristic numeral may be applied to equipment if that numeral simultaneously corresponds to all the lower degrees of protection. In this case, the tests for determining the correspondence with a particular lower degree of protection may be ignored if the results of such tests are obviously satisfactory.

5.1 Protection against access to dangerous parts of equipment and penetration of foreign hard objects.

The description of degrees of protection against access to dangerous parts of equipment, against penetration of foreign hard objects and the methods of appropriate tests performance are given in Table 5.1.

Table 5.1

First characteristic numeral	Degree of protection against access to dangerous parts of equipment		Degree of protection against penetration of foreign hard objects	
	Brief description	Tests	Brief description	Tests
0	No protection	Tests not needed	No protection	Tests not needed
1	Protected against access with the back of one's hand to dangerous parts	Rigid ball 50 mm in diameter[1] shall not touch dangerous parts of equipment at a force of 50 N ± 10 %	Protected against external hard objects ⩾ 50 mm in diameter	Rigid ball 50 mm in diameter[1] shall not fully penetrate at a force of 50 N ± 10 %

First characteristic numeral	Degree of protection against access to dangerous parts of equipment		Degree of protection against penetration of foreign hard objects	
	Brief description	Tests	Brief description	Tests
2	Protected against access with a finger to dangerous parts	Test link pin (refer to fig. 5.1-1) 12 mm in diameter and 80 mm long shall not touch dangerous parts of equipment	Protected against external hard objects ⩾ 12,5 mm in diameter	Rigid ball 12,5 mm in diameter[2] shall not fully penetrate at a force of 30 N ± 10 %
3	Protected against access with tools to dangerous parts	Rigid steel rod 2,5 mm in diameter[1] shall not penetrate inside the equipment enclosure at a force of 3 N±10 %	Protected against external hard objects ⩾ 2,5 mm in diameter	Rigid steel rod 2,5 mm in diameter[1] shall not either fully or partially penetrate at a force of 3 N ± 10 %
4	Protected against access with wire to dangerous parts	Rigid steel wire 1,0 mm in diameter[1] shall not penetrate inside the equipment enclosure at a force of 1 N±10 %	Protected against external hard objects ⩾ 1,0 mm in diameter	Rigid steel wire 1,0 mm in diameter[1] shall not either fully or partially penetrate at a force of 1 N ± 10 %
5	Protected against access with wire to dangerous parts	Rigid steel wire 1,0 mm in diameter[1] shall not penetrate inside the equipment enclosure at a force of 1 N±10 %	Protected against dust	Dust penetration not fully prevented, but its amount shall be inadequate to upset the normal functioning of equipment or to impair its safety
6	Protected against access with wire to dangerous parts	Rigid steel wire 1,0 mm in diameter[1] shall not penetrate inside the equipment enclosure at	Dust-proof	Dust does not penetrate the enclosure

[1] The diameter may only be increased by a value which is less or equal to 0,05 mm.
[2] The diameter may only be increased by a value which is less or equal to 0,2 mm.

Test conditions.

A testing article is pressed to or inserted into every hole in the equipment enclosure.

The test for dust effect is carried out with use of a special dust chamber of which the main design and key details are shown in Fig. 5.1-2. In so doing, a dust-circulating pump may be replaced by any other device maintaining talcum powder in suspension in the closed testing chamber. The talcum powder used shall pass through sieve having a square mesh dimensioned 75 μm and wire 50 μm thick.

The amount of talcum powder is taken 2 kg per 1 m^3 of the testing chamber volume. In testing, the air volume equal to 80 enclosure volumes shall be circulated through the enclosure at a rate of air renewal not more than 60 enclosure volumes per hour. In this case, a vacuum value measured with a manometer shall not excced 2 kPa (20 mbar) (Fig. 5.1-2). The test lasts for 2 h at a rate of air change from 40 to 60 volumes per hour.

The protection corresponding to the first characteristic numeral 5 is considered satisfactory if the check evidences that talcum powder is not accumulated in such an amount or a place wherein the ingress of dust of any other kind could upset the normal functioning of equipment or effect the safety requirements. Excepting special cases specified in standards for the particular kind of a product, dust shall not be accumulated in places where it may cause tracking (formation of current conducting tracks) on creepage paths.

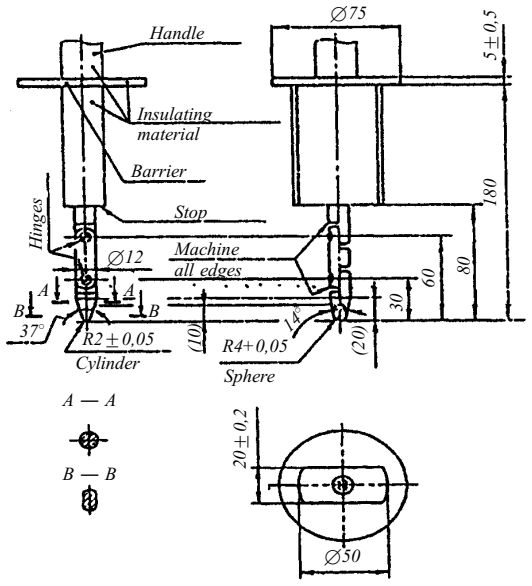


Fig. 5.1-1
Test link pin

Note. Linear dimensions are given in mm. If not specified in Figure, the tolerances are as follows: for angles – from 0′ to 10′, for linear dimensions up to 25 mm – from 0 to 0,05 mm, and over 25 mm, ±0,2 mm.

Two hinges shall ensure mobility in the same plane and direction at an angle of 90° to tolerances from 0 to + 10°

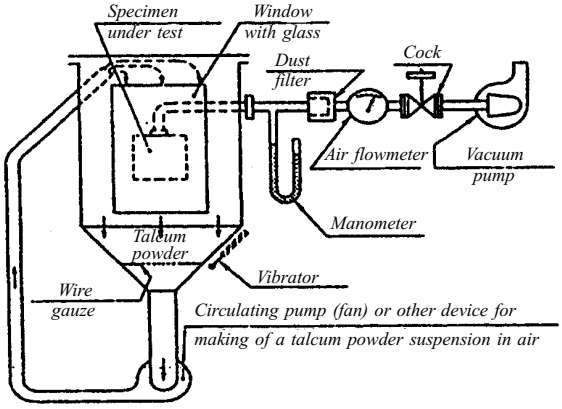


Fig. 5.1-2
Device for checking dust protection (a dust chamber)

The protection corresponding to the first characteristic numeral 6 is considered satisfactory if no dust deposits are found inside the enclosure after tests completion.

5.2 Protection against ingress of water.

The description of degrees of protection against ingress of water and the methods of appropriate tests performance are given in Table 5.2-1.

Test conditions.

Fresh water is used in testing.

In testing for characteristic numerals from 1 to 7, the water temperature shall not differ from the temperature of the specimen under test by more than 5 °C. If the water temperture is below the specimen temperature by more than 5 °C, the pressure in the enclosure shall be equalized.

Table 5.2-1

Second characteristic numeral	Degree of protection against ingress of water	
	Brief description	Tests
0	No protection	Tests not needed
1	Protected against water drops falling vertically	Equipment in a normal working position is exposed to vertically falling water drops from a tank through holes in its bottom arranged at nodes of an imaginary net with a mesh dimensioned 20 mm. The area of the bottom shall be larger than that of the equipment being tested. Rain intensity shall be 1 mm/min[1] during 10 min.
2	Protected against vertically falling water drops when equipment is deflected from the vertical through an angle up to 15°	Tests are performed in a similar way as for the first characteristic figure with the alternate deflection of a product from the vertical position through an angle of 15° to any sides. Rain intensity makes up 3 mm/min[1] during 2,5 min for each inclined position.
3	Protected against water like raining	Equipment in a normal working position is poured over with water: 1) from a swinging pipe deflecting from the vertical through angles ±60° (Fig. 5.2-1); a water flow rate is 0,07 l/min ±5 % through one hole multiplied by a number of holes in the pipe; duration of a full swing (2 × 120°) shall be about 4 s; after 5 min testing, the equipment is turned through an angle of 90° in a horizontal plane and the tests are continued for 5 min more; 2) or by spraying at an angle of ±60° to the vertical (Fig. 5.2-2); a water flow rate is 10 l/min ±5 %; test duration is determined from 1 min per 1 m² of the surface of the equipment tested, but at least 5 min.
	Protected against continuous spraying with water	Tests are performed in a similar way as in item 3 of Table, but the equipment is sprayed on all sides.
4 **5**	Protected against streams of water	Equipment is poured over with water on all sides from a fire nozzle having a nozzle diameter of 6,3 mm with a delivery rate of 12,5 l/min ±5 % from a distance of 2,5 to 3,0 m.Test duration is determined from 1 min per 1 m² of the surface of the equipment tested, but at least 3 min.
6	Protected against powerful water jets	Equipment is poured over with water on all sides from a fire nozzle having a nozzle diameter of 12,5 mm with a delivery rate of 100 l/min ±5 % from a distance of 2,5 to 3,0 m.Test duration is determined from 1 min per 1 m² of the surface of the equipment tested, but at least 3 min.
7	Protected against the effects of temporary (short) immersion in water	Equipment is immersed in a tank filled with water. If the equipment is less than 850 mm high, the lowest point of the equipment enclosure shall be 1 m below the water surface. If the equipment height is equal or over 850 mm, the highest point of the equipment enclosure shall be 150 mm below the water surface. Test duration is 30 min.
	Protected against the effects of prolonged immersion in water	Equipment is immersed in a tank filled with water. The water level and test duration are determined by agreement with the equipment manufacturer. The test conditions therewith shall not be inferior to those for characteristic numeral 7.

[1] Rain intensity may only be increased by a value which is less or equal to 0,5 mm/min.

During tests, moisture inside the enclosure may partially condense. The condensate accumulated shall not to be confused with the water infiltrating into the enclosure from outside during testing.

Following tests, the equipment shall be checked for the ingress of water inside it.

The permissible amount of water that may infiltrate inside the enclosure depends on the type of equipment. When such is the case, the following shall be prevented:

break of the normal functioning of equipment and of its safety;

accumulation of water on electroinsulated parts where water may cause tracking (formation of current conducting tracks) on creepage paths;

ingress of water to live parts or windings not designed for operating in damp conditions;

accumulation of water at cable entries or penetration inside the cables.

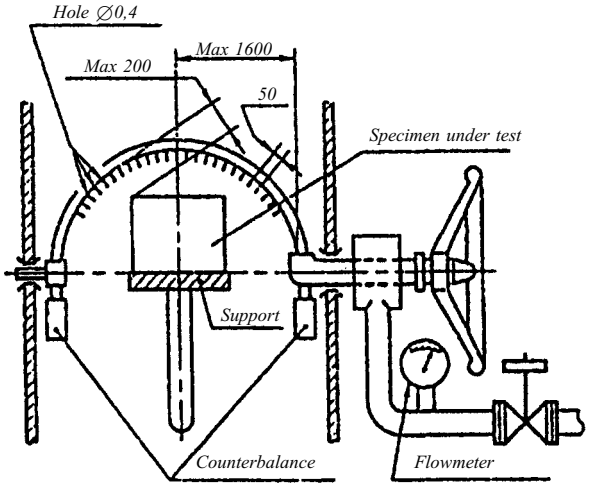


Fig. 5.2-1
Arrangement for checking protection against raining and water spraying (a swinging pipe), dimensions are given in mm

Note. 121 holes of 0,5 mm in diameter, one hole is at the centre; 12 holes at an angle of 30° in each of two inside circles, and 24 holes at an angle of 15° in each of four outside circles. The screen is made of aluminium, the sprayer, of brass.

If the enclosure has drain holes, the inspection shall ensure that the infiltrating water does not accumulate in the enclosure and can run out through those holes without damages to the equipment.

A swingning pipe shall have holes arranged in an arc of 60° on each side from the centre. The table for installation of the enclosure shall be of a gridwork structure.

The number of holes and water flow rate are specified in Table 5.2-2.

Table 5.2-2

Pipe radius R, mm	Protection degree IPX3		Protection degree IPX4	
	Number of holes, N[1]	Full water flow rate, l/min	Number of holes, N[1]	Full water flow rate, l/min
200	8	0.56	12	0,84
400	16	1,1	25	1,8
600	25	1,8	37	2,6
800	33	2,3	50	3,5
1000	41	2,9	62	4,3
1200	50	3,5	75	5,3
1400	58	4,1	87	6,1
1600	67	4,7	100	7,0

[1] Depending on the actual arrangement of hole centres, the number of holes may be increased by one hole.

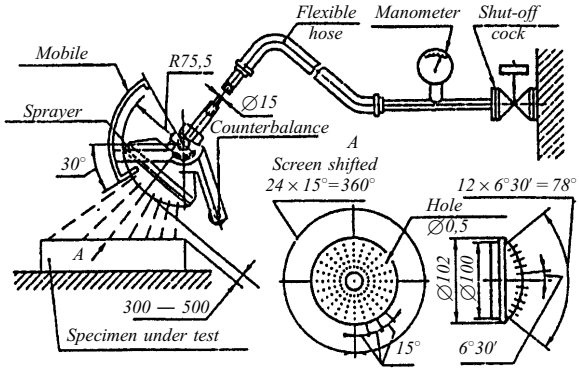


Fig. 5.2-2
Portable arrangement for checking protection against raining and water spraying (a sprayer), dimensions are given in mm

6. Tests for electromagnetic compatibility (EMC).

6.1 Tests for the level of unwanted electromagnetic emission.

The scope of tests for the level of unwanted electromagnetic emission is specified in Table 6.1.

Table 6.1

Nos.	Equipment propertieis to be checked in testing	Equipment for installation in ships		
		in internal spaces	on open deck	portable
1.	Level of conducted emissions voltage	+	+	—
2.	Level of radiated emissions field strength	+	+	+

During tests, the equipment shall operate under normal test conditions, and the setting of controls affecting the level of emissions shall be varied in order to ascertain the maximum emission level. If the equipment has more than one energized state, for example operation, stand-by, etc., the state which produces the maximum emission level shall be ascertained, and full measurements for that state shall be made. The aerial connection of the equipment shall be terminated in a non-radiating artificial aerial. Equipment including a transmitter shall be in the operational state, but not the transmitting state for radiation emission tests.

6.1.1 Tests for level of conducted emissions voltage.

These tests measure any signals generated by equipment which appear on its power supply port and which can, therefore, be conducted into the ship's mains, and potentially disturb other equipment.

The voltage level for conducted emissions generated by radio equipment at the power supply terminals shall not exceed the limits shown in Fig. 6.1.1.

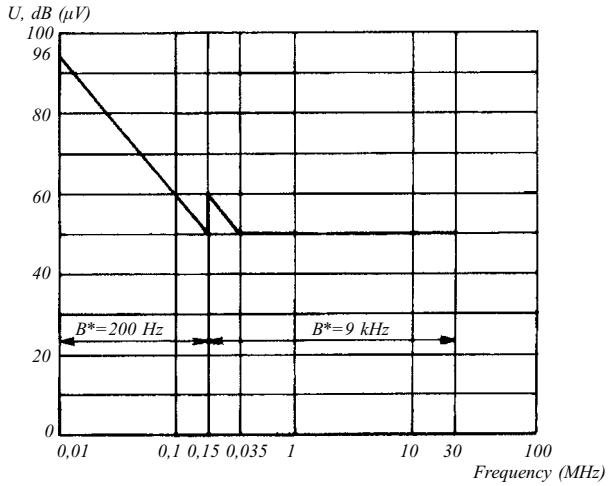


Fig. 6.1.1
Radiofrequency terminal voltage limits U for conducted emissions.
B^* — measuring receiver bandwidth

The emission shall be measured by means of the quasi-peak measuring receiver. The measuring bandwidth of the receiver in the frequency range 10 kHz to 150 kHz shall be 200 Hz, and in the frequency range 150 kHz to 30 Mz shall be 9 kHz.

The power input cables between the a.c. and d.c. power ports of the equipment under test and the artficial mains network shall be screened and not exceed 0,8 m in length. If the equipment under test consists of more than one unit with individual a.c. and/or d.c. power ports, power ports of identical supply voltage may be connected in parallel.

Measurements shall be made with all measuring equipment and the equipment under test mounted on, and bonded to, an earthed plane. Where provision of an earthed plane is not practicable, equivalent arrangements shall be made using the metallic frame or mass of the equipment under test as the earth reference.

6.1.2 Tests for level of radiated emissions field strength.

These tests measure any signals radiated by an equipment (other than through an aerial) which can potentially disturb other equipment on the ship, such as radio receivers.

The level of field strength for radiated emissions generated by the radio equipment at a distance of 3 m from its enclosure shall not exceed the limits shown in Fig. 6.1.2.

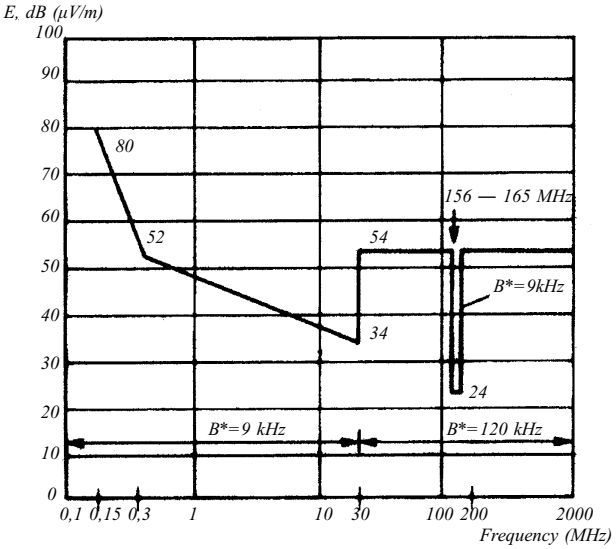


Fig. 6.1.2
Limiting values of field strength E measured at a distance of 3 m from an enclosure for radiated emissions from enclosure ports.
B^* — measuring receiver bandwidth

The quasi-peak measuring receiver shall be used for measurements. The receiver bandwidth in the frequency ranges 150 kHz to 30 MHz and 156 MHz to 165 MHz shall be 9 kHz, and in the frequency ranges 30 MHz to 156 MHz and 165 MHz to 2 GHz is to be 120 kHz.

For frequencies from 150 kHz to 30 MHz, measurements shall be made of the magnetic field. The measuring aerial shall be a loop aerial of the dimension so that the aerial can be completely enclosed by a square having sides of 60 cm in length, or an appropriate ferrite-rod aerial.

The correction factor for the aerial shall include the factor + 51,5 dB to convert the magnetic field strength to equivalent electric field strength.

For frequencies above 30 MHz, measurements shall be made of the electric E field. The measuring aerial shall be a balanced dipole, a shortened dipole or high-gain directional aerial.

The dimension of the measuring aerial in the direction of the equipment under test shall not exceed

20 % of its distance from that equipment. At frequencies above 80 MHz, it shall be possible to vary the height of the centre of the measuring aerial above the ground over a range of 1 m to 4 m.

The test site shall have an earthed metal plane. The equipment under test shall be fully assembled, complete with its associated interconnecting cables and mounted in its normal plane of operation.

When the equipment under test consists of more than one unit, the interconnecting cables (other than microwave) between the main and all other units shall be of the maximum length as specified by the manufacturer. Available input and output ports shall be connected to the maximum length cable as specified by the manufacturer, and terminated to simulate the impedance of the ancillary equipment to which they are normally connected.

The excess length of these cables shall be bundled at the approximate centre of the cable with bundles 30 cm to 40 cm in length running in the horizontal plane from the port to which they are connected. If it is impractical to do so because of cable bulk or stiffness, the disposition of the excess cable shall be as close as possible to that required.

The test aerial shall be placed at a distance of 3 m from the equipment under test. The centre of the aerial shall be at least 1,5 m above the earthed plane. The E-field aerial shall only be adjusted in height and rotated to give horizontal and vertical polarisation, the one being parallel to the ground, in order to determine the maximum emission level. Finally, the aerial is either to be moved around the equipment under test, again in order to determine the maximum emission level, or, alternatively, that equipment may be placed on a plane orthogonal to the test aerial at its mid-point and rotated to achive the same effect.

6.2 Immunity to electromagnetic environment. Methods of testing and required test results.

For these tests, the equipment under test shall conform to its normal operational configuration, mounting and earthing arrangements and to operate under normal test conditions.

For the tests of immunity to electromagnetic environment, the results are evaluated against performance criteria relating to the operating conditions and functional specifications of the equipment under test, and defined as follows:

performance criterion A: the equipment under test shall continue operating as intended during and after the test. No degradation of performance or loss of function is allowed, as defined in the relevant equipment standard and in the technical specification published by the manufacturer;

performance criterion B: the equipment under test shall continue operating as intended during and after the test. No degradation of performance or loss of function is allowed, as defined in the relevant equipment standard and in the technical specification published by the manufacturer. During the test, degradation or loss of function or performance, which is selfrecoverable, is however allowed, but no change of actual operating state or stored data is allowed;

performance criterion C: temporary degradation or loss of function or performance is allowed during the test, provided the function is self-recoverable, or can be restored at the end of the test by the operation of the controls, as defined in the relevant equipment standard and in the technical specification published by the manufacturer.

The scope of tests for immunity to electromagnetic environment is given in Table 6.2.

Table 6.2

Nos.	Equipment propertieis to be checked in testing	Equipment for installation in ships		
		in internal spaces	on open deck	portable
1.	Immunity to conducted low-frequency interference	+ performance criterion A	+	—
2.	Immunity to conducted radiofrequency interference	+ performance criterion A	+	—
3.	Immunity to radiated radiofrequency interference	+	+ performance criterion A	+
4.	Immunity to nanosecond pulse interference due to fast transients on a.c. power, signal and control lines	+ performance criterion B	+	—
5.	Immunity to microsecond pulse interference due to slow transients on a.c. power lines	+ performance criterion B	+	—
6.	Immunity to power supply short-term variation	+ performance criterion B	+	—
7.	Immunity to power supply failure	+ performance criterion C	+	—
8.	Immunity to electrostatic discharge	+	+ performance criterion B	+

If the equipment includes a radio receiver, then frequencies on which the equipment is intended to operate, together with any known received spurious responses, are excluded from the immunity tests for conducted and radiated interference.

6.2.1 Immunity to conducted low-frequency interference.

This test simulates the effects of power supply harmonics on a.c. supplies, and alternator ripple on d.c. supplies. This test is not applicable for the equipment under test intended for operation from battery power sources.

The equipment shall maintain its operability (performance criterion A) when the following test voltages are superimposed on the power lines in the frequency range from 50 Hz to 10 kHz:

for d.c.-powered equipment — a sinusoidal r.m.s. voltage of amplitude 10 % of the nominal supply voltage;

for a.c.-powered equipment — a sinusoidal r.m.s. voltage of amplitude which varies depending on frequency according to Fig.6.2.1.

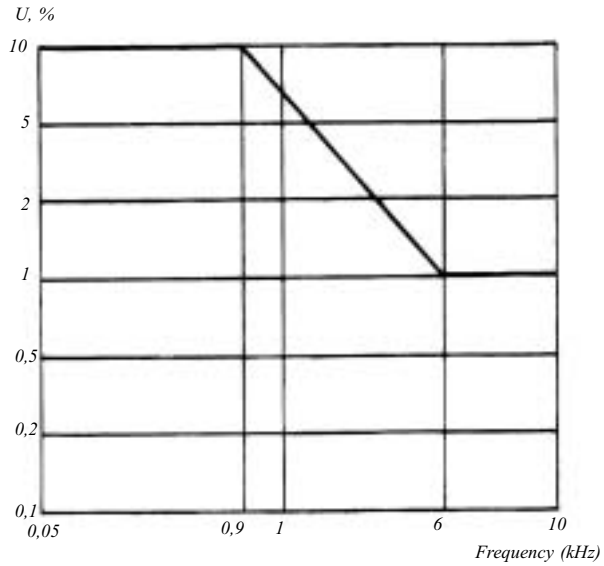


Fig. 6.2.1
Test voltage for immunity to conducted low-frequency interference
In single cases, the maximum applied power to the supply lines may be limited to 2 W

6.2.2 Immunity to conducted radiofrequency interference.

This test simulates the effects of disturbances induced in power, signal and control lines from switching power supplies, engine ignition noise, echo sounders and ship's radio transmitters at frequencies below 80 MHz.

The equipment under test shall be placed on an insulating support of 0,1 m height above an earthed reference plane. The cables connected to the equipment under test shall be provided with appropriate coupling and decoupling devices located at a distance of 0,1 m to 0,3 m from the equipment.

The test shall be performed with the test generator connected in turn to each of the coupling and decoupling devices. In this case, the other non-excited RF input ports to the coupling and decoupling devices are terminated by an equivalent having noninductive impedance equal to the cable wave impedance. The test generator shall be set for each coupling and decoupling device with the auxiliary equipment and the equipment under test disconnected and replaced by noninductive resistors of appropriate values (for cable impedance of 50 Ω, additional values are to make up 150 Ω). The test generator shall be set so that it provides an unmodulated E.M.F. at the port of the equipment under test of the required test level.

The test shall be carried out with the following test levels:

3 V r.m.s. amplitude swept over the frequency range 10 kHz to 80 MHz;

10 V r.m.s. amplitude at spot frequencies: 2 MHz, 3 MHz, 4 MHz, 6,2 MHz, 8,2 MHz, 12,6 MHz, 16,5 MHz, 18,8 MHz, 22 MHz and 25 MHz.

The modulation during testing shall be at 400 Hz $\pm$10 % to a depth of 80 % $\pm$10 %.

The frequency sweep rate shall not exceed $1{,}5 \times 10^{-3}$ decades/s in order to allow for the detection of any malfunction of the equipment under test.

6.2.3 Immunity to radiated radiofrequency interference.

This test simulates the effects of radio transmitters at frequencies above 80 MHz, such as the ship's VHF transmitter and hand-held portable radios, close to the equipment.

The equipment under test shall be installed in a suitably shielded room or anechoic chamber of a size commensurate with the size of the equipment. The equipment under test shall be set in the area of uniform field and insulated from the floor by a dielectric support. The test shall be carried out in all orientations (on all sides) of the equipment.

If the wiring to and from the equipment under test is not specified, unshielded parallel conductors shall be used, and left exposed to the electromagnetic fields for a distance of 1 m from the equipment.

The frequency range shall be swept at a rate in the order of $1{,}5 \times 10^{-3}$ decades/s, and shall be slow enough to allow the detection of any malfunction of the equipment. Any sensitive frequencies or frequencies of dominant interest shall be separately analyzed in testing.

The equipment shall retain its operability (performance criterion A) when placed in a modulated electric field of strength 10 V/m swept over the frequency range 80 MHz to 1 GHz.

The modulation shall be at 400 Hz $\pm$10 % to a depth of 80 % $\pm$10 %.

6.2.4 Immunity to nanosecond pulse interference due to fast transients on a.c. power, signal and control lines.

This test simulates the fast, low-energy transients produced by equipment switching which causes arcing at contacts.

The equipment shall retain its performance (performance criterion B), when pulses of the following characteristics are applied to its power, control and signal lines:

rise time: 5 ns (at the level of 10 % to 90 % of an amplitude)

width: 50 ns (at the level of 50 % of an amplitude)

amplitude: 2 kV differential on a.c. power lines (input in power supply lines relative to an enclosure) and 1 kV common mode on signal and control lines (input in signal and control lines using the capacitive tongs)

repetition rate: 5 kHz (1 kV), 2,5 kHz (2 kV)

application: 15 ms burst every 300 ms

duration: 3 min to 5 min for each of positive and negative polarity pulses.

6.2.5 Immunity to microsecond pulse interference due to slow transients on a.c. power lines.

This test simulates the slow, high-energy surges produced by thyristor switching on a.c. power supplies.

The equipment shall retain its performance (performance criterion B), when pulses of the following characteristics are applied to its power lines:

rise time: 1,2 μs (at the level of 10 % to 90 % of an amplitude)

width: 50 μs (at the level of 50 % of an amplitude)

amplitude: 2 kV line/earth, 1 kV line/line

repetition rate: 1 pulse/min

duration: 5 min for each of positive and negative polarity pulses.

6.2.6 Immunity to power supply short-term variation.

This test simulates power supply variations due to large changes in load. This test is not applicable to d.c.-powered equipment.

Power supply variations shall be applied using a programmable power supply.

The equipment shall retain its performance (performance criterion B), when submitted to the following power supply variations relative to nominal values for 10 min:

a) voltage: nominal +(20 ± 1) %, duration 1,5 s ± 0,2 s;

frequency: nominal +(10 ± 0,5) %, duration 5 s ± 0,5 s, superimposed;

b) voltage: nominal — (20 ± 1) %, duration 1,5 s ± 0,2 s;

frequency: nominal — (10 ± 0,5) %, duration 5 s ± 0,5 s, superimposed;

Voltage and frequency variation rise and decay times are to be 0,2 s ± 0,1 s (at the level of 10 % to 90 % of an amplitude).

6.2.7 Immunity to power supply failure.

This test simulates short breaks in the ship's power supply due to power supply changeover and breaker drop-out. This test is not applicable to the equipment intended for operation from battery power sources only.

The equipment shall retain its performance (performance criterion C) after each of three breaks in power supply of duration 60 s. There shall be no corruption of operational software or loss of essential data.

6.2.8 Immunity to electrostatic discharge.

This test simulates the effect of electrostatic discharges from personnel which may occur in environments which cause them to become charged, such as contact with artificial fibre carpets or vinyl garments.

The test shall be carried out using an electrostatic discharge generator, that is an energy storage capacitance of 150 pF and a discharge resistance of 330 Ω connected to a discharge tip. The equipment under test shall be placed on, but insulated from, an earthed metal plane which projects at least 0,5 m beyond the equipment on all sides. Discharges from the generator shall be applied to those points and surfaces which are accessible to personnel during normal usage. During testing, the generator shall be held perpendicular to the surface, and the positions at which discharges can be applied selected by an exploration with 20 discharges per second. Each position shall then be tested with 10 discharges positive and negative with intervals of at least 1 s between discharges to allow for any misoperation of the equipment to be observed. Contact discharge is the preferred method: but air discharge shall be used where contact discharge cannot be applied (for painted surfaces).

To simulate discharges on objects placed or installed near to the equipment under test, 10 single contact discharges, positive and negative, shall be applied to the earthed plane at positions on each side of, and 0,1 m from, the equipment under test.

A further 10 discharges shall be applied to the centre of an earthed plane dimensioned 0,5 m × 0,5 m. This test shall be carried out for all four sides of the equipment. The vertical plane therewith shall be in enough different positions so that the four faces of the equipment are completely illuminated.

The equipment shall retain its performance (performance criterion B), when the test levels are 6 kV contact discharge and 8 kV air discharge.

7. Determination of magnetic compass safe distance.

At each unit of equipment usually located in way of a standard or a steering compass the minimum safe distance between such unit and compass shall be indicated in order to install such unit. Alternatively, the information on the minimum safe distance to magnetic compass may be indicated in the technical documentation for radio equipment, except portable equipment.

The compass-safe distance is defined as the minimum distance between the nearest point of the unit and the centre of compass or magnetometer when a deviation

of the compass is less than 5,4°/*B* for the standard compass and 18°/*B* for the steering compass, where *B*, μT — is the horizontal component of terrestrial magnetic field induction at the place of the equipment testing.

For determination of compass-safe distance the magnetic compass is to be used having the compass card scale interval equal to 0,1°.

During the tests the unpowered equipment is advanced to the magnetic compass till the deviation is equal to 5,4°/*B* (18°/*B*).

Similar tests shall be carried out with the powered equipment.

Further, inspection of the magnetic compass safe distance is performed after magnetization of equipment in the unpowered condition. For magnetization the direct current field is used with the strength 120 A/m with imposition of alternating current field with the frequency 50 Hz and effective strength value of 1430 A/m. In case the testing equipment may be damaged as the result of such influence, action of alternating current field is excluded. Field direction shall be such that the resulting magnetization is the greatest. Magnetized unpowered equipment shall be advanced to the magnetic compass till the deviation is equal to 5,4 °/B. The distance between the nearest point of equipment and the centre of the compass shall be measured.

During each test the equipment shall be rotated to define the direction where the maximum deviation is revealed.

The greatest distance obtained under all these conditions is the safe distance. Distances shall be rounded up to the nearest 5 or 10 cm.

8. Determination of electromagnetic radiofrequency radiation.

Radio equipment which is designed to radiate electromagnetic radio frequency energy at frequencies above 30 MHz shall not produce dangerous E-field level at the work places.

Power flux density or the corresponding electromagnetic field strength shall be measured at the distance 0,2 m from the units of radio transmitters, feeder components and switching devices.

Measurements shall be performed at the level: 0,5; 1; 1,7 m from the floor. Depending of the particular conditions of the equipment arrangement the measurements may be performed at other levels also.

Equipment shall be operated at the maximum radiant power.

In case the measured value of flux density of electromagnetic field power exceed 10 and 100 W/m^2, the measurements shall be repeated at greater distance from the equipment. A number of measuring points shall be sufficient for specifying the boundaries of the area corresponding to the said levels. Maximum distances at which power flux density reaches 10 and 100 W/m^2 shall be stated in the technical documentation for the radio equipment.

Measuring of intensity of electromagnetic fields in the frequency range up to 300 MHz shall be carried out by measuring instrumentation intended for determination of root-mean-square value of electromagnetic field strength, and within the range from 300 MHz up to 2 GHz – by measuring instrumentation intended for determination of average values of power flux density.

9. Determination of emission from the visual display units.

Visual information display units of radio equipment shall be tested for the level of generated electrostatic, magnetic and electromagnetic fields (except those visual display units where the maximum number of displayed text lines is four).

Radiation from visual display units with the display diagonal size up to 0,5 m shall not exceed the levels given in the Table 9.

Table 9

Parameter to be measured	Frequency range	Maximum admissible values
Electromagnetic field strength at the distance of 30 cm from the front side of the unit	5 Hz — 2 kHz	10 V/m
	2 — 400 kHz	1 V/m
Electromagnetic field strength at the distance of 50 cm from the equipment in every direction	2 — 400 kHz	1 V/m
Magnetic induction at the distance of 30 cm from the front side of the unit	5 Hz — 2 kHz	200 nT
Magnetic induction at the distance of 50 cm in every direction	5 Hz — 2 kHz	200 nT
	2 — 400 kHz	25 nT
Electrostatic field strength at the distance of 10 cm from the front side of the unit	—	5±0,5 kV/m

Measuring of the electrostatic field strength should not be carried out for the units during the operation of which the electrostatic potential doe not exceed 500 V.

While conducting the measurements of the equipment radiation any de-gaussing arrangements shall be switched off. The plane of the display screen is to be positioned vertically, where practicable. Equipment and measurement instrumentation shall be grounded. There shall be at least 50 cm clearance between the equipment to enclosures of the measurement instrumentation and other metal or grounded objects.

Measurements shall be carried out with the powered visual display units when the operator and service controls are placed in the positions enabling the maximum radiation on retention of normal capacity for work. Internal settings not intended for adjustment during the normal operation of the equipment are not considered as service ones. Units provided with the switching of operating modes shall be checked in the modes with the minimum and maximum scanning

frequency. Image brightness shall be set to maximum but not exceeding 100 cd/m. Contrast shall be set so that the background raster is just visible in normal room lighting. The screen shall display the image with the maximum density of information typical for the particular kind of work. The image pattern shall be described in the test report.

Measurements of strength of electromagnetic field and magnetic induction shall be carried out in front of the screen centre of the unit at the distance of 30 cm on the normal from the screen, as well as at the height of the screen centre round the equipment at the distance equal to the sum of the maximum depth of equipment and 50 cm. During the last measurement the measurement probe shall be kept fixed and the equipment shall be rotated around vertical axis. While measuring the strength of electromagnetic field the rotation of the equipment is carried by steps of 90°. While magnetic induction measuring the rotation of the equipment is carried by steps of 45°, and the height of the measurement probe is changed of ± 30 cm from the height of the screen centre.

Electrostatic field shall be measured using the suitable instrument mounted in the centre grounded square $0{,}5 \times 0{,}5$ m metal plate. The plate shall be placed parallel to the plane of the display screen so that the measurement probe is 10 cm from the screen centre.

For the visual display unit with the display diagonal over 0,5 m the measurements of the maximum distance shall be measured, where:

magnetic induction does not exceed 250 nT within the frequency range 5Hz to 2 kHz and 150 nT within the frequency range 2 to 400 kHz;

electric field strength is no more than 15 V/m within the frequency range 5Hz to 2 kHz and 10 V/m within the frequency range 2 to 400 kHz;

electrostatic field strength does not exceed $5 \pm 0{,}5$ kV/m.

These distances are to be specified in the technical documentation for the equipment.

Measurements shall be carried out using the instrumentation with the permissible basic relative error not exceeding ± 20 %.

10. Determination of X-radiation level.

Measurements of X-radiation level are performed for the equipment which might emit X-radiation during its operation (cathode-ray tube, transceiver components, etc.).

None of the equipment shall give rise to a dose rate above 5μJ/kgh (0,5 mrem/h) at 50 cm distance from the surface of the equipment.

Measuring of X-radiation is carried out using the suitable X-ray survey instrument at all typical operating conditions of the equipment. The controls of the equipment effecting the radiation level shall be set in the positions ensuring the maximum radiation. Inspection of the entire surface of the X-radiation source shall be carried out till the maximum radiation intensity is detected. The indicator of the instrument shall be moved at 50 mm distance from the equipment with the speed enabling to record the steady readings of the instrument. For control the measurement results of the natural background radiation power in the area of location of the equipment subject to checking with the switched-off source of radiation. Measurements shall be carried out by the instrumentation with the permissible basic relative error not exceeding ± 20 %.

11. Measuring of acoustic noise level.

During the tests the acoustic pressure level producing by the radio equipment during the operation shall be checked.

Acoustic noise level producing by the radio equipment during the operation (with the audible alarm switched-off) shall not exceed 60 dB (A) at the distance of 1 m from any part of the equipment. Acoustic noise level producing by the audible alarm at the distance of 1 m from the source of radiation shall be within the range of 75 – 85 dB.

Measurements are carried out in the laboratory by means of sound pressure-level meter with the function of frequency response analyzer complying with the IEC 60651 and IEC 60804 requirements, 1-st grade of accuracy, with the frequency response weighted according to "A" type.

APPENDIX 2

STANDARD CONDITIONS FOR DETERMINATION OF TRANSMITTER OR RECEIVER FREQUENCY DEVIATION

The frequency deviation for transmitters or receivers, in Hz, is determined by the formula:

$$\Delta f_{max} = \Delta f_1 + \sqrt{\Delta f_2^2 + f_3^2}$$

where Δf_1 = maximum absolute numerical value of the frequency deviation from the rated one during and after exposure to one of the following destabilizing factors: an elevated temperature, a lowered temperature and increased humidity. The measurements of the frequency deviation from the rated one during and after exposure to the above factors shall be performed at reduced and increased voltage of a primary power source separately for each destabilizing factor;

Δf_2 = maximum numerical value of the frequency deviation during and after exposure to vibrations from the frequency measured prior to the vibrations exposure;

Δf_3 = maximum numerical value of the frequency deviation during and after exposure to impacts from the frequency measured prior to the impacts exposure.

The frequency deviation for transmitters or receivers, in millionth parts, is determined by the formula:

$$(\Delta f/f)_{max} = (\Delta f_1/f_1) + \sqrt{(\Delta f_2/f_2)^2 + (\Delta f_3/f_3)^2}$$

where Δf_1 = maximum absolute numerical value of the frequency deviation from the rated one during and after exposure to one of the following destabilizing factors: an elevated temperature, a lowered temperature and increased humidity. The measurements of the frequency deviation from the rated one during and after exposure to the above factors shall be performed at reduced and increased voltage of a primary power source separately for each destabilizing factor;

f_1 = rated frequency;

Δf_2 = maximum numerical value of the frequency deviation during and after exposure to vibrations from the frequency f_2 measured prior to the vibrations exposure;

Δf_3 = maximum numerical value of the frequency deviation during and after exposure to impacts from the frequency f_3 measured prior to the impacts exposure.

Notes. 1. All frequency measurements shall be carried out after the preliminary warm-up of an exciter thermostat.

2. Frequency trimming during tests is not permitted.

16 NAVIGATIONAL EQUIPMENT

16.1 GENERAL

16.1.1 The provisions of this Section apply in technical supervision of the navigational equipment listed in the RS Nomenclature.

16.1.2 The Section contains the requirements for the technical supervision by the Register during the development and manufacture of the navigational equipment at the manufacturer's.

16.1.3 General provisions concerning the organization of the technical supervision during manufacture of the navigational equipment are set out in Part I "General Regulations for Technical Supervision", those concerning the technical documentation – in Part II "Technical Documentation".

Navigational equipment fitted on board ships shall be of approved type. Certificates drawn up in accordance with Form 6.5.30 (6.5.31) shall be issued on the basis of the Type Approval Certificate in force, or, in exceptional cases (single delivery, non-standard ship, etc.) on agreement with the RHO basing on the survey carried out.

16.1.4 Technical supervision during the development and manufacture of the navigational equipment shall be subdivided into the following stages:

.1 review and approval of the technical documentation within the scope stipulated in 1.3, Part V "Navigational Equipment" of Rules for the Equipment of Sea-Going Ships;

.2 review and approval of the programs and procedures of bench and operational tests;

.3 participation in the bench and operational tests of the pilot sample of the equipment in accordance with the programs approved by the Register;

.4 review and approval of the technical documentation on navigational equipment updated as a consequence of the test results;

.5 survey and test of the equipment prototype according to the program approved by the Register;

.6 survey and test of the equipment at the manufacturer's under stable production conditions according to the program approved by the Register.

16.2 TECHNICAL DOCUMENTATION

16.2.1 When reviewing the technical documentation on the navigational equipment, the compliance of the design and performance of the products with the requirements of Sections 1, 3 and 4, Part V "Navigational Equipment" of Rules for the Equipment of Sea-Going Ships shall be checked.

16.3 TESTING SCOPE AND SURVEYING PROCEDURE OF THE NAVIGATIONAL EQUIPMENT

16.3.1 Scope and procedure of the navigational equipment surveying and testing.

16.3.1.1 The scope of the bench tests of the navigational equipment at different stages of development and manufacture shall comply with the Table 1.2 of Appendix 1.

16.3.1.2 In case of stable production, the scope of testing and the procedure of surveying navigational equipment shall be specified in the list of supervised items in accordance with 11.2, Part I "General Regulations for Technical Supervision".

The list shall be developed on the basis of the requirements of 16.3.4, 16.4 and Table 1.2 of Appendix 1. The surveys at the intermediate stages of the equipment manufacture shall be generally included into the list.

On agreement with the Register, the list shall be updated by the manufacturer based on the Register supervision during installation, mooring and sea tests and use of the navigational equipment on board ships.

16.3.2 Survey of pilot samples.

16.3.2.1 Prior to the test of pilot sample(s), the availability of the following shall be checked:

.1 approved technical documentation;

.2 approved test program;

.3 technical specification and operating manual;

.4 full set of testing equipment with necessary documents confirming its characteristics;

.5 full set of instruments with the documents of the competent bodies, which confirm their metrological ratings;

.6 documents of the competent bodies which confirm positive results of special test types if envisaged by the test program (for spark proofness, resistance to solar radiation, interference immunity, etc.).

16.3.2.2 During the surveys and tests of the pilot sample the compliance of the sample presented with the requirements of Rules for the Equipment of Sea-Going Ships and the approved design shall be identified. Along with that, checks mentioned in 16.3.3, 16.3.4 and 16.4 shall be carried out and bench tests shall be conducted within the scope not less than that specified in 1.2 of Appendix 1.

The results of the bench tests shall be documented as the Register Report and, based on them, the possibility of admitting the product to the operational tests shall be explored.

The tests of the pilot sample (bench and operational) shall be conducted in the presence the Register representative (also refer to Section 1).

16.3.3 Survey of prototypes.

16.3.3.1 Tests and surveys of the prototype shall be carried out in accordance with the program approved by the Register, as a rule, at the manufacturer's within the scope not less than specified in Table 1.2 of Appendix 1. In addition to the checking in 16.3.4.3, the following shall be checked:

.1 operability and functioning of the equipment during and after mechanical and environmental effects and electromagnetic compatibility (EMC) (check for the compliance with the shipboard conditions);

.2 electric strength of the insulation of the circuits supplied from the ship's mains;

.3 operability under fluctuations of the voltage and supply line frequency;

.4 protective enclosure of the equipment;

.5 electric protection throughout the circuit supplied from the ship's mains (if provided);

.6 tests for continuous operation.

Tests shall be conducted in the presence of the Register representative.

Test results shall be documented as the Register Report which shall contain a conclusion on the compliance of the prototype with the requirements of the RS Rules and on the possibility of issuing Type Approval Certificate. When a decision has been taken to issue Type Approval Certificate, the latter shall be drawn up in accordance with the established procedure (refer to Section 6, Part I "General Regulations for Technical Supervision").

16.3.3.2 Periodical tests of the equipment shall be conducted within the scope of the requirements for the prototype (refer to 16.3.3.1).

16.3.4 Survey of the products in case of stable production.

16.3.4.1 Surveys of the navigational equipment in case of stable production shall be performed in accordance with the list (refer to 16.3.1.2) and may be combined with the bench tests of the equipment conducted by the manufacturer.

Test program shall be approved by the Register. Before the Register supervision has been commenced, the enterprise shall be surveyed in accordance with Section 10, Part I "General Regulations for Technical Supervision".

16.3.4.2 Only fully completed products having documents of the manufacturer's inspection body shall be presented for surveying.

16.3.4.3 Bench tests of each product at the manufacturer's shall include the following checks:

.1 check of the documents on the related materials and articles (according to the RS Nomenclature) confirming the Register supervision;

.2 check for the completeness of the facilities and technical documentation;

.3 check for the compliance of the designs with the technical documentation;

.4 external examination of the product and control and monitoring devices;

.5 examination of the interior wiring and marking;

.6 check of the quality of the fixing, locking devices and linking-up of joints;

.7 check of the availability of the protective earthing terminals;

.8 check of the interlocking and protection of the attending personnel against high voltage;

.9 check of operation of the circuits protecting against overload and short-circuits;

.10 check of the insulation resistance;

.11 check of the availability of the instrument and control illumination (where required) regulation;

.12 check of the functioning and operability;

.13 check of the built-in monitoring system (if any);

.14 check of the completeness of the spare parts and interchangeability of the main spare units with the regular ones in the product;

.15 check of the vibration resistance on one frequency (to be performed if necessary);

.16 check of the availability of an inscription indicating safe distance to the magnetic compass (for devices intended to be fitted in the wheel house, unless such information is indicated in the technical documentation on the product);

.17 check of the marking (type, serial number, date of manufacture).

16.4 ADDITIONAL GUIDELINES FOR SURVEYING INDIVIDUAL KINDS OF NAVIGATIONAL AIDS

In addition to the abovementioned surveys and tests common for all kinds of navigational aids, the individual aids and systems cited below shall be checked.

16.4.1 Radars and radar plotting aids (EPA, ATA or ARPA).

During survey of the radars and automatic radar plotting aids (ARPA) on the manufacturer' bench, the following shall be checked and tested:

16.4.1.1 Starting period from the time the power is turned on.

16.4.1.2 Operation of the control and checking devices.

16.4.1.3 Determination of the transmitter peak power.

16.4.1.4 Determination of the receiver sensitivity.

16.4.1.5 Determination of the characteristics:

.1 temporary gain control;

.2 duration of the transmitted pulses on different range scales;

.3 transmitted pulse recurrence rate.

16.4.1.6 Compliance of the range scales with the requirements of the documents.

16.4.1.7 Agreement between the zero reading of the digital range counter and the zero radius of the range ring.

16.4.1.8 Time required to read out the bearing and range with the use of the electronic bearing line and variable range marker.

16.4.1.9 Clear display of the course mark, range rings and possibility of varying the brilliance.

16.4.1.10 Readout of the radar information and other navigational aids and systems.

16.4.1.11 Determination of the maximum and minimum target detection range.

16.4.1.12 Range and bearing resolution of the radar.

16.4.1.13 Performance monitoring. Ease of maintaining, repairing and storing.

16.4.1.14 Operation of the facilities for target acquisition and cancellation (EPA, ATA or ARPA).

16.4.1.15 Operation of the visual and audible signalling (EPA, ATA or ARPA).

16.4.1.16 Period of time during which full plotting information is displayed after changing range scales on which the EPA, ATA or ARPA facilities are available or resetting the display.

16.4.1.17 Test checking of the performance of the EPA, ATA or ARPA facilities with the use of the radar signal simulators and all necessary sensors including evaluation of the accuracy characteristics of the target's motion parameters according to test scenarios.

Check specified in 16.4.1.10 to 16.4.1.12 shall be carried out in the process of operational tests on a special site or on board ship.

16.4.2 Radionavigation system receivers.

During the survey of the receivers of the land-based radionavigation systems operating on the principle of measuring the time and phase difference, the following shall be checked and tested:

16.4.2.1 Facility sensitivity.

16.4.2.2 Operation of the facility on the stipulated spacing frequencies.

16.4.2.3 General gain control.

16.4.2.4 Determination of the root-mean-square error in measurement of the time interval on the signals of the system.

16.4.2.5 Limiting sensitivity in different modes.

16.4.2.6 Instrumental accuracy in the phase difference measurement.

16.4.2.7 Allowable lag error of the readout devices.

16.4.2.8 Root-mean-square error in correlation of the coarse display scale rotation.

16.4.2.9 Sufficiency of the indicator scale illumination.

When surveying the receivers for a satellite global positioning system (GPS) checks and tests for the compliance with the following requirements and documents shall be carried out:

16.4.2.10 The manufacturer's document confirming the possibility for the receiver to operate on new exclusion frequencies defined by the plan of step-by-step modification of the GPS frequency range (for the GLONASS receivers).

16.4.2.11 Ease of maintaining, repairing and storing.

16.4.2.12 Built-in performance test system.

16.4.2.13 Sensitivity of the radio receiving device.

16.4.2.14 Frequency selectivity characteristics of the radio receiving device.

16.4.2.15 Dynamic range.

16.4.2.16 Systems of co-ordinates used and means provided to transform the computed position base upon WGS-84 into another reference system of co-ordinates.

16.4.2.17 Output for transmitting data to other radio and navigational facilities.

16.4.2.18 Susceptibility level of the radio receiving device on the side receiving channels.

16.4.2.19 Interference immunity of the radio receiving device to the effects of interferences in the passband.

16.4.2.20 Interference immunity of the radio receiving device to the pulse interference.

16.4.2.21 Software and information support.

16.4.2.22 Time of receiving the navigational parameters.

16.4.2.23 Accuracy in determination of the navigational parameters.

16.4.3 Standard and spare magnetic compasses, transmitting heading device.

The following shall be checked:

16.4.3.1 Accuracy in indicating course on a stationary base and under motions in all directions.

16.4.3.2 Steps in the card dial graduation and marking.

16.4.3.3 Total error in positioning of the card in any direction (heading) due to inaccuracy in the dial graduation, eccentricity of the card on the pin and inaccuracy in orientation in relation to the magnetic system.

16.4.3.4 Distance at which the card readings may be readily taken with the naked eye.

16.4.3.5 The extent of the card observation sector transmitted to the conning station from the position where the standard compass is installed with the use of geometric or light-fibre optics.

16.4.3.6 Card stagnation (friction error).

16.4.3.7 Deflection of the card from the magnetic meridian when the compass rotates in the horizontal plane.

16.4.3.8 Semi-period of oscillation and time during which the card is brought in alignment with the magnetic meridian in case of forced deflection.

16.4.3.9 Compass bowl inclination angle at which the card retains horizontal position.

16.4.3.10 Free inclination angle of the bowl in gimbal suspension.

16.4.3.11 Limiting values and accuracy in compensation of semicircular, intercardinal, inclination and latitude deviation.

16.4.3.12 Transparency of liquid and absence of air in the bowl.

16.4.3.13 Availability of an inscription in a conspicuous position to warn of the composition and potential hazard for the personnel health, posed by the liquid put into the bowl.

16.4.3.14 Reading accuracy of bearing finder.

16.4.3.15 Agreement in readings of the repeaters and main sensitive element in case of electric remote transmission of dial readings.

16.4.3.16 Error of the device for remote transmission of course when magnetic course is converted in the true course and the latter is transmitted to other navigational equipment (if any).

16.4.3.17 Operability of the signalling system to indicate error in the electric system for remote transmission of course (if any).

16.4.3.18 Hardware and software support to the protection of the device for the compensation of deviation due to unauthorized access.

16.4.3.19 Main, emergency (supplied from accumulator battery) and independent lighting of the card, sufficient to make the dial divisions of the compass card distinctly visible.

16.4.3.20 Provision of an alarm to indicate a failure of the power supply to the compass system and the device for remote transmission of course.

16.4.4 Gyrocompasses.

The following special checks and tests shall be carried out:

16.4.4.1 Time period during which the gyrocompass is brought into alignment with meridian in latitudes up to 60°.

16.4.4.2 Steady state error at any course.

16.4.4.3 Permissible error from one run-up to another.

16.4.4.4 Errors in readings due to rolling up to 20° with a period of 10 ± 1 s, pitching up to 10° with a period of 6 ± 1 s and yawing up to 5° with a period of 15 ± 1 s and the maximum horizontal accelerations not more than 1 m/s^2.

16.4.4.5 Follow-up system performance speed.

16.4.4.6 Divergence in readings between the master compass and repeaters.

16.4.4.7 Possibility of correcting the compass readings in respect to ship speed and latitude.

16.4.4.8 Operability of an alarm to indicate the main faults of the gyrocompass.

16.4.4.9 Possibility of transmitting the information on course to other navigational equipment.

16.4.4.10 Time error in the course recorder reading.

16.4.5 Logs for measuring speed made good through the water and over the ground.

The following shall be checked:

16.4.5.1 Unambiguity of displaying the operation mode and measured parameters by the indicators of the log units when several primary transducers are installed on board ship.

16.4.5.2 Minimum depth of functioning.

16.4.5.3 Range of the speeds to be measured.

16.4.5.4 Initial sensitivity.

16.4.5.5 Error in measuring the ship speed.

16.4.5.6 Error in measuring the distance run through the water.

16.4.5.7 Steps of the readings of the digital displays and electromagnetic distance displays, scale graduation of the analogue speed displays (if any).

16.4.5.8 Effect of the rolling and pitching on the accuracy characteristics of the log.

16.4.5.9 Functioning in the automatic and forced modes of measuring speed through the water and over the ground (if provided).

16.4.5.10 Maximum operating depth (for Doppler sonar speed logs).

16.4.5.11 Structural measures to ensure tightness of the equipment penetrating the hull and signalling system to indicate position of the primary log transducer protruding from the hull.

16.4.5.12 Availability and operability of the arrangements for connecting with other ship equipment.

16.4.5.13 Functioning of an alarm and indication to notify of the faults and operating status of the log (fidelity of readings).

16.4.5.14 Possibility and ease of calibrating and making corrections.

16.4.5.15 Additional servicing potentialities (e.g. signalling system to indicate the preset distance run, mean speed during the assigned time interval, timer, etc.).

16.4.6 Echo sounders.

The following shall be checked:

16.4.6.1 The minimum depth to be measured by echo sounder (in acoustic basin).

16.4.6.2 Compliance of the main performance of the echo sounder with the requirement for measuring the maximum depth (a quantitative integral evaluation of the system indicator of the equipment purpose meeting the requirement for measuring the maximum depth at maximum ship speed and in rolling and pitching shall be made in laboratory conditions).

16.4.6.3 Availability of graphical and digital indication of the depth.

16.4.6.4 Scale ranges.

16.4.6.5 Scale of displaying depths in graphical form (resolution of the graphic display).

16.4.6.6 Intervals between the digital depth indicator readings and agreement thereof with the graphic display.

16.4.6.7 Presentation of servicing information (time marks and their intervals, depth scale graduation marks and their intervals, warning of the termination of the paper tape, if used).

16.4.6.8 Immediate and long-term data record.

16.4.6.9 Instrumental tolerance of the indicated depths on the shallow and deep range scales in digital and graphical indication.

16.4.6.10 Accuracy of operation of the dangerous/ preset depth alarm, limits and discreteness of its setting.

16.4.6.11 Recurrence frequency of the transmissions.

16.4.6.12 Safety of the operator when access to the echogram being recorded is permitted with the echo sounder switched on (if provided).

16.4.6.13 Availability and operability of arrangements for connecting with other ship equipment.

16.4.6.14 Design of the echo sounder transducers with respect to protections (IP).

16.4.6.15 Starting period.

16.4.7 Heading control systems/ Ship's track control systems.

The following shall be checked:

16.4.7.1 Stability of keeping the ship on a preset heading and/or on a preset course line (on special bench with simulators).

16.4.7.2 Adjustment of the sensitivity of the system performance in actuation of the rudder.

16.4.7.3 Limits of the rudder shifting and availability of the rudder stops.

16.4.7.4 Time of changing-over from "automatic" and/or "track" mode and back.

16.4.7.5 Indication of the system operation mode used.

16.4.7.6 An alarm both audible with mute function and visual to indicate when the actual heading and/or track line deviates from the preset heading and/or track beyond a permissible limit as well as to warn about a failure of any information sensor, reduction in the ship speed below the limit necessary for steering the ship.

16.4.7.7 An audible and visual alarm to indicate overloading of the steering gear electric motors and reduction in the power supply to the system.

16.4.7.8 A visual alarm to indicate existence of the power supply to the system and normal operation of the steering gear electric motors.

16.4.7.9 Determination of the disagreement extent between the "preset" – "true" pointers of the rudder indicator in the "follow-up" and "automatic" modes.

16.4.7.10 Manual adjustment of the system in case of absence or failure of the automatic adaptation to the sailing conditions.

16.4.7.11 Functioning of the remote steering stations.

16.4.7.12 Output of the data on the operation mode and performance of the system for automatic recording.

Moreover, the following shall be checked during the tests of the ship's track control system:

16.4.7.13 Information displayed in the analogue and digital form on the system control panel.

16.4.7.14 Monitoring the ship position by another independent positioning system.

16.4.7.15 Actuation of an alarm when approaching the wheel-over and at the moment of manoeuvre starting.

16.4.7.16 Actuation of an alarm where the wheel-over was not acknowledged by the navigator.

16.4.7.17 Possibility of modifying a waypoint when the track was changed or a new track was plotted.

16.4.7.18 Possibility of sailing from one point to another at the preset turn radius and at the design radius basing on a preset ship turning motion pattern (if any).

16.4.8 Integrated navigation systems (INS).

During the bench tests the following shall be checked:

16.4.8.1 Interface between the INS information processing unit and its integrated display and the navigational information sensors.

16.4.8.2 Availability of the duplicated equipment ensuring safe ship control.

16.4.8.3 Extent of functions performed according to the A, B or C categories.

16.4.8.4 Scope of information displayed permanently and on the operator's demand.

16.4.8.5 Availability of protection against operator's errors during data input.

16.4.8.6 Continuous automatic monitoring of the incoming information through comparison of the readings of two different independent sensors.

16.4.8.7 Audible and visual alarm to be actuated on failure of the connected information sensors and data processing system.

16.4.8.8 No impact of the data processing unit failure on the operation of the sensors.

16.4.8.9 Possibility of the manual input of data.

16.4.8.10 System for recording every case of alarm operation and possibility for the officer on watch to confirm such operation.

16.4.9 Ship control desks.

The following shall be checked:

16.4.9.1 Compliance with the basic ergonomics requirement (height, depth, panel inclination, etc.).

16.4.9.2 Arrangement of the controls and information displays by functional groups and depending on the degree of importance from the stand-point of ensuring safe and unimpeded navigation.

16.4.9.3 Symbols and markings showing the purpose and the direction of the control operation.

16.4.9.4 Access to inner wiring and protection devices of the power supply sources.

16.4.9.5 Ease of using and maintaining.

16.4.9.6 Audible (with mute function) and visual alarm to indicate failure of the instruments and machinery.

16.4.9.7 Presentation of the navigational information by the indicating devices continuously (automatically) and on call.

16.4.9.8 Compliance of the colours and illumination of the scales, signs and inscriptions with the requirements of the RS Rules.

16.4.9.9 Possibility for the operator to work at the desk in upright and sitting position.

16.4.10 Gyromagnetic, electromagnetic compasses and directional gyros.

Error in the heading indication (on stationary base and on rocking platform) and continuous operation shall be checked.

16.4.10.1 During the tests of the compasses in association with the course translator, the following shall be checked:

.1 error in transformation of the information on the course;

.2 static error on stationary base;

.3 dynamic error under motions and vibration conditions.

16.4.10.2 During the tests of the directional gyro the hourly drift value shall be checked.

16.4.10.3 Alarm to indicate fault and power failure.

16.4.10.4 Possibility of data output to other navigational instruments and systems.

16.4.11 Unified timing system.

The following shall be checked:

16.4.11.1 Error of the primary clock run during twenty-four-hour operation.

16.4.11.2 Variations in the clock run during twenty-four-hour operation.

16.4.11.3 Possibility of correcting the system against the International accurate hour's service signals transmitted through the radio channels.

16.4.11.4 Possibility of an emergency power supply.

16.4.11.5 Capability of indicating time on at least 10 secondary clocks.

16.4.12 Electronic chart display and information system (ECDIS).

The following shall be checked during the bench tests:

16.4.12.1 Completeness and details of description of the equipment and operating regulations in the manufacturer's technical documentation.

16.4.12.2 Connection with the receiver of the Global Satellite Positioning System, gyrocompass, log, radar, etc.

ECDIS equipment shall not degrade accuracy of the data on position, ship course and speed generated by the cited devices.

Parameters of the digital input facility shall meet the requirements of the international standard.

16.4.12.3 Capability of displaying information contained in the electronic navigational chart and all updates without any quantitative or qualitative degradation of their information content when compared with the standard test chart edited by an authorized hydrographic office.

16.4.12.4 Capability of correct loading of the supplementary ENC memory cells. The list of charts in the ship's chart outfit shall be updated.

16.4.12.5 Agreement between the accuracy of measurements and accuracy of computations in performing the following tasks:

estimation of the distance and observance of the bearing between two known positions,

establishment of the position by bearing and of the distance from the known position,

conversion of the co-ordinates from local system into WGS-84 and back.

16.4.12.6 Capability of scaling up and down the chart displaying. Whilst so doing, the size of symbols, letters and figures shall remain unchanged.

16.4.12.7 Capability of displaying the ship position either in true scale or as a symbol.

16.4.12.8 Display of:

co-ordinates in degrees, minutes and parts thereof,

depths in meters and decimeters,

heights in meters,

distances in miles and decimal parts thereof or meters,

speed in knots and parts thereof,

time in hours, minutes and seconds,

direction in degrees and parts thereof.

16.4.12.9 Amount of information on the chart objects including:

units of depth,

units of height,

scale of displaying,

zero reading of heights and depths,

name of the geographic co-ordinate system,

dangerous depth value,

dangerous isobath value,

edition number and edition date of the electronic navigational chart,

date and number of the last updates made.

16.4.12.10 Colour of the chart display.

16.4.12.11 Resolution and size of the display.

16.4.12.12 Capability of displaying notes of the navigator in text and graphic form.

16.4.12.13 Capability of changing orientation of the chart display and the true or relative motion modes (chart display is stationary, ship mark moves and vice versa).

16.4.12.14 Actuation of an alarm in case of:

availability of a chart at a larger scale than provided by the display,

limit for deviation from the planned route, set by the operator, is exceeded,

ship enters the areas for which special conditions exist,

input from the position fixing system is lost,

approach to planned point,

use of reference system of the chart other that used in position fixing system,

failure of RCDIS,

situation when the planned route crosses the selected safety contour.

16.4.12.15 Capability of using at least one electronic sighting device and movable range marker.

16.4.12.16 Capability and correctness of deriving co-ordinates from the automatic positioning system.

16.4.12.17 Capability, if envisaged, of overlaying the electronic chart by radar image.

16.4.12.18 Acceptance of the updates from a diskette or another information carrier.

Confirmation of the fidelity of the updates and compilation of the update list.

Capability of manual entering the updates.

16.4.12.19 Automatic testing the performance of the major functions.

16.4.12.20 Ability of reproducing the information sufficient to reconstruct the operator's actions and verify the official database within the previous 12 h. Impossibility of changing the recorded information.

16.4.12.21 Recording of the route data and impossibility of changing them.

16.4.12.22 Retention of the operability in case of interruption of power supply within 45 s.

16.4.13 Rate-of-turn indicators.

The following shall be checked and tested during the survey of the rate-of-turn indicators:

16.4.13.1 Operation independently of gyrocompass and radar operation with indication of the direction and angular speed of the ship turn.

16.4.13.2 Accuracy of the rate-of-turn determination with due regard for the influence of the Earth's revolution at ship's speed up to 10 knots.

16.4.13.3 Time of readiness of the indicator for operation.

16.4.13.4 Capability of using the indicator both with the automatic and manual ship steering.

16.4.13.5 Capability of transmitting the information on the rate-of-turn to other navigational instruments and systems.

16.4.14 Shipborne automatic identification (information) system (AIS).

The following shall be checked during the bench tests of AIS together with connected aids and systems or simulators thereof:

16.4.14.1 Complete equipment of AIS.

16.4.14.2 Automatic switching-on of the AIS equipment when the power is turned on and readiness of the equipment for operation within 2 min of switching-on (this requirement does not apply to the time of putting the receiver of the global navigation satellite system on the operational mode).

16.4.14.3 Capability of operating in an "autonomous mode" and capability of being switched to other modes ("assigned mode" and "polling mode") and back to the "autonomous mode".

16.4.14.4 Content of the information transmitted by AIS:

.1 static:

IMO number assigned to the ship;

call sign and name;

length and beam;

type of ship;

location of position-fixing antenna on the ship (aft or bow and port or starboard of centerline);

.2 dynamic:

ship's position with accuracy indication and integrity status);

time in UTC;

course over ground;

speed over ground;

true course;

navigational status: underway, at anchor, etc. – manual input;

rate-of-turn (where the rate-of-turn indicator is available);

.3 voyage related:

ship's draught;

hazardous cargo and its type (as required by competent authority);

destination and estimated time of arrival (at Master's discretion);

safety related messages.

16.4.14.5 Capability of transmitting information with the prescribed time intervals:

.1 static information – every 6 min and at request;

.2 dynamic information – depending on the navigational status of the ship, change in its speed and course;

.3 voyage-related information – every 6 min, when data have been amended and on request.

16.4.14.6 Ability to transmit at least 2000 reports per minute.

16.4.14.7 Capability of operating in assigned mode.

16.4.14.8 Capability of operating in polling mode.

16.4.14.9 Responding to the calls on the same channel.

16.4.14.10 Automatic switching-on of the Global Navigational Satellite System receiver in the event of failure of the main source of ship's positional information as well as an appropriate built-in integrity test indication.

16.4.14.11 Possibility of receiving differential corrections in the N17 message format.

16.4.14.12 Availability and proper operation of two high-speed in-put/output ports (for interfacing the graphic display systems and addi-tional equipment).

16.4.14.13 Availability and proper operation of ports for interfacing the dynamic information sensors.

16.4.14.14 Availability and proper operation of a port for interfacing the long-range communication facilities.

16.4.14.15 Protection of the input and transmitted data against unauthorized alteration.

16.4.14.16 Functioning of the built-in integrity test equipment including automatic record of all periods when the AIS installation is non-functioning in a non-volatile memory.

16.4.14.17 Actuation of an alarm and indication when the status of the dynamic information sensor is changed.

16.4.14.18 Ability of ensuring the required priority in selecting the source of ship's positional information and automatic switching to the source of higher priority within 30 s of switching-on.

16.4.14.19 Capability of displaying the following information using the minimum keyboard and display of the AIS:

.1 bearing, range and ship's name;

.2 alarm information and indications as a result of built-in integrity test;

.3 input of voyage-related information and safety-related messages;

.4 received safety-related messages;

.5 received requests from the long-range communication facilities.

If no appropriate interfaced information sensors or simulators thereof are connected on the manufacturer's bench, operational tests of the pilot sample of the AIS equipment shall be carried out on board ship with the real equipment being connected thereto.

16.4.15 Voyage data recorder.

The following shall be checked during the bench tests with the interfaced instruments, systems or simulators thereof connected:

16.4.15.1 Automatic switching-on of the recorder when the power from ship's sources is applied thereto as well as transfer to power supply from an emergency ship's source in the event of failure of the main source.

16.4.15.2 Operation of the recorder supplied from its own reserve power source within 2 h with automatic switching-off.

16.4.15.3 Manual switching-off of the recorder on prolonged stay of the ship in port and under repair.

16.4.15.4 Capability of recording, on the end information carrier, the initial ratings and list of the sensors in use with indication of their type for permanent storage.

16.4.15.5 Check of protection of the capsule with the end information carrier against unauthorized access and capability of extracting the recorded information without opening of the protective capsule.

16.4.15.6 Availability of documents confirming special tests of the protective capsule for deep-water immersion, high temperature and impact.

16.4.15.7 Design of the end information carrier with protective capsule which makes it possible to record data during accident; availability of devices to aid search and location of the capsule as well as a mechanism to release the capsule during immersion of the ship (emerging version).

16.4.15.8 Check of the capability of continuous recording and storing the instrument and system readings within 12 h ± 5 min.

16.4.15.9 Check of the relation between different events in time and capability of determining the date and time from the records.

16.4.15.10 Check of the volume of the compulsory information to be recorded and stored.

16.4.15.11 Capability of interpreting and documenting the information recorded on the end carrier with the use of special land-based facilities.

16.4.15.12 Capability of recording attempts of an authorized intervention in the recorder operation.

16.4.15.13 Integrity of the recorded data and actuation of an alarm when a non-correctable error is detected during recording.

16.4.15.14 Check of recording the bridge audio if the ship's source of electric power supply fails for a period of 2 h with subsequent automatic switching-off of the recorder.

16.4.15.15 Absence of the recorder's impact on the operation of the information sensors in the event of failure of the recorder or individual communication channels.

If no appropriate interfaced information sensors or simulators thereof are connected on the manufacturer's bench, operational tests of the pilot sample of the recorder shall be carried out on board ship with the real equipment being connected thereto.

16.4.16 Sound reception system.

The following shall be checked:

16.4.16.1 Range and direction of receiving outside sound signals (by comparison with the operator's perception).

16.4.16.2 Check of the audio band for reception of the sound signals.

16.4.16.3 Provision and possibility of adjusting the volume of outside sound signals reproduced in the wheelhouse.

16.4.16.4 Time of determination of the direction of the received sound signal.

If no conditions for determining the range and direction of the received sound signals exist at the manufacturer's, these parameters shall be checked during the operational tests on board ship.

16.5 REGISTER DOCUMENTS

16.5.1 Where the results of survey of the navigational equipment at the manufacturer's are positive, the Register documents shall be issued in accordance with the set type of supervision (refer to Section 3, Part I "General Regulations for Technical Supervision").

16.5.2 The results of the tests of the pilot and prototype sample of the product carried out in the presence of the Surveyor as well as the results of the survey of the manufacturer's shall be documented as the Register Report (refer to Section 1).

APPENDIX 1

STANDARDS AND METHODS OF TESTING NAVIGATIONAL EQUIPMENT

1. General.

1.1 This Appendix contains minimum requirements imposed on the tests of the navigational equipment of sea-going ships.

1.2 Equipment tested according to these requirements shall be considered to have passed the tests if it meets the conditions set out in Appendix 1. The scope of testing at various production stages as well as dependence on the position on board ship are given in Table 1.2.

Table 1.2

Nos	Properties of equipment to be checked during the tests	Equipment intended to be installed on board ship		
		in internal spaces	on open deck	immersed in water[1]
1.	Protection	++	++	++
2.	Vibration resistance and resonance	++	++	++
3.	Vibration resistance on one frequency	+++	+++	+++
4.	Shock resistance[2]	+	+	+
5.	Resistance to motions	+	+	+
6.	Wind resistance[2]	—	+	—
7.	Heat stability	++	++	++
8.	Cold endurance	++	++	++

Table 1.2 — continued

Nos	Properties of equipment to be checked during the tests	Equipment intended to be installed on board ship		
		in internal spaces	on open deck	immersed in water[1]
9.	Resistance to hoarfrost and dew[2]	—	+	—
10.	Resistance to moisture	++	++	—
11.	Corrosion resistance	+	+	+
12.	Mould resistance[2,3]	—	—	—
13.	Electromagnetic compatibility (EMC)	++	++	++
14	Magnetic compass safe distance	++	++	—
15	Electromagnetic radio-frequency radiation	++	++	—
16	Emission from visual display unit (VDU)	++	++	—
17	X-radiation level	++	++	—
18	Acoustic noise level	++	—	—

Symbols:
+ — tests of pilot sample
++ — tests of pilot sample, tests of prototype
+++ — tests of pilot sample, prototype of products in case of stable production.

[1] Primary log transducers and echo sounder transducers immersed in water.

[2] Depending on the equipment type, its position and sea navigation area the mechanical tests for shock resistance on the shock bench and for wind resistance, as well as environmental tests for the effects of hoarfrost, dew and mould may be subject of to special consideration of the Register.

[3] If all the types and kinds of related articles being part of the equipment have passed the tests for mould resistance, the tests of the equipment in assembly for mould resistance may be dispensed with.

2. Definitions and explanations.

2.1 Vibration resistance of equipment is the capability of the equipment to perform its functions under vibration conditions while maintaining the parameters within the prescribed limits.

2.2 Shock resistance of equipment is the capability of the equipment to resist the destructive effects of shocks while maintaining the parameters within the prescribed parameters after such effects.

2.3 Wind resistance of equipment is the capability of the equipment to resist the destructive efforts of wind of the greatest force which is likely to occur under the service conditions, while maintaining its parameters within the prescribed limits.

2.4 Heat stability of equipment is the capability of the equipment to perform its functions at the highest ambient air temperature which is likely to occur under service conditions, while maintaining its parameters within the prescribed limits and experiencing no damages.

2.5 Cold endurance of equipment is the capability of the equipment to perform its functions at the lowest ambient air temperature which is likely to occur under service conditions, while maintaining the parameters within the prescribed limits and experiencing no damages.

2.6 Moisture resistance of equipment is the capability of the equipment to perform its functions in a medium with the highest relative humidity which is likely to occur under service conditions, while maintaining its parameters within the prescribed limits and experiencing no damages.

2.7 Corrosion resistance is the capability of the metal articles to resist corrosion when exposed to salt solution.

2.8 Mould resistance is the capability of the article to resist development of the fungus mould in fungi contaminated medium.

2.9 Normal environmental conditions are the conditions characterized by the combination of the following atmosphere parameters:

temperature – 25 ± 10 °C;

relative humidity – from 20 to 75 %.

2.10 Standard environmental conditions are the conditions characterized by the combination of the following atmosphere parameters:

temperature – $(20 \pm 1$ °C);

relative humidity – 65 ± 2 %.

2.11 Protection of equipment means a degree of protection of the personnel against contact with the live parts inside the enclosure, degree of protection of the enclosed equipment against penetration of foreign solid objects as well as against ingress of water.

2.12 Radiated interference is the interference radiated by the equipment casing (other than the direct radiation of the equipment aerials).

2.13 Conductive interference is the interference generated by the equipment at the terminals for connecting the power supply mains.

Note. If it is impossible to maintain the standard environmental conditions at the beginning and in the end of the test for heat stability, cold endurance, moisture resistance and mould resistance it is permitted to change the parameters under normal environmental conditions. However, the difference between the atmosphere parameters at the beginning and in the end of the tests shall not, where possible, exceed the tolerance specified for the standard environmental conditions. The deviations from the standard values of the temperature and humidity defined by the test conditions shall be indicated in the Test Report.

3. Mechanical tests of equipment.

3.1 Tests of the equipment for vibration resistance and resonance.

The equipment of sea-going ships shall be resistant to vibrations and stand the tests using the procedure given below.

Nos	Sequence, conditions and standards of tests	Numerical value
1	Installation of equipment on vibration bench, switching-on and measurement of parameters	—
2	Holding of the equipment in vibration condition within the prescribed frequency range in three mutually perpendicular directions in relation to the article:	
	frequency range of the vibration bench platform oscillation, Hz	2 — 100
	amplitude for frequencies from 2 Hz to 13,2 Hz, mm	±1
	acceleration for frequencies from 13,2 Hz to 100 Hz, m/s^2	7
3	Measurement of parameters during the tests	—
4	Removal of the equipment from the bench, measurement of parameters, switching-off and examination	—

The equipment shall be mounted on the bench in normal operational position, on the shock-mounts. During the tests the equipment shall be in working state, under normal environmental conditions.

The speed variation rate shall be sufficient to ensure detection of resonances in the individual parts of the equipment as well as check and record of the necessary parameters but not more than two octave per minute. Advancement of the whole frequency range shall take not less than 30 min.

During the vibration tests a search shall be made for the resonance frequencies at which the parameters of the articles are degraded. When the resonances are found, the amplitude of which is twice or more as large as the rated amplitude of the bench platform oscillation, a prolonged test shall be conducted at each resonance frequency during 2 h.

If no resonances are found, the prolonged test shall be conducted at the frequency of 30 Hz in accordance with 3.2. The equipment shall be considered to have passed the tests, if in the process of the tests and thereafter it maintains its parameters and receives no damages.

3.2 Tests of the equipment for resistance to vibration at one frequency.

Tests of the equipment for resistance to vibration at one frequency shall be carried out in order to detect rough manufacturing defects which may appear in the process of production. The tests shall be conducted according to the following procedure:

The equipment shall be considered to have passed the tests if in the process of the tests and thereafter it maintains its parameters and receives no damages.

Nos	Sequence, conditions and standards of tests	Numeric value
1	Installation of the equipment on vibration bench, switching-on and measurement of parameters	—
2	Holding of the equipment in vibration condition at one frequency in three mutually perpendicular directions:	
	frequency range of the vibration bench platform oscillation, Hz	30
	acceleration, m/s^2	7
	duration, h	2[1]
3	Measurement of parameters during the tests	—
4	Removal of the equipment from the bench, measurement of parameters, switching-off and examination	—

[1] In case of stable production, the time of the tests of serial samples may be reduced down to 30 min, and the test may be conducted in one normal operational position.

N o t e . The equipment shall be installed on the bench without shock-mounts. During the tests the equipment shall be in working state under normal environmental conditions.

3.3 Tests of equipment for shock resistance.

The equipment of sea-going ships shall be resistant to shock and stand the tests using the following procedure:

Nos	Sequence, conditions and standards of tests	Numeric value
1	Installation of equipment on shock bench, switching-on, measurement of parameters and switching-off	—
2	Holding of equipment in jarring condition in three mutually perpendicular positions in turn on the shock bench:	
	shock frequency of the shock bench platform, shock/min	40 — 80
	acceleration, m/s^2	100
	duration of shock pulse, ms	10 — 15
	total number of shocks	not less than 1000
3	Removal of equipment from the bench, switching-on, measurement of parameters, switching-off and examination	—

During the tests the equipment shall be in in-operating mode. Depending on the type of the shock bench, the tests shall be carried out by one of the following methods:

in three mutually perpendicular positions, in turn, on a one-component bench;

in two mutually perpendicular positions, on a two-component bench;

in normal operational position, on a three-component bench. The minimum number of shocks may be reduced by 1/3 if a two-component bench is used, and by 2/3 if a three-component bench is used.

As a rule, the tests on the shock bench shall be carried out with regular shock-mounts, if any. However, when the equipment is tested in inclined position the regular shock-mounts may be replaced by rubber or other means selected so as to provide the same static deflection as the regular shock-mounts do.

The equipment shall be considered to have passed the tests if upon finalization thereof it maintains its parameters, strength and tightness.

3.4 Tests for resistance of the equipment to motions and prolonged inclinations.

The equipment of sea-going ships shall be resistant to motions and prolonged inclinations and stand the tests using the following procedure:

Nos	Sequential, conditions and standards of tests	Numerical value
1	Installation of equipment on the bench, switching-on and measurement of parameters	—
2	Holding of the equipment under motions conditions, when installed in two mutually perpendicular positions in turn and measurement of parameters in each position:	
	limiting angle of inclination from the vertical, deg.	45
	motions period, s	7 — 9
	duration of the tests in each position, min	not less than 5
3	Holding of the equipment in two mutually perpendicular inclined positions in turn and measurement of parameters in each position;	
	angle of inclination to the horizontal, deg.	45
	duration of the tests in each position, min	not less than 3
4	Removal of the equipment from the bench, measurement of parameters, switching-off and examination	

During the tests the equipment shall be in operating mode under normal environmental conditions. The equipment shall be installed on a special bench with the use of regular shock-mounts and tested in two mutually perpendicular normal operational positions.

The equipment shall be considered to have passed the tests if during the tests and thereafter it maintains its parameters and receives no damages.

The tests for resistance to motions and prolonged inclinations may be dispensed with if the equipment has stood the shock tests on a one-component bench in three mutually perpendicular positions.

3.5 Tests of the equipment for resistance to wind.

The equipment and all the aerials intended for operation on open decks of ship shall be resistant to wind and stand the tests using the following procedure:

Nos	Sequence, conditions and standards of tests	Numerical value
1	Installation of equipment on bench in normal operational position, switching-on, measurement of parameters and switching-off	—
2	Air flowing of the equipment from eight horizontal directions, in turn, every 45 s with a specific velocity:	
	air flow velocity, m/s	60
	duration of the tests in each of the eight directions of the air flow	5 min
3	Cessation of air supply, switching-on, measurement of parameters, switching-off and examination	—

During the tests the equipment shall be inoperative.

The equipment shall be considered to have passed the tests if it maintains its parameters and receives no damages.

4. Environmental tests of equipment.

4.1 Tests of equipment for heat stability.

The equipment of sea-going ships shall have heat stability and stand the tests using the following procedure:

Nos	Sequence, conditions and standards of tests	Numerical value for equipment intended for operation		
		in internal spaces	on open deck	immersed in water
1	Installation of equipment in heating chamber, switching-on and conditioning under standard environmental conditions, h.	0,2 — 2	0,2 — 2	0,2 — 2
2	Measurement of parameters under standard environmental conditions	—	—	—
3	Temperature elevation in the chamber up to the working temperature:			
	temperature elevation rate, °C/min;	0,5 — 3	0,5 — 3	0,5 — 3
	working temperature, °C	55±3	55±3	55±3
	relative humidity, %	not more than 20	not more than 20	not more than 20
4	Conditioning of equipment at the working temperature, h	10 — 16	10 — 16	10 — 16
5	Measurement of parameters at the working temperature and switching-off	—	—	—
6	Temperature elevation in the chamber up to the limiting temperature:			
	temperature elevation rate, °C/min	0,5 — 3	0,5 — 3	0,5 — 3
	working temperature, °C	70±3	70±3	70±3
	relative humidity, %	not more than 20	not more than 20	not more than 20
7	Conditioning of equipment at the limiting temperature, h.	10 — 16	10 — 16	10 — 16
8	Temperature drop in the chamber down to the standard temperature, °C/min	0,5 — 3	0,5 — 3	0,5 — 3
9	Conditioning of equipment under standard environmental conditions, h	2 — 6	2 — 6	2 — 6
10	Switching-on and conditioning of equipment under standard environmental conditions, h.	0,2 — 6	0,2 — 6	0,2 — 6
11	Measurement of parameters under standard environmental conditions, switching-off and examination of the equipment	—	—	—

The equipment shall be considered to have passed the tests if during the tests and thereafter it maintains its parameters and receives no damages.

4.2 Tests of equipment for cold endurance.

The equipment of sea-going ships shall display cold endurance and pass the tests using the following procedure:

Nos	Sequence, conditions and standards of tests	Numerical value for equipment intended for operation		
		in internal spaces	on open deck	immersed in water
1	Installation of equipment in heating chamber, switching-on and conditioning under standard environmental conditions, h.	0,2 — 2	0,2 — 2	0,2 — 2
2	Measurement of parameters under standard environmental conditions and switching-off	—	—	—
3	Temperature drop in the chamber down to the working temperature:			
	temperature drop rate, °C/min;	1 — 2	1 — 2	1 — 2
	working temperature, °C	−15±3	−40±3	−4
	relative humidity, %	not more than 20	not more than 20	not more than 20
4	Conditioning of equipment at the working temperature, h	10 — 16	10 — 16	10 — 16
5	Switching-on, measurement of parameters at the working temperature and switching-off	—	—	—
6	Temperature drop in the chamber down to the limiting temperature:			
	temperature drop rate, °C/min	1 — 2	1 — 2	1 — 2
	limiting temperature, °C	−60±3	−60±3	−60±3
7	Conditioning of equipment at the limiting temperature, h.	2	2	2
8	Temperature elevation rate in the chamber up to the standard temperature, °C/min	0,5 — 3	0,5 — 3	0,5 — 3
9	Conditioning of equipment under standard environmental conditions, h	3 — 4	3 — 4	3 — 4
10	Switching-on and conditioning of equipment under standard environmental conditions, h.	0,2 — 2	0,2 — 2	0,2 — 2
11	Measurement of parameters under standard environmental conditions, switching-off and examination of the equipment	—	—	—

The equipment shall be considered to have passed the tests if during the tests and thereafter it maintains its parameters and receives no damages.

4.3 Tests of equipment for resistance to hoarfrost and dew.

All the equipment intended for installation on open decks of sea-going ships shall stand the tests for resistance to hoarfrost and dew using the following procedure:

Nos	Sequence, conditions and standards of tests	Numerical value
1	Installation of equipment into a cold chamber and conditioning in switched-off state:	
	temperature, °C	−20±5
	duration , h.	2
2	Removal of equipment from the chamber, switching-on and conditioning under normal environmental conditions. Immediately after switching-on and at 30 — 60 min intervals parameters of the equipment shall be measured: duration of conditioning, h.	3
3	Switching-off and examination	—

The equipment shall be considered to have passed the tests if it maintains its parameters within the prescribed limits and receives no damages.

4.4 Tests of equipment for resistance to moisture.

The equipment of sea-going ships shall be resistant to moisture and stand the tests using the following procedure:

Nos	Sequence, conditions and standards of tests	Numerical value
1	Installation of equipment in a moisture chamber, switching-on and conditioning under standard environmental conditions, h.	0,2 — 2
2	Measurement of parameters under standard environmental conditions and switching-off	—
3	Rise in temperature and relative humidity in the chamber up to the working ones, h	3±0,5
	Working temperature, °C	40±2
	Working relative humidity, %	95±3
4	Conditioning of equipment at working temperature and relative humidity, h.	10 —16
5	Switching-on, measurement of parameters at working temperature and relative humidity, h.	2
6	Decrease of temperature and humidity in the chamber until the standard environmental conditions are reached, h.	1
7	Measurement of parameters under standard environmental conditions, switching-on and examination of equipment	—

The equipment shall be considered to have passed the tests if during the tests and thereafter it maintains its parameters and receives no damages.

4.5 Tests of equipment for resistance to corrosion.

The metal parts of the equipment of sea-going ships shall be resistant to corrosion and stand the tests using the following procedure:

Nos	Sequence, conditions and standards of tests	Numerical value
1	Examination of equipment and installation thereof in a chamber	—
2	Conditioning of equipment in the chamber with the salt solution (sea fog) being cyclically sprayed	
	temperature in the chamber ,°C	25 ± 10
	solution composition, parts by weight:	
	NaCl	5 ± 1
	distilled water	95
	duration of solution spraying, h	2
3	Conditioning of equipment in the chamber:	
	temperature in the chamber, °C	40 ± 2
	relative humidity in the chamber, %	90 — 95
	duration of conditioning, days	7
4	Repetition of the operations 2 and 3, total number	4
5	Removal of equipment from the chamber and examination	—

During the tests the equipment shall be inoperative. The equipment shall be considered to have passed the tests if upon finalization thereof it maintains its parameters and receives no damages.

4.6 Tests of equipment for resistance to mould.

The equipment of sea-going ships shall be resistant to mould and stand the tests using the following procedure.

Prior to the tests, the equipment shall be held at the temperature of 60 ± 2 °C during 6 h and then placed for 1 – 6 h into standard environmental conditions for examination and measurement of parameters. The tests of the equipment shall be carried out in a medium contaminated by fungus mould with no light and movement of air. The mould shall be water suspension consisting of a mixture of mould fungi spores the names of which are given in Table 4.6. As a culture medium for growing the mould fungi it is recommended to use brewing wort or synthetic medium Chapek–Doxa.

Sterilized culture medium in Petri dishes together with the equipment disconnected from the supply sources shall be placed into a test chamber and sprayed with water suspension of the mould fungi spores through an atomizer with an orifice diameter not less than 1 mm at a rate of 50 ml of suspension per 1 m^3 of usable volume of the chamber. After spraying, a temperature of 20 ± 5 °C and relative humidity of 95 – 98 % shall be set-tled in the test chamber.

The equipment shall be held under these conditions during 48 h. If after a lapse of such holding time no growth of mould is observed in the Petri dishes it is necessary to spray again the dishes and equipment by viable suspension of mould fungi spores and held them for the second time during 48 h. After the mould growth is detected in the check dishes the temperature in the chamber shall be elevated up to 29 ± 1 °C at the relative humidity of 95 – 98 % and the equipment shall be held under such conditions during 28 days. After a lapse of this time, the equipment shall be placed into standard environmental conditions for 24 h, whereupon examination and measurement of parameters shall be made.

The equipment shall be considered as resistant to mould, if when examined through a magnifier with 50X magnification no signs of fungus mould are detected or only isolated sprouted spores are seen.

Table 4.6

Nos	Spore	Strain	Typical cultures	Properties
1	Aspergillus niger	v. Tieghem	ATCC. 6275	Grows copiously on many materials, resistant to copper salts
2	Aspergillus terreus	Thom	PQMD. 82j	Affects plastics
3	Aureobasidium pullulans	(DE Barry) Arnaud	ATCC. 9348	Affects varnishes and paints
4	Paecilomyces varioti	Bainier	JAM. 5001	Affects plastics and leather
5	Penicillium funiculosum	Thom	JAM. 7013	Affects many materials, especially textiles
6	Penicillium ochrochloron	Biourge	ATCC. 9112	Resistant to copper salts
7	Scopulariopsis brevicaulis	(Sacc) Bain Var. GIabra	JAM. 5146	Affects rubber
8	Trichoderma viride	Thom Pers. Ex Fr.	JAM. 5061	Affects cellulose, textile and plastics

5. Tests of equipment protection.

The tests of the equipment protection are defined by the protection of the equipment enclosure. The degree of protection of the equipment is designated by the letters IP and two distinctive figures:

the first distinctive figure defines protection of the equipment against access to dangerous parts inside the enclosure as well as against penetration of foreign solid objects inward;

the second distinctive figure defines protection of the equipment against ingress of water.

The equipment may be assigned a certain degree of protection designated by the first distinctive figure only if it corresponds simultaneously to all lower degrees of protection. In this case it is not a necessity to conduct tests in order to establish correspondence with a particular lower degree of protection if it is evident that the results of such tests will be reliably successful.

5.1 Protection against access to the dangerous parts of the equipment, penetration of foreign solid objects.

Description of the protection against access to the dangerous parts of the equipment, penetration of foreign solid objects and their associated test procedures are given in Table 5.1.

Table 5.1

First distinctive figure	Protection against access to dangerous parts of equipment		Protection against penetration of foreign solid objects	
	Brief description	Tests	Brief description	Tests
0	No protection	Tests are not required	No protection	Tests are not required
1	Protected against access to dangerous parts by back of the hand	Rigid ball of 50 mm[1] in diameter, with an effort of 50N ±10 % shall not touch dangerous parts of equipment	Protected against foreign solid objects with a diameter more or equal to 50 mm	Rigid ball of 50 mm[1] diameter with an effort of 50N ±10 % shall not penetrate fully
2	Protected against access to dangerous parts by finger	Test knucle pin (refer to Fig.5.1-1) of 12 mm diameter and 80 mm length shall not touch dangerous parts of equipment	Protected against foreign solid objects with a diameter more or equal to 12,5 mm	Rigid ball of 12,5 mm[2] diameters with an effort of 30N±10 % shall not penetrate fully
3	Protected against access to dangerous parts by tools	Rigid steel rod of 2,5 mm[1] diameter with an effort of 3N ±10 % shall not penetrate inside the equipment enclosure	Protected against foreign solid objects with a diameter more or equal to 2,5 mm	Rigid steel rod of 2,5 mm[1] diameter with an effort of 3N ±10 % shall not penetrate neither fully nor partly
4	Protected against access to dangerous parts by wire	Rigid steel wire of 10 mm[1] diameter with an effort of 1N ±10 % shall not penetrate inside the equipment enclosure	Protected against foreign solid objects with a diameter more or equal to 1,0 mm	Rigid steel wire of 1,0 mm[1] diameter with an effort of 1N ±10 % shall penetrate neither fully nor partly
5	Protected against access to dangerous parts by wire	Rigid steel wire of 1,0 mm[1] diameter with an effort of 1N ±10 % shall not penetrate inside the equipment enclosure	Protected against dust	Ingress of dust is excluded not fully, however dust shall not ingress in an amount sufficient for disturbing normal operation of equipment or impairing its safety
6	Protected against access to dangerous parts by wire	Rigid steel wire of 1,0 mm[1] in diameter with an effort of 1N ±10 % shall not penetrate inside the equipment enclosure	Dust-tight	Dust does not ingress into enclosure

[1] The diameter may be only larger by a value less than or equal to 0,05 mm.
[2] The diameter may be only larger by a value less than or equal to 0,2 mm.

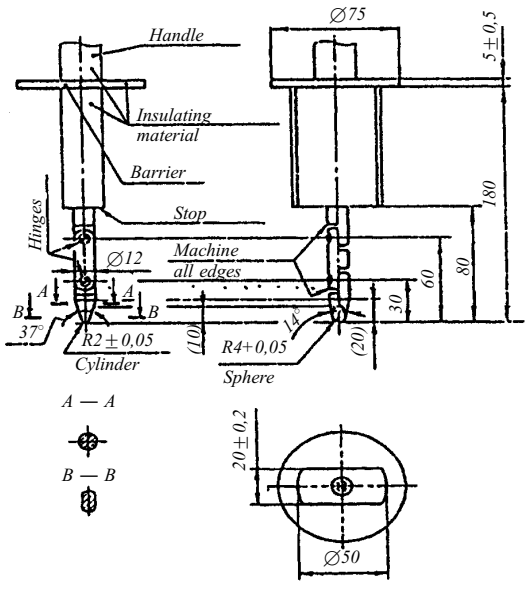


Fig. 5.1-1 Test knuckle pin

Note. Linear dimensions are given in mm. Tolerances for dimensions where omitted on the figure: for angles: from 0 to 10 mm; for linear dimensions up to 25 mm: from 0 to 0,05 mm; for linear dimensions above 25 mm: ±0,2 mm.

Two knuckles shall provide mobility in the same plane and direction at an angle 90° with a tolerance from 0 to +10°

Test conditions.

The test object shall be pressed against or put into each opening in the equipment enclosure.

The tests for the effect of dust shall be carried out with the use of a special dust chamber the structural and principal features of which are shown on Fig. 5.1-2. The dust circulation pump in the chamber may be replaced by any other device which enables the talc powder to be maintained in suspended condition in the chamber. The talc powder used shall pass through a sieve with square mesh size of 75 μm and wire thickness of 50 μm.

The amount of the talc powder shall be 2 kg per 1 m^3 of the test chamber volume. During the tests, an air volume equal to 80 volumes of the enclosure shall be pumped through the enclosure at the air renewal rate not more than 60 enclosure volumes per hour. Along with that, the vacuum value shall not exceed 2 kPa (20mbar) by the pressure gauge (Fig.5.1-2). The test shall last 2 h. The air change rate shall be from 40 to 60 volumes per hour.

Protection for the first distinctive figure 5 shall be considered as satisfactory if the check results show that the talc does not accumulate in such amount or on such a spot that the normal operation of the equipment may be

disturbed or safety requirements violated when dust of any other type lodges on these spots. With the exception of special cases specified exactly in the standards for a specific type of the article, dust shall not accumulate on the spots where it may cause tracking (generation of current-carrying tracks) on the leakage paths.

Protection for the second distinctive figure 6 shall be considered satisfactory if upon finalization of the tests dust deposits cannot be seen inside the enclosure.

5.2 Protection against ingress of water.

Description of the protection against the ingress of water and its associated test procedure is given in Table 5.2-1.

Test conditions.

During the tests fresh water shall be used.

When conducting tests for the distinctive figures from 1 to 7 the temperature of the water shall differ by

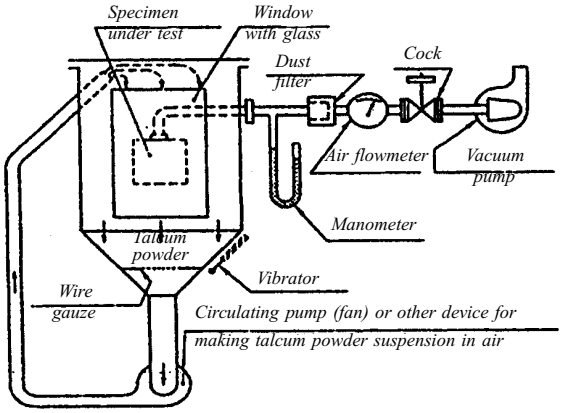


Fig. 5.1-2
Device for checking dust protection (a dust chamber)

Table 5.2-1

Second distinctive figure	Protection against ingress of water	
	Brief description	Tests
0	No protection	Tests are not required.
1	Protected against water drops falling vertically	Equipment in normal working position shall be exposed to water drops falling vertically from a reservoir through the holes in bottom located at the intersection of an imaginary net with the side of a mesh of 20 mm. The bottom area shall be larger than the area of the equipment tested. The intensity of the rain shall be of 1 mm/min1 during 10 min.
2	Protected against vertically falling water drops when the equipment is inclined at an angle up to 15°	The tests shall be conducted in much the same manner as the tests for the distinctive figure 1 with the article being deviated from vertical position at 15° to any side, in turn. The intensity of the rain is 3 mm/min[1] during 2,5 min in each inclined position.
3	Protected against water falling in the form of rain	The equipment in normal working position shall be drenched with water from: rocking pipe deviated from the vertical at angles of ±60° (Fig. 5.2-1). Flow rate of water: 0,07 l/min ± 5 % multiplied by the number of holes in the pipe. Duration of one complete oscillation (2 × 120°) shall be about 4 s. After 5 min of tests the equipment shall be turned at 90° in a horizontal plane and the tests shall be continued for more 5 min; or sprayer at an angle of ±60° to the vertical (Fig. 5.2-2). Flow rate of water: 10 l/min ±5 %. The duration of the test shall be estimated based on 1 min per 1 m^2 of the surface of the equipment tested but not less than 5 min.
4	Protected against entire spraying	The tests shall be conducted in much the same manner as the tests for the distinctive figure 3 but with spraying of the equipment on all sides.
5	Protected against water jets	The equipment, from the distance of 2,5 – 3,0 m, shall be drenched on all sides with water from a fire hose nozzle of 6.3 mm in size and delivery rate of 12,5 l/min ±5 %. The duration of test shall be estimated based on 1 min per 1 m^2 of surface of the equipment tested but not less than 3 min.
6	Protected against high pressure water jets	The equipment, from a distance of 2,5 – 3,0 m, shall be drenched on all sides with water from a fire hose nozzle of 12,5 mm in size and supply rate of 100 l/min ±5 %. The duration of tests shall be estimated based on 1 min per 1 m^2 of surface of the equipment tested but not less than 3 min.
7	Protected against exposure when immersed for a while in water	The equipment shall be immersed in a water reservoir. If the height of the equipment is less than 850 mm the lowest point of the enclosure shall be at a depth of 1000 mm below the water level. If the height of the equipment is more than or equal to 850 mm the highest point of the equipment shall be at a depth of 150 mm below the water level. Duration of the test is 30 min.
8	Protected against exposure when immersed for a long time in water	The equipment shall be immersed in a water reservoir. The water level and test duration shall be determined by agreement with the equipment manufacturer. The test conditions shall be not inferior to those for the distinctive figure 7.

[1] The rain intensity may be only larger by a value less than or equal to 0,5 mm/min.

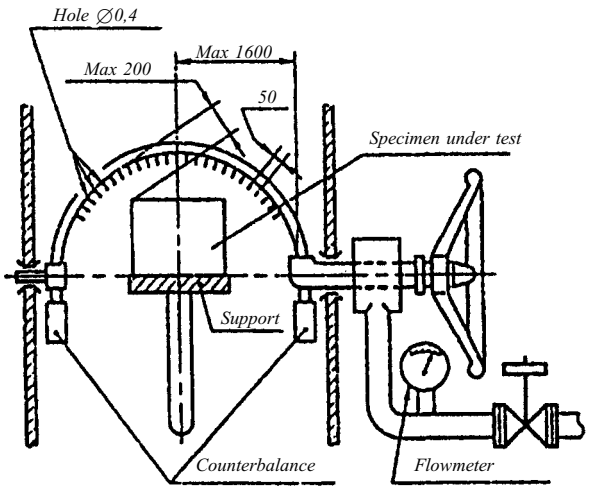


Fig. 5.2-1
Set-up for checking the protection against rain and spraying with water (rocking pipe), dimensions are given in mm

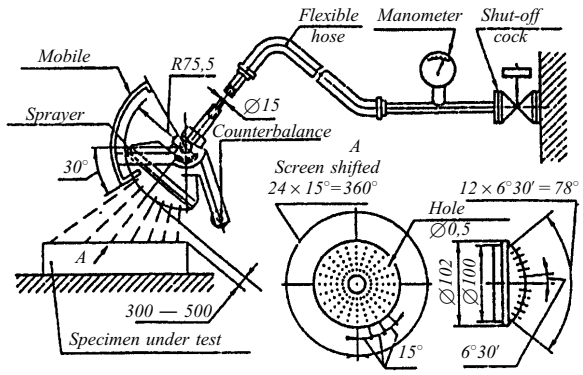


Fig. 5.2-2
Portable set-up for checking the protection against rain and spraying with water (sprayer), dimensions are given in mm

more than 5 °C from the temperature of the specimen tested. If the temperature of the water is lower by more than 5 °C than the temperature of the specimen provision shall be made for equalizing the pressures in the enclosure.

During the tests moisture contained inside the enclose may condense partially. The accumulated condensate shall not be confused with water seeping inside the enclosure during the tests.

Upon completion of the tests, the equipment shall be checked for ingress of water therein.

The allowable amount of water which may ingress inside the enclosure shall be defined by the equipment type. In the general case, if a certain amount of water penetrates inside the enclosure, there shall not be:

disturbance of normal operation of the equipment or impairment of its safety;

accumulation of water on the electrical insulating parts where the water may cause tracking (generation of current-carrying tracks) on the leakage paths;

appearance of water on the live parts or windings which are not designed for operation in a moistened condition;

accumulation of water near the cable lead-ins or ingress inside the cables.

If the enclosure has drain holes it is necessary to make certain by examination that the penetrating water does not accumulate in the enclosure and may flow out freely through the mentioned holes without damaging the equipment.

The rocking pipe shall be provided with holes arranged along an arc of 60° on each side of the centre. The table for installation of the enclosure shall not be of latticed type.

The number of holes and flow rate of water are given in Table 5.2-2.

Table 5.2-2

Pipe radius, R, mm	Degree of protection IPX3		Degree of protection IPX4	
	Number of holes N^1	Full flow rate of water (l/min)	Number of holes N^1	Full flow rate of water (l/min)
200	8	0.56	12	0,84
400	16	1,1	25	1,8
600	25	1,8	37	2,6
800	33	2,3	50	3,5
1000	41	2,9	62	4,3
1200	50	3,5	75	5,3
1400	58	4,1	87	6,1
1600	67	4,7	100	7,0

[1] Depending on the actual location of the hole centres the number of holes may be increased by 1.

Note: 121 holes of 0,5 mm in diameter, one hole is in the centre; 12 holes at an angle of 30° on each of the two inner circles, 24 holes at an angle of 15° on each of the four outer circles. Material of the screen – aluminium. Material of the sprayer – brass.

6. Tests for electromagnetic compatibility (EMC).

6.1 Tests for the inference for other equipment.

The scope of tests and the level of electromagnetic interference for other equipment are given in Table 6.1.

Table 6.1

Nos	Properties of equipment to be checked during tests	Equipment intended for installation on board ships		
		in internal spaces	on open decks	portable
1.	Conductive interference voltage level	+	+	—
2.	Radiated interference field strength level	+	+	+

During the tests the equipment shall operate under normal conditions and the position of controls affecting

the interference level shall be such that the maximum level of interference generated by the equipment being tested can be established. If the equipment has several power modes, for example "operation", "standby", etc., a mode generating the maximum interference level shall be identified, and it is just for this mode all measurement shall be made. The equipment including the transmitter shall be in operating mode but not in the radiation mode.

6.1.1 Tests for the conductive interference voltage level.

During the tests for the conductive interference level, any signals generated by the equipment which appear on its power supply terminals and therefore can be conducted into the ship's mains and disturb the normal operation of other equipment shall be measured.

The voltage level of the conductive interference generated by radio equipment at the power supply terminals shall not exceed the limiting values given on Fig. 6.1.1.

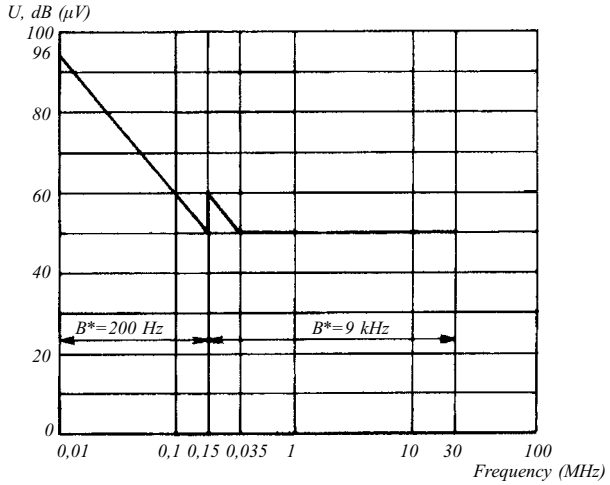


Fig. 6.1.1
Curve of the level of allowable conductive interference voltage U, measured at the power supply terminals of the equipment:
B^* — passband width of the measuring receiver

To measure the levels of interference voltage, use shall be made of a quasi-peak measuring receiver. The passband width of the receiver when measurements are made in the frequency range from 10 kHz to 150 kHz shall be 200 Hz and in the frequency range from 150 kHz to 30 MHz shall be 9kHz.

The connecting cables between the electric power supply terminals of the equipment being tested and the artificial mains network shall be screened and not exceed 0,8 m in length. If the equipment being tested consists of several units with individual terminals for alternating and direct current, the power supply terminals with identical nominal supply voltage may be connected in parallel.

When making measurements, all the measuring instruments and the equipment being tested shall be mounted on an earth plane and bonded thereto. Where the use of an earth plane is impossible, an artificial earthing shall be carried out using the metal frame or mass of the equipment being tested as the earth reference.

6.1.2 Tests for the radiated interference field strength level.

During these tests any signals radiated by the equipment (except for antenna radiation) which can potentially disturb the normal operation of other ship's equipment, e.g. ship's radio receivers, shall be measured.

The field strength level of the radiated interference generated by radio equipment at a distance of 3 m from its casing shall not exceed values given on Fig. 6.1.2.

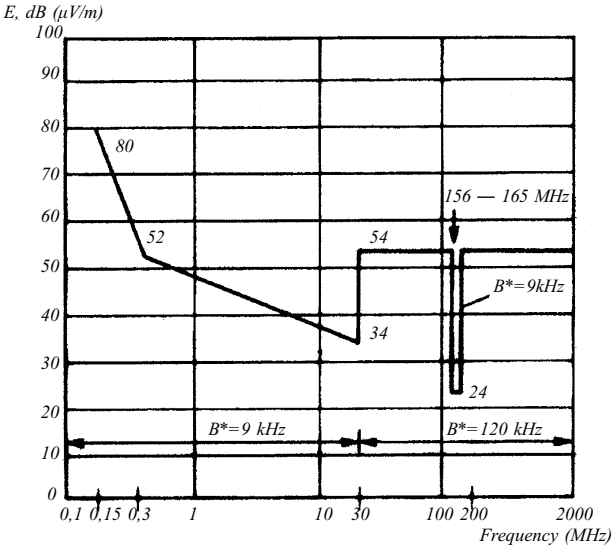


Fig. 6.1.2
Curve of the allowed radiated interference field strength E measured at a distance of 3 m from the equipment casing.
B^* — passband width of the measuring receiver

To make measurements, use shall be made of a quasi-peak measuring receiver. The passband width of the receiver in the frequency range from 150 kHz to 30 MHz and from 156 MHz to 165 MHz shall be 9 kHz and in the frequency range from 30 MHz to 156 MHz and from 165 MHz to 2GHz shall be 120 kHz.

At frequencies from 150 kHz to 30 MHz, the strength of the magnetic component of the electromagnetic field shall be measured. A loop antenna shall be used as the measuring antenna. The size of such antenna shall fit within a square with a side of 60 cm. As an alternative, a ferrite-rod antenna may be used.

When the magnetic field strength is converted into an equivalent electric field strength, a correction factor of +51,5 dB shall be taken into account.

For frequencies in excess of 30 MHz the strength of the electromagnetic field electric component shall be measured. The measuring antenna shall be a balanced dipole, shortened dipole or other antenna with a high directivity.

The size of the measuring antenna in the direction to the equipment being tested shall not exceed 20 % of the distance thereto. At frequencies more than 80 MHz a possibility shall be provided of changing the height of the antenna centre position in relation to the earth from 1 m to 4 m.

The test room shall have a metal earth plane. The equipment to be tested shall be presented in full configuration with all inter-unit connecting cables and installed in the normal working position.

If the equipment being tested consists of several units, the connecting cables (including the microwave ones) between the basic and all other units shall be of maximum length stated in the manufacturer's specification. The existing input and output ports of the equipment being tested shall be connected to the equivalents of the usually used auxiliary equipment with the use of cables of maximum length specified by the manufacturer.

The surplus length of the cables shall be coiled and located at 30 – 40 cm (horizontally) from the connectors to which they are hooked up. If this is impracticable, the position of the surplus length of cables shall be as close as possible to the stated requirement.

The measuring antenna shall be located at a distance of 3 m from the equipment being tested. The antenna centre shall be situated by at least 1,5 m above the earth plane. To determine the maximum interference level the antenna which measures the electric field strength shall be adjusted in the vertical extent only and be capable of rotating to obtain horizontal and vertical polarization. The antenna itself shall remain parallel to the floor. In order to determine the maximum interference level provision shall be made for movement of the antenna around the equipment being tested or for rotation of the equipment itself located in the orthogonal plane of the measuring antenna at its middle point level.

6.2 Immunity to external electromagnetic interference. Methods and required results of the tests.

When conducting these tests, the equipment shall be presented in its normal working configuration and operate under normal conditions.

During the tests for immunity to external electromagnetic interference the results shall be assessed against the performance criteria related to the working conditions and functional purpose of the equipment under test. These criteria shall be defined as follows:

performance criterion A. The equipment being tested shall continue to operate as intended during and after the tests. No degradation of performance or loss of functions specified in an appropriate standard for the equipment and technical documentation of the manufacturer shall be allowed;

performance criterion B. The equipment being tested shall continue to operate as intended during and after the tests. No degradation of performance or loss of functions specified in an appropriate standard for the equipment and technical documentation of the manufacturer shall be allowed. Nevertheless, degradation or loss of functions or performance which can be self-restored may be allowed during the tests, but no change in the set mode or essential data shall be permitted;

performance criterion C. Temporary degradation or loss of functions or performance may be allowed during the tests. Along with that, a self-recoverable function is ensured or restoration of the disturbed functions or performance can be provided in the end of the tests through the use of adjustments in accordance with the standard for the equipment and technical documentation of the manufacturer.

The scope of the tests and resistance to electromagnetic interference are given in Table 6.2.

Table 6.2

Nos	Properties of equipment to be checked during the tests	Equipment intended for installation on board ships		
		In internal spaces	On open deck	Portable
1.	Immunity to conductive low frequency interference	+ performance criterion A	+	—
2.	Immunity to conductive radio frequency interference	+ performance criterion A	+	—
3.	Immunity to radiated radio frequency interference	+ performance criterion A	+	+
4.	Immunity to nanosecond pulse interference due to fast transients on of a.c. supply, signal and control lines	+ performance criterion B	+	—
5.	Immunity to microsecond pulse interference due to slow transients on a.c. supply lines	+ performance criterion B	+	—
6.	Immunity to power supply short-time variation	+ performance criterion B	+	—
7.	Immunity to power supply failure	+ performance criterion C	+	—
8.	Immunity to electrostatic discharges	+ performance criterion B	+	+

If the equipment contains a radio receiver, the prescribed working frequencies of the equipment together with any known false responses shall be excluded from the tests for immunity to conductive and radiated interference.

6.2.1 Immunity to conductive low frequency interference.

These tests simulate effect of the harmonic components in the a.c. supply lines or voltage ripple in the d.c. lines. These tests shall not be applied to the equipment supplied solely by accumulators.

The equipment shall remain operable (performance criterion A) when additional test voltages in the frequency range from 50 Hz to 10 kHz are superimposed on its supply voltage:

for equipment supplied by direct current:

sine voltage the effective value of which is 10 % of the nominal supply voltage;

for equipment supplied by alternating current:

sine voltage the effective value of which changes depending on the frequency as shown on Fig. 6.2.1.

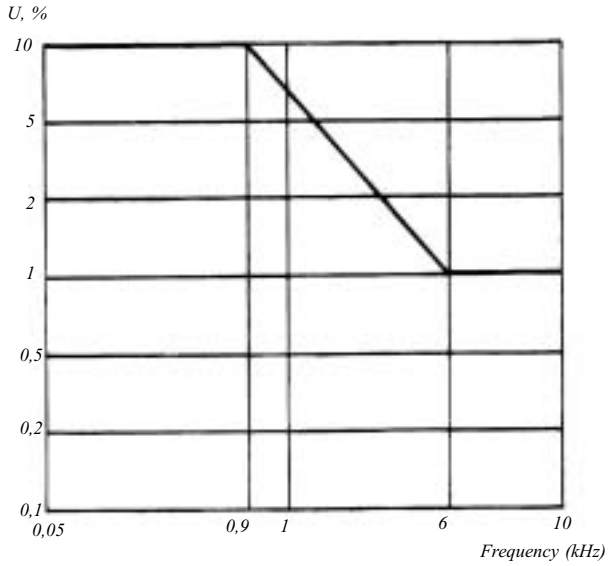


Fig. 6.2.1
Test voltage curve during the check of the equipment for immunity to low frequency radio interference

In specific cases, the maximum power of the voltage applied additionally shall be restricted by up to 2 W.

6.2.2 Immunity to conductive radio frequency interference.

These tests simulate the effect of disturbances induced in the supply, signalling and control circuits due to turning-on of the power supply source, engine ignition system, echo sounders and ship's radio transmitters operating on frequencies below 80 MHz.

The equipment to be tested shall be mounted on an insulated support located at an altitude of 0,1 m above the earthed surface. Cables connected to the equipment being tested shall de provided with suitable coupling and decoupling devices located at a distance of 0,1 m to 0,3 m from the equipment being tested.

The tests shall be carried out with the use of a generator connected in series with each coupling and decoupling device. The unused input terminals of the coupling and decoupling device used for connection of the test generator shall be loaded by an equivalent with noninductive impedance equal to the characteristic impedance of the cable. The test generator shall be tuned for each circuit design of the coupling and decoupling device; whilst so doing, the additional and tested equipment shall be disconnected and replaced by noninductive resistors of suitable ratings (when the cable resistance is 50 Ohm additional resistors shall be of 150 Ohm). The test generator shall be tuned in such a way as to provide a non-modulated electromotive force of the required level at the input terminals of the equipment being tested.

The tests shall be carried out at the following levels of test signal:

effective voltage value of 3 V at the frequency varying in the range from 10 kHz to 80 MHz;

effective voltage value of 10 V at points with frequencies: 2 MHz, 3 MHz, 4 MHz, 6,2 MHz; 8,2 MHz, 12,6 MHz, 16.5 MHz, 18.8 MHz, 22 MHz and 25 MHz.

The modulation frequency shall be 400 Hz $\pm$ 10 % at the modulation depth 80 % $\pm$ 10 %.

The frequency variation rate shall not exceed $1{,}5 \times 10^{-3}$ decade/s in order to provide a possibility of finding any fault of the equipment being tested.

6.2.3 Immunity to radiated radio frequency interference.

These tests simulate the effect of radio transmitters operating on frequencies over 80 MHz, for example, shipboard fixed and portable VHF radio located nearby the equipment.

The equipment to be tested shall be installed in a suitable screened space or in an anechoic chamber the size of which is commensurable with the size of the equipment. The equipment being tested shall be installed in an uniform (homogenous) field zone and insulated from the floor by a di-electric base. The tests shall be carried out in all orientations (on all sides) of the equipment.

If the cables for the equipment to be tested are not specified, non-screened parallel conductors shall be used. These conductors shall be subjected to the electromagnetic field from a distance of 1 m away from the equipment being tested.

The frequency variation rate shall be of $1{,}5 \times 10^{-3}$ decade/s and be sufficient for detecting any faults of the equipment being tested. Separately, during the tests, any frequencies at which the equipment is particularly sensitive to interference shall be analyzed.

The equipment shall remain operable (performance criterion A) when arranged in a modulated electric field with a strength of 10 V/m and when the frequency varies in the range from 80 MHz to 2GHz. The modulation frequency shall be 400 Hz ± 10 % at the modulation depth of 80 % x 10 %.

6.2.4 Immunity to nanosecond pulse interference due to fast transients on a.c. power supply, signal and control lines.

These tests simulate the fast low-energy transients generated by the equipment the switching-on of which is accompanied by sparking at con-tacts.

The equipment shall remain operable (performance criterion B) if pulse voltage with the following parameters is applied to the input ports of the supply sources, signal and control lines:

rise time — 5 ns (at 10 % — 90 % amplitude level)

duration — 50 ns (at 50 % amplitude level)

amplitude — 2 kV at differential input ports of the a. c. supply sources (to be conducted into power supply circuits in relation to the casing) and 1 kV at the input ports of the signal and control lines relative to the common earthed input port (to be conducted into the signal and control lines with the use of a standard capacitive coupling clamp)

repetition rate — 5 kHz (1kV), 2.5 kHz (2kV)

application —15 ms burst every 300 ms

duration — from 3 to 5 min for each positive and negative pulse polarity.

6.2.5 Immunity to microsecond pulse interference due to slow transients on a.c. power supply lines.

These tests simulate effect of the high-energy pulse voltages induced by a thyristor switching on a.c. power supplies.

The equipment shall remain be operable (performance criterion B) if a pulse voltage with the following parameters is applied to its supply lines:

rise time — 1,2 μs (at 10 % — 90 % amplitude level)

duration — 50 μs (at 50 % amplitude level)

amplitude — 2 kV – line/earth, 1 — kV — line/line

repetition rate — 1 pulse per minute

duration — 5 min for each positive and negative pulse polarity.

6.2.6 Immunity to power supply short-term variation.

These tests simulate variations of the voltage and frequency due to large changes in load. The tests shall not be applicable to d.c. powered equipment.

The variation of parameters of the supply line shall be applied using a programmable power supply source.

The equipment shall remain be operable (performance criterion B) at the following variations of the parameters of the supply line relative to the nominal values during 10 min.:

voltage: nominal value +(20 ± 1) %, duration: 1,5 s ± 0,2 s;

frequency: nominal value + (10 ± 0,5) %, duration: 5s ± 0,5s, with the stated changes of parameters being superimposed;

voltage: nominal value — (20 ± 1) %, duration: 1,5s + 0,2s;

frequency: nominal value — (10 ± 5) %, duration: 5s ± 0,5s, with the stated variations of parameters being superimposed.

Time of the voltage and frequency rise and decay shall be 0,2s ± 0,1s (at 10 % — 90 % amplitude level).

6.2.7 Immunity to power supply failure.

These tests simulate short breaks in the ship's power supply due to change-over to another supply source or due to breaker drop-out. These tests shall not be applied to the equipment supplied solely from the accumulator batteries.

The equipment shall remain be operable (performance criterion C) after being subjected to three breaks in power supply of duration 60 s each. In this case the software shall not be corrupted and the essential data stored in the digital memory of the system shall not be lost.

6.2.8 Immunity to electrostatic discharge.

These tests simulate the effect of electrostatic discharges from personnel which may occur in environments which cause them to become charged, such as contacts with artificial fibre carpets or vinyl garments.

The tests shall be carried out using an electrostatic discharge generator (energy storage capacitance of 150 pF and discharge resistance of 330 Ohm connected to discharge tip). The equipment under test shall be placed on, but insulated from, a metal ground plane which shall projects at least 0,5 m beyond the equipment under test on all sides. Discharges from the generator shall be applied to those points and surfaces which are accessible to personnel during normal usage. During the tests the generator shall be held perpendicular to the surface, and the positions at which discharges can be applied selected by an exploration with 20 discharges per minute. Each position shall then be tested with 10 discharges positive and negative with intervals of at least 1 s between discharges to allow for any mis-operation of the equipment under test to be observed. Contact discharge is the preferred method; but air discharge shall be used where contact discharge cannot be applied, such as on painted surfaces.

In order to simulate discharges on objects placed or installed near the equipment under test, 10 single contact discharges, positive and negative, shall be applied to the ground plane at positions on each side of, and 0,1m from, the equipment under test.

A further 10 discharges shall be applied to the centre of the ground plane, with this plane in enough different positions so that the four faces of the equipment under test are completely illuminated.

The equipment shall remain be operable (performance criterion B) at the test discharge voltage levels of 6 kV for the contact discharge and 8 kV for the air discharge.

7. Determination of magnetic compass safe distance.

At each unit of equipment usually located in way of a standard or a steering compass the minimum safe distance between such unit and compass shall be indicated in order to install such unit. Alternatively, the information on the minimum safe distance to magnetic compass may be indicated in the technical documentation for radio equipment, except portable equipment.

The compass-safe distance is defined as the minimum distance between the nearest point of testing equipment and the centre of compass or magnetometer when a deviation of the compass is less than 5,4 °/*B* for the standard compass and 18 °/*B* for the steering compass, where *B*, μT – is the horizontal component of terrestrial magnetic field induction at the place of the equipment testing.

For determination of compass-safe distance the magnetic compass shall be used having the compass card scale interval equal to 0,1°.

During the tests the unpowered equipment is advanced to the magnetic compass till the deviation is equal to 5,4 °/B (18 °/B).

Similar tests shall be carried out when the equipment is powered.

Further, inspection of the magnetic compass safe distance is performed after magnetization of equipment in the unpowered condition. For magnetization the direct current field is used with the strength 120 A/m with imposition of alternating current field with the frequency 50 Hz and effective strength value of 1430 A/m. In case the testing equipment may be damaged as the result of such influence, action of alternating current field is excluded. Field direction shall be such that the resulting magnetization is the greatest. Magnetized unpowered equipment shall be advanced to the magnetic compass till the deviation is equal to 5,4 °/B. The distance between the nearest point of equipment and the centre of the compass shall be measured.

During each test the equipment shall be rotated to define the direction where the maximum deviation is revealed.

The greatest the distance obtained under all these conditions is the safe distance. Distances shall be rounded up to the nearest 5 or 10 cm.

8. Determination of electromagnetic radiofrequency radiation.

Radio equipment which is designed to radiate electromagnetic radio frequency energy at frequencies above 30 MHz should not produce dangerous E-field level at the work places.

Power flux density or the corresponding electromagnetic field strength shall be measured at the distance 0,2 m from the units of radio transmitters, feeder components and switching devices.

Measurements shall be performed at the level: 0,5; 1; 1,7 m from the floor. Depending of the particular conditions of the equipment arrangement the measurements may be carried out at other levels also.

Equipment shall be operated at the maximum radiant power.

In case the measured value of flux density of electromagnetic field power exceeds 10 and 100 W/m^2, the measurements are to be repeated at greater distance from the equipment. A number of measuring points shall be sufficient for specifying the boundaries of the area corresponding to the said levels. Maximum distances at which power flux density reaches 10 and 100 W/m^2 shall be stated in the technical documentation for radio equipment.

Measuring of intensity of electromagnetic fields in the frequency range up to 300 MHz shall be carried out by measuring instrumentation intended for determination of root-mean-square value of electromagnetic field strength, and within the range from 300 MHz up to 2 GHz – by measuring instrumentation intended for determination of average values of power flux density.

9. Determination of emission from the visual display units.

Visual information display units of radio equipment shall be tested for the level of generated electrostatic, magnetic and electromagnetic fields (except those visual display units where the maximum number of displayed text lines is four).

Radiation from visual display units with the display diagonal size up to 0,5 m should not exceed the levels given in Table 9.

Table 9

Parameter to be measured	Frequency range	Maximum admissible values
Electromagnetic field strength at the distance of 30 cm from the front side of the unit	5 Hz – 2 kHz	10 V/m
	2 – 400 kHz	1 V/m
Electromagnetic field strength at the distance of 50 cm from the equipment in every direction	2 – 400 kHz	1 V/m
Magnetic induction at the distance of 30 cm from the front side of the unit	5 Hz – 2 kHz	200 nT
Magnetic induction at the distance of 50 cm in every direction	5 Hz – 2 kHz	200 nT
	2 – 400 kHz	25 nT
Electrostatic field strength at the distance of 10 cm from the front side of the unit	—	5 ±0,5 kV/m

Measuring of the electrostatic field strength shall not be carried out for the units during the operation of which the electrostatic potential does not exceed 500 V.

While conducting the measurements of the equipment radiation any de-gaussing arrangements shall be switched off. The plane of the display screen shall be positioned vertically, where practicable. Equipment and measurement instrumentation shall be grounded. There shall be at least 50 cm clearance between the equipment to enclosures of the measurement instrumentation and other metal or grounded objects.

Measurements shall be carried out with the powered visual display units when the operator and service controls are placed in the positions enabling the maximum radiation on retention of normal capacity for work. Internal settings not intended for adjustment during the normal operation of the equipment are not considered as service ones. Units provided with switching of operating modes shall be checked in the modes with the minimum and maximum scanning frequency. Image brightness shall be set to maximum but not exceeding 100 cd/m^2. Contrast shall be set so that the background raster is just visible in normal room lighting. The screen shall display the image with the maximum density of information typical for the particular kind of work. The image pattern shall be described in the test report.

Measurements of strength of electromagnetic field and magnetic induction shall be carried out in front of the screen centre of the unit at the distance of 30 cm on the normal from the screen, as well as at the height of the screen centre round the equipment at the distance equal to the sum of the maximum depth of equipment and 50 cm. During the last measurement the measurement probe shall be kept fixed and the equipment shall be rotated around vertical axis. While measuring the strength of electromagnetic field the rotation of the equipment is carried by steps of 90°. While magnetic induction measuring the rotation of the equipment is carried by steps of 45°, and the height of the measurement probe is changed of ± 30 cm from the height of the screen centre.

Electrostatic field shall be measured using the suitable instrument mounted in the centre grounded square $0,5 \times 0,5$ m metal plate. The plate shall be placed parallel to the plane of the display screen so that the measurement probe is 10 cm from the screen centre.

For the visual display unit with the display diagonal over 0,5 m the measurements of the maximum distance shall be measured, where:

magnetic induction does not exceed 250 nT within the frequency range 5 Hz to 2 kHz and 150 nT within the frequency range 2 to 400 kHz;

electric field strength is no more than 15 V/m within the frequency range 5 Hz to 2 kHz and 10 V/m within the frequency range 2 to 400 kHz;

electrostatic field strength does not exceed $5 \pm 0,5$ kV/m.

These distances shall be specified in the technical documentation for the equipment.

Measurements shall be carried out using the instrumentation with the permissible basic relative error not exceeding ± 20 %.

10. Determination of X-radiation level

Measurements of X-radiation level are performed for the equipment which might emit X-radiation during its operation (cathode-ray tube, transceiver components, etc.).

None of the equipment shall give rise to a dose rate above 5 μJ/kgh (0,5 mrem/h) at 50 cm distance from the surface of the equipment.

Measuring of X-radiation is carried out using the suitable X-ray survey instrument at all typical operating conditions of the equipment. The controls of the equipment effecting the radiation level shall be set in the positions ensuring the maximum radiation. Inspection of the entire surface of the X-radiation source shall be carried out till the maximum radiation intensity is detected. The indicator of the instrument shall be moved at 50 mm distance from the equipment with the speed enabling to record the steady readings of the instrument. For control the measurement results of the natural background radiation power in the area of location of the equipment subject to checking with the switched-off source of radiation. Measurements shall be carried out by the instrumentation with the permissible basic relative error not exceeding ± 20 %.

11. Measuring of acoustic noise level.

During the tests the level of acoustic pressure producing by the radio equipment during the operation shall be checked.

Acoustic noise level producing by the radio equipment during the operation (with the switched-off audible alarm) shall not exceed 60 dB (A) at the distance of 1 m from any part of the equipment. Acoustic noise level producing by the audible alarm at the distance of 1 m from the source of radiation shall be within the range of 75 to 85 dB.

Measurements are carried out in the laboratory by means of sound pressure-level meter with the function of frequency response analyzer complying with the IEC 60651 and IEC 60804 requirements, 1-st grade of accuracy, with the frequency response weighted according to "A" type.

APPENDIX 2

ADDITIONAL TECHNICAL DOCUMENTATION ON NAVIGATIONAL EQUIPMENT OF SEA-GOING SHIPS

Recommendation on performance standards for gyrocompasses (Resolution A.424(XI)).

Recommendation on performance standards for radar equipment (Resolution MSC.64(67), Annex 4).

Performance standards for automatic radar plotting aids (Resolution A.823(19)).

Recommendation on performance standards for electronic chart display and information systems (ECDIS) (Resolution A.817(19) as amended by Resolution MSC.86(70)).

Accuracy standards for navigation (Resolution A.529(13)).

Performance standards for shipborne LORAN-C and CHAYKA receivers (Resolution A.818(19)).

Adoption of the revised performance standards for shipborne Global Posi-tioning System (GPS) receiver equipment (Resolution MSC.112(73)).

Adoption of the revised performance standards for shipborne GLONASS receiver equipment (MSC.113(73)).

Adoption of the revised performance standards for shipborne DGPS and DGLONASS maritime radio beacon receiver equipment (Resolution MSC.114(73)).

Adoption of the revised performance standards for shipborne combined GPS/GLONASS receiver equipment (Resolution MSC.115(73)).

Adoption of the revised performance standards for heading control systems (Resolution MSC.64(67), Annex 3 and Resolution MSC.74(69), Annex 2).

Recommendation on performance standards for universal shipborne automatic identification system (AIS) (Resolution MSC.74(69), Annex 3).

Performance standards for echo-sounding equipment (Resolution A.224 (VII) as amended by Resolution MSC.74(69), Annex 4).

Performance standards for devices to indicate speed and distance (Resolution A.824 (19) as amended by Resolution MSC.74(69), Annex 4.

Performance standards for rate-of-turn indicators (Resolution A.526 (13)).

Recommendation on unification of performance standards for navigational equipment (Resolution A.575 (14)).

Recommendation on methods of measuring noise levels at listening posts (Resolution A.343 (IX)).

As regards unification of ARPA symbols, see Circular MSC/Circ.563 and IEC Publication 872.

Recommendation on performance standards for radar reflectors (Resolution A.384 (X)).

Magnetic compasses carriage and performance standards (Resolution A.382(X)).

Performance standards for daylight signalling lamps (Resolution MSC.95(72)).

Performance standards for marine transmitting heading devices (Resolution MSC.116(73)).

Recommendation on performance standards for shipborne voyage data recorders (Resolution A.861 (20)).

Recommendation on performance standards for sound reception systems (Resolution MSC.86 (70), Annex 1).

Recommendation on performance standards for marine transmitting magnetic heading devices (Resolution MSC.86(70), Annex 2).

Recommendation on performance standards for an integrated navigation system (Resolution MSC.86 (70), Annex 3).

17 EQUIPMENT FOR THE PREVENTION OF POLLUTION FROM SHIPS

17.1 GENERAL

17.1.1 The provisions of this Section apply in technical supervision of the equipment for the prevention of pollution from ships, subject to technical supervision of the Register in accordance with the RS Nomenclature.

17.1.2 The Section establishes the procedure for performing the technical supervision of the Register during manufacture the equipment for the prevention of pollution from ships (PPS equipment).

17.1.3 General provisions for the organisation of the technical supervision are set out in Part I "General Regulations for Technical Supervision", the requirements for the technical documentation are set out in Part II "Technical Documentation".

17.1.4 This Section provides the following definition of the external examination of the equipment.

External examination is examination of a component, material, related parts, verification of the accompanying documents issued in accordance with the technical supervision form during the manufacture and other documentation defining the compliance of the supervised items with the approved technical documentation, for example, measurement results, availability of brands (if provided), results of flaw detection (if provided).

Based on the results of the external examination, the possibility of continuing the manufacturing process (treatment), installation, hydraulic test, etc. shall be explored.

17.1.5 All the materials and related parts intended for the PPS equipment shall have documents confirming the compliance of the material and manufacture method with those specified in the approved technical documentation. These documents shall be drawn up in conformity with the technical supervision form, specified by the RS Nomenclature.

17.1.6 The necessary tests and scope thereof, procedure for the survey of the PPS equipment and related parts shall be specified in accordance with the list of supervised items and the normative documents in force agreed with the Register.

17.1.7 Should the need arise, the Surveyor may carry out periodic checks and surveys not specified by the list but resulting from the Agreement on Survey or Recognition Certificate for Manufacturer, for example:

.1 check of inspection operations effectiveness;

.2 check of adherence to production process;

.3 check of assemblies and components not included into the list, the manufacture quality of which affects the performance of the equipment as a whole and their check at the final manufacture stage is impossible;

.4 survey and tests for issue of Type Test (Approval) Certificate for the product or Certificate for Production Process;

.5 survey with the aim to recognise the firm, laboratory, test station.

In all cases, where an impermissible defect or fault is detected at any stage of presentation of the supervised item, the Surveyor, if necessary, may require a repeat check of any preceding operation within the scope sufficient to reveal the causes and prevent occurrence of the defect.

17.1.8 The methods of inspection, tools and accessories for the check during the manufacture and installation of the PPS equipment shall be defined by the manufacturer on agreement with the Register and specified in the documentation on the production process.

17.1.9 The tolerance rates and installation not accounted for in the approved documentation on the manufacture shall be indicated in the documentation on the production process approved by the Register.

17.1.10 When conducting the hydraulic tests, it is necessary to be guided by the requirements of 1.3, Part IX "Machinery" of Rules for the Classification and Construction of Sea-Going Ships.

The conditions for conducting the hydraulic tests shall meet the standards in force and the following requirements:

.1 ambient air temperature shall be not less than 5 °C;

.2 difference in the temperature between the ambient air and medium used for the hydraulic tests shall not exceed 10 °C, to exclude sweating, use shall be made of a medium with a temperature exceeding the ambient air temperature;

.3 any work on the components subjected to the hydraulic test shall be prohibited.

17.1.11 Electrical equipment, automatic or remote control and measurement systems as well as the alarm, protection, indication devices shall be tested in association with the installation as intended for compliance with the requirements of Rules for PPS Equipment.

Prior to and after the tests, it is necessary to measure the insulation resistance of the electrical equipment and automation facilities.

17.1.12 Technical supervision during the manufacture of the PPS equipment under established production conditions shall be performed in accordance with 1.7 and 17.3.

17.1.13 Technical supervision during the manufacture of the pilot samples and products of the first-off production batch of the PPS equipment shall be performed in accordance with 1.5, 1.6, 17.4 and 17.5.

17.2 TECHNICAL DOCUMENTATION

17.2.1 The PPS equipment, components and assemblies shall be manufactured and production operations performed under the technical supervision of the Register following its approved technical documentation in compliance with 1.4.

17.3 TECHNICAL SUPERVISION DURING MANUFACTURE OF POLLUTION PREVENTION EQUIPMENT UNDER ESTABLISHED PRODUCTION CONDITIONS

17.3.1 General.

17.3.1.1 Technical supervision during manufacture of the PPS equipment shall be performed in conformity with the requirements of this Chapter within the scope specified in Table 17.3.1.1.

17.3.1.2 Components of the products, prior to assembling, shall be checked at random for the compliance with the drawing dimensions and the material used. The accompanying documents shall be verified as well.

17.3.1.3 The welds of the PPS equipment casings shall be double-sided or single-sided whith complete-penetration welds.

17.3.1.4 To obtain the required conjugation, the components to be joined shall not be adjusted through excessive tightening by bolts, clamps and fitted in cold condition by blows.

If necessary, on agreement with the Surveyor to the Register, they may be fitted by heating.

17.3.1.5 The components of the systems being part of the PPS equipment shall be subjected to hydraulic tests in accordance with the requirements 21.1 and 21.2, Part VIII "Systems and Piping" of Rules for the Classification and Construction of Sea-Going Ships.

17.3.1.6 The PPS equipment shall have a data plate showing the purpose of the equipment, name of the manufacturer, type and model, serial number and year of manufacture. The plate shall be securely fastened to the equipment.

Table 17.3.1.1

Nos	Items of technical supervision	Examination of material, blanks of assemblies and components	Verification of accompanying documents	External and internal examination	Check of welding operations	Check of component and assembly manufacture	Hydraulic tests	Check in operation
1	Equipment for the prevention of pollution by oil:							
	.1 15 ppm bilge separators	+	+	+	+	+	+	+
	.2 ballast and washing water discharge oil content meters	+	+	+	+	+	+	+
	.3 15 ppm bilge alarms	+	+	+	+	+	+	+
	.4 oil/water interface detectors in slop tanks	+	+	+	+	+	+	+
	.5 tank washing machines	+	+	+	+	+	+	+
2	Equipment for the prevention of pollution by sewage:							
	.1 sewage treatment plants	+	+	+	+	+	+	+
	.2 sewage comminution and disinfection systems	+	+	+	+	+	+	+
	.3 sewage pumps	+	+	+	+	+	+	+
3	Equipment for the prevention of pollution by garbage:							
	.1 incinerators	+	+	+	+	+	+	+
	.2 garbage treatment plants	+	+	+	+	+	+	+
4	Equipment for the prevention of pollution by noxious liquid substances carried in bulk:							
	.1 ventilation equipment	+	+	+	+	+	+	+
	.2 tank washing machines	+	+	+	+	+	+	+
	.3 pumps for collection of noxious substances	+	+	+	+	+	+	+
5	Equipment for the prevention of air pollution:							
	.1 diesel engines complying with Regulation 13, Annex VI of MARPOL 73/78 and the requirements of the Technical Code on Control of Emission of Nitrogen Oxides from Marine Diesel Engines	+	+	+	+	+	+	+
	.2 exhaust gas cleaning systems of diesel engines in accordance with the requirements of Annex VI of MARPOL 73/78	+	+	+	+	+	+	+
	.3 equipment for fuel oil sampling	+	+	+	+	+	+	+

N o t e . The PPS equipment shall be subjected to special and bench tests in accordance with 1.7.3 and also at the request of the Regional Office which performs supervision during the manufacture.

[1] When needed.

17.3.1.7 When replacing the related parts or incorporating structural modifications in the PPS equipment approved by the Register, type tests according to 1.7.3.3 shall be carried out.

17.3.1.8 The first stock-produced article of the PPS equipment shall be tested on the bench of the manufacturer in accordance with the program worked out in compliance with the test procedure (refer to Appendix 1) and approved by the Register.

Based on the positive results of the tests, Type Test (Approval) Certificates[1] shall be drawn up for the articles specified in 1.1 to 1.4, 2.1, 3.1.5.2 of Table 17.3.1.1 in accordance with Appendix 2:

.1 15 ppm bilge separators – in accordance with Form 2.4.17.1[2];

.2 15 ppm bilge alarms – in accordance with Form 2.4.11.1[2];

.3 for ballast and washing water discharge oil content meters – in accordance with Form 2.4.16.1[2];

.4 for oil/water interface detectors in slop tanks – in accordance with Form 2.4.19.1[1];

.5 for sewage treatment plants – in accordance with Form 2.4.13[1];

.6 for incinerators – in accordance with Form 2.4.12[2]

An instruction on drawing up and issuing Type Test (Approval) Certificates is given in Appendix 3.

17.3.1.9 For the articles and PPS equipment referred to in 1.5, 2.2, 2.3, 3.2, 4.1 to 4.3, 5.2 and 5.3 of Table 17.3.1.1, subject to fulfilment of the requirements of 17.3.1.8, Type Approval Certificates in accordance with Form 6.8.3 shall be drawn up as stipulated in Section 7, Part I "General Regulations for Technical Supervision".

17.3.1.10 For the stock-produced articles of the PPS equipment referred to in Table 17.3.11, the Register certificates in accordance with a set form shall be drawn up. Issuing certificates for the products specified in 1.1 to 1.4, 2.1, 3.1 and 5.2 of Table 17.3.1.1, an entry shall be made on availability of Type Approval (Test) Certificate with its number and date of issue.

17.3.1.11 The scope of the acceptance tests of the stock-produced articles shall be defined when approving the program based on the test results of the first stock-produced article.

17.3.2 15 ppm bilge separators.

17.3.2.1 The equipment and devices shall be checked for the ease of access to assemblies and components being subject to periodical inspection, maintenance and repair, as well as to functional tests on bench in accordance with a program worked out by the manufacturer and approved by the Register with due account of the features and functions of the meter of specific design. Each equipment shall be delivered with filled in manufacturer's certificate including the acceptance test report.

17.3.2.2 The installation quality of the pipelines and fittings as well as the cabling shall be surveyed by external examination. The tightness of the piping and fitting joints shall be checked during the hydraulic tests of the articles.

17.3.2.3 If the equipment incorporates a separator of centrifugal type it shall meet the requirements of Section 5.

17.3.3 15 ppm bilge alarms.

17.3.3.1 15 ppm bilge alarms bilge alarms shall be checked for the ease of access to assemblies and components being subject to periodical inspection and maintenance, as well as to functional tests on bench in accordance with a program worked out by the manufacturer and approved by the Register with due account of the features and functions of the meter of specific design. Each meter shall be delivered with filled in manufacturer's certificate including the acceptance test report.

17.3.4 Meters for automatic measurement of oil content in ballast and washing water discharge.

17.3.4.1 Each meter for automatic measurement of oil content in ballast and washing water discharge and each control section of the oil discharge monitoring and control system shall be subjected to functional tests on bench in accordance with a program worked out by the manufacturer and approved by the Register with due account of the features and functions of the meter of specific design. Each meter shall be delivered with filled in manufacturer's certificate including the acceptance test report.

17.3.4.2 The program of functional tests shall include:

.1 check of flow rate, pressure drop or other equal parameter whichever is applied;

.2 check of all external connections;

.3 check of all alarm devices built in the meter;

.4 check of correction of the readings for several concentrations when running on oil for which the meter is designated (check method may by any approved by the Register).

17.3.4.3 The program of functional tests of the oil discharge control section shall include:

.1 check of all signals;

.2 check of the functioning of the signal processing device and recording equipment when the simulated input signals on oil content, flow rate and speed are changed;

.3 check in case of change in the input signals when:

instantaneous rate of discharge of oil exceeds 30 l per nautical mile;

total quantity of oil discharged exceeds 1/30000 of the total quantity of cargo of the type concerned;

.4 check of actuation of an alarm when the overboard discharge is stopped and in alarm conditions;

[1] Hereinafter referred to as the Type Test Certificate.
[2] A Type Approval Certificate shall be issued.

.5 check of reception of signals when each input signal exceeds the effective capacity of the system.

17.3.5 Oil/water interface detectors in slop tanks.

17.3.5.1 Detectors are subject to functional tests similar to those specified in 17.3.4.1.

17.3.6 Tank washing machines for crude oil washing.

17.3.6.1 The machines shall be checked for the ease of access to the assemblies and components to be subjected to periodical inspection, maintenance and repair.

17.3.6.2 The quality of assembling shall be checked by external examination. The tightness of joints shall be checked during hydraulic tests of the articles.

17.3.6.3 The continuity of electric circuit of the hydraulic monitor from the nozzle to connecting flange shall be checked at the manufacturer's using a tester or other method approved by the Register.

17.3.7 Sewage treatment, comminution and disinfection systems, plants.

17.3.7.1 The systems shall be checked for the ease of access to the assemblies and components to be subjected to periodical inspection, maintenance and repair.

17.3.7.2 The quality of installation of the piping and fittings as well as installation of cabling shall be checked by external examination. The joint tightness of the piping and fittings shall be checked during the hydraulic tests of the items.

17.3.7.3 The safety devices shall be set to a pressure not exceeding 1,1 the working pressure.

17.3.8 Sewage pumps.

17.3.8.1 Sewage pumps shall meet the requirements of Sections 5 and 8.

17.3.9 Incinerators.

17.3.9.1 Incinerators shall be checked for the ease of access to the assemblies and components to be subjected to periodical examination and maintenance.

17.3.9.2 The quality of installation of the piping and fittings as well as installation of cabling shall be checked by external examination. The joint tightness of the piping and fittings shall be checked during the hydraulic tests of the items.

17.3.9.3 Before mounting of the refractory lining, it is necessary to examine walls which shall have no bulges, deflections and unevenesses in excess of 10 mm per 1 m.

17.3.9.4 After mounting it is necessary to check, by external examination, the quality of the refractory lining. The surface of the brickwork shall be smooth; as an exception, individual steps not exceeding 2 to 3 mm at joints and total uneveness of not more than 10 mm per 1m may be allowed. Mobility of the refractory lining or individual parts thereof shall not be allowed.

Deviation of the tuyere hole diameter from the prescribed value shall not exceed ± 5 mm and the misalignment of the tuyere hole and burner shall not exceed 2 mm.

17.3.9.5 Upon finalization of the complete assembling, it is necessary to test the incinerator jacket for tightness by air (if stipulated by the technical documentation). The pressure and permissible leaks in this case shall not exceed those specified in the approved technical documentation.

17.3.9.6 Each incinerator is subject to functional tests similar to those specified in 17.3.2.1. The tests shall be carried out in accordance with the IMO Guidelines for the implementation of Annex V of MARPOL 73/78 (Appendix 2 "Standard Specification for Shipboard Incinerators", item 2).

17.3.10 Garbage treatment plants.

17.3.10.1 Garbage treatment plants shall meet the requirements of 17.3.9.1 and 17.3.9.2.

17.3.11 Diesel engines of power output 130 kW and over

17.3.11.1 Diesel engines are tested on the manufacturer's bench in accordance with the requirements of the Technical Code on Control of Emission of Nitrogen Oxides from Marine Diesel Engines. Following the installation onboard a ship, diesel engines are checked by an engine parameter check method or using other methods provided by the Technical Code.

17.3.12 Exhaust gas cleaning systems of diesel engines complying with the requirements of Annex VI of MARPOL 73/78

17.3.12.1 The type testing of system models shall be carried out in accordance with the requirements of Chapter 5 of the Technical Code on Control of Emission of Nitrogen Oxides from Marine Diesel Engines. The system operation onboard a ship is verified according to the requiremnts of the Operation manual for such system.

17.3.13 Equipment for fuel oil sampling

17.3.1.3.1 Functional tests of samplers are carried out at the manufacturer plant prior to issuing Type Approval Certificate

17.3.14 Register documents.

17.3.14.1 Based on the test results, the Register documents shall be drawn up in accordance with 1.7.4 of Section 1.

17.3.14.2 Type Test (Approval) Certificates approved by the Register Head Office shall be issued for each item referred to under 1.1 to 1.4, 2.1 and 3.1 of Table 17.3.1.8.

17.3.15 Ventilators for the disposal of noxious liquid residues using ventilation procedures shall meet the requirements of Sections 5 and 10.

17.3.16 Washing machines shall meet the requirement of 17.3.6.

17.3.17 Pumps for noxious substances shall meet the requirements of Sections 5 and 10.

17.4 DETAILS OF TECHNICAL SUPERVISION DURING MANUFACTURE OF PILOT SAMPLES (BATCHES) OF THE POLLUTION PREVENTION EQUIPMENT

17.4.1 Technical supervision during manufacture of pilot samples (batches) of the pollution prevention equipment shall be performed by the Surveyor to the Register.

17.4.2 All requirements of this Chapter concerning the manufacture of the supervised items under established production conditions apply equally to the manufacture of pilot samples (batches). Assemblies and components with radically new design or new manufacturing technology shall be subjected to additional checking.

17.4.3 The pilot sample shall be subjected to bench tests in accordance with the procedure specified in Appendix 1 and the program approved by the Register in order to check the reliability and longterm performance of components, assemblies and articles as a whole as well as to check them for compliance with the parameters and characteristics specified in the technical documentation.

17.4.4 The pilot samples shall be subjected to the following tests:

.1 hydraulic tests in conformity with the requirements of 17.1.10;

.2 bench and special tests in conformity with the test program approved by the Register;

.3 tests of other types in conformity with the test program approved by the Register, if necessary;

.4 operational tests in conformity with 1.8 (if they are approved for such tests).

17.4.5 Bench tests shall be conducted in the presence of a representative from the Register Head Office as well as Regional Branch office performing supervision during the manufacture of the pilot sample.

17.4.6 Prior to the bench tests of the PPS equipment, it is necessary to make certain that the following documents are available:

.1 set of approved working drawings;

.2 approved test program;

.3 approved specifications;

.4 technical description and operating instruction;

.5 bench plan, technical description and operating instruction;

.6 Inspection Department's document on the readiness of the bench for the tests of pilot sample;

.7 Inspection Department's document on the readiness of the pilot sample for bench tests;

.8 documents of competent authorities which confirm positive results of the special tests (for explosion-proofness, etc.) if stipulated by the program;

.9 documents on related parts which confirm the Register supervision during the manufacture thereof;

.10 documents on verification of the instruments and automatic monitoring devices, made by a metrologic agency;

.11 certificate for the used oil products or the chemical analysis data of the oil products prepared by the competent authorities;

.12 documents on recognition of the laboratories which make the analysis of oily water samples.

17.4.7 Based on the bench test results the Register documents shall be drawn up as specified in 1.5.4.

17.5 DETAILS OF TECHNICAL SUPERVISION DURING MANUFACTURE OF THE FIRST-OFF PRODUCTION BATCH OF THE POLLUTION PREVENTION EQUIPMENT

17.5.1 Technical upervision during the manufacture of the first-off production batch of the PPS equipment shall be performed by the Surveyor to the Register.

17.5.2 All requirements of this Section concerning the manufacture of the supervised items under established production conditions apply equally to the manufacture of the first-off production batch.

17.5.3 The prototype of the first-off production batch shall be subjected to bench tests in accordance with the program approved by the Register.

The tests shall be conducted in the presence of a representative from the Register Head Office and Branch office which performs supervision during the manufacture of the first-off production batch.

17.5.4 Based on the test results, the Register documents shall be drawn up as specified in 1.6.4 of Section 1.

17.5.5 If the Survey Report for the last article of the first-off production batch confirms implementation by the manufacturer of the serial production of the articles and the appropriate form of supervision according to the RS Nomenclature, as well as if positive operational results of the first articles of the first-off production batch have been presented to the Register, then, based on the stated Report, the article concerned may be approved for the serial production.

APPENDIX 1

TEST SPECIFICATIONS FOR EQUIPMENT FOR THE PREVENTION OF POLLUTION

1. TEST SPECIFICATIONS AND PERFORMANCE STANDARDS FOR 15 PPM BILGE SEPARATORS TYPE APPROVAL

The technical requirements for tests and performance standards for 15 ppm bilge separators type approval are set forth in IMO Resolution MEPC.107(49) "Revised Guidelines and Specifications for Pollution Prevention Equipment for Machinery Space Bilges of Ships".

2. TEST SPECIFICATIONS AND PERFORMANCE STANDARDS FOR 15 PPM BILGE ALARMS TYPE APPROVAL

The technical requirements for tests and performance standards for 15 ppm bilge alarms type approval are set forth in IMO Resolution MEPC.107(49) "Revised Guidelines and Specifications for Pollution Prevention Equipment for Machinery Space Bilges of Ships".

3. SPECIFICATIONS FOR TYPE APPROVAL OF THE OIL CONTENT METER AND THE CONTROL SECTION OF AN OIL DISCHARGE MONITORING AND CONTROL SYSTEM

The technical requirements for the type approval of the oil content meter and the control section of an oil discharge monitoring and control system are set forth in IMO Resolution MEPC.108(49) "Revised Guidelines and Specifications for Oil Discharge Monitoring and Control Systems for Oil Tankers".

4. TEST SPECIFICATIONS FOR TYPE APPROVAL OF DETECTORS FOR DETERMINATION OF OIL/WATER INTERFACE IN SLOP TANKS

The technical requirements for tests for the type approval of detectors for the determination of the oil/water interface in slop tanks are set forth in IMO Resolution MEPC.5(XIII) "Specifications for oil/water interface detectors".

5.TEST SPECIFICATIONS FOR DESIGN, OPERATION AND CONTROL OF CRUDE OIL TANK WASHING MACHINES

The technical requirements for control of the operation of crude oil tank washing machines are set forth in IMO Resolution A.446(XI) "Revised Specifications for the Design, Operation and Control of Crude Oil Washing Systems".

6. TEST SPECIFICATIONS FOR TYPE APPROVAL OF SEWAGE TREATMENT PLANTS

The technical requirements for tests for the type approval of sewage treatment plants are set forth in IMO Resolution MEPC.2(VI) "Recommendations on International Effluent Standards and Guidelines for Performance Tests for Sewage Treatment Plants".

The technical requirements of IMO Resolution MEPC.159(55) "Revised Guidelines on Implementation of Effluent Standards and Performance Tests for Sewage Treatment Plants" shall be applied to tests for the type approval of sewage treatment plants for new ships the keel of which is laid on or after 1 January 2010, and for existing ships with contracts for delivery of new sewage treatment plants on or after 1 January 2010.

7. TEST SPECIFICATIONS FOR TYPE APPROVAL OF INCINERATORS

The technical requirements for tests for the type approval of incinerators are set forth in IMO Resolution MEPC.76(40) "Standard Specifications for Shipboard Incinerators".

8. TEST SPECIFICATIONS FOR SHIPBOARD INTERNAL COMBUSTION ENGINES IN ACCORDANCE WITH THE NOX TECHNICAL CODE

The technical requirements for tests of shipboard internal combustion engines being subject to Regulation 13, Annex VI of MARPOL 73/78 with the issuance of the relevant Certificates are set forth in the NOx Technical Code.

APPENDIX 2

TYPE TEST (APPROVAL) CERTIFICATE FOR EQUIPMENT FOR THE PREVENTION OF POLLUTION

1. Type Test (Approval) Certificate is a document of the Register, which certifies that the PPS equipment meets the requirements of the international documents specified in Appendix 1 of these Rules.

2. Type Test (Approval) Certificate does not supersede the Register Certificate to be issued for the finished product.

3. Type Test (Approval) Certificate is a compulsory document for the following items of supervision:

.1 Type Test Certificate:

for oil/water interface detectors in slop tanks (Form 2.4.19);

for sewage treatment plants (Form 2.4.13);

.2 Type Approval Certificate:

for 15 ppm bilge separators (Form 2.4.17.1);

for 15 ppm bilge alarms (Form 2.4.11.1);

for ballast and washing water discharge oil content meters (Form 2.4.16.1);

for incinerators (Form 2.4.12).

4. In order to obtain Type Test (Approval) Certificate, the item of supervision shall be surveyed and tested by the Surveyor to the Register.

5. The scope of tests of the supervised items in order to obtain Type Test (Approval) Certificate shall be specified on the basis of the requirements set out in the international documents specified in Appendix 1 of these Rules and additional requirements of this Section.

The tests shall be carried out in accordance with a program worked out by the disigner of the supervised item and approved by the Register.

6. Type Test (Approval) Certificate is issued if:

.1 full set of technical documentation for the manufacture of the PPS equipment approved by the Register is available;

.2 laboratories performing an analysis of the oily water samples meet the requirements of Appendices 1 to 3;

.3 results of the tests carried out in accordance with the approved program meet the requirement of the Register;

7. Type Test (Approval) Certificate shall be issued by the Register Head Office or, if specially authorized by the Head Office, by the Regional Branch office which performs supervision during the manufacture of the PPS equipment.

Type Test (Approval) Certificate drawn up by the Regional Branch office which performs supervision during the manufacture of the PPS equipment together with the attached documents specified by the Instruction on Drawing Up and Issue of the Type Test (Approval) Certificate (refer to Appendix 3) shall be submitted to the Register Head Office for approval.

8. Type Test (Approval) Certificate shall be issued to the supervised item without any limitation of its validity period.

9. The Register shall cancel Type Test (Approval) Certificate in the following cases:

.1 when the conditions of issuing the Certificate have been infringed;

.2 when amendments concerning matters within the competence of the Register have been inserted into the approved technical documentation without agreement with the Register;

.3 when intolerable defects have been detected or when the extent and stability of the cleaning capability of the equipment have been disturbed.

10. The list of the supervised items which have obtained Type Test (Approval) Certificate shall be published by the Register.

11. For the issuance of Type Test (Approval) Certificate, the Register charges a duty in accordance with the current time rates for performance of the Register basic services.

APPENDIX 3

INSTRUCTION ON DRAWING UP AND ISSUE OF TYPE TEST (APPROVAL) CERTIFICATE FOR THE EQUIPMENT FOR THE PREVENTION OF POLLUTION

1. Type Test (Approval) Certificate shall be issued in accordance with 17.3.14.2 of this Section.

2. Type Test (Approval) Certificate shall be issued by the Register on the basis of the test results in accordance with the following procedure:

.1 Head Office or, if specially authorized by the Head Office, the Regional Branch office which performs technical supervision during the manufacture of the stock-produced articles of the PPS equipment draws up and issues Type Test (Approval) Certificates for the supervised items listed in 1.1 to 1.4 and 3.1 of Table 17.3.1.1 of this Section.

Addenda to Type Test (Approval) Certificates shall be signed by the Surveyor who attended the tests of the PPS equipment and certified by his personal stamp;

.2 the drawn up Type Test (Approval) Certificates together with the Survey Report (Form 6.3.18) on the basis of which they are drawn up shall be sent to the Register Head Office for approval.

The following diagrams shall be attached to Type Approval Certificate for the 15 ppm bilge separator (Form 2.4.17.1):

diagram of test rig;

diagram of sampling arrangement;

.3 Type Test (Approval) Certificate shall be drawn up in three copies:

one copy, after having been approved by the Register Head Office shall be issued to the manufacturer of the PPS equipment;

one copy shall be kept by the Information Processing and Information Technology Implementation Department of the Register Head Office;

one copy shall be kept by the Regional Branch office performing supervision during the manufacture of the stock-produced articles of the PPS equipment;

.4 numbers shall be assigned to the Certificates by the Regional Branch office which has participated in the tests of the PPS equipment;

.5 the Certificates are drawn up in Russian and English (Forms 2.4.11.1, 2.4.12, 2.4.13, 2.4.16.1, 2.4.17.1, 2.4.19). In so doing, the Surveyor witnessing the tests signs addenda to the Certificates and certifies them with his stamp;

.6 the Certificates shall be signed by the management of the Register Head Office and certified by a round stamp with an anchor picture;

.7 the record of all the Certificates issued by the Register shall be kept by the Information Processing and Information Technology Implementation Department of the Register Head Office.

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