



**GUIDELINES
ON TECHNICAL
SUPERVISION
OF SHIPS
UNDER
CONSTRUCTION**

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Guidelines on Technical Supervision of Ships under Construction have been approved in compliance with the established approval procedure and come into force on 1 July 2018.

The Guidelines have been prepared on the basis of the Rules for Technical Supervision during Construction of Ships and Manufacture of Materials and Products for Ships, 2017, taking into account the amendments developed immediately before publication of the Guidelines.

On the entry into force of the Guidelines, Part V "Technical Supervision during Construction of Ships" of the Rules for Technical Supervision during Construction of Ships and Manufacture of Materials and Products for Ships become void.

In case of discrepancies between the Russian and English versions, the Russian version shall prevail.

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1 GENERAL

1.1 SCOPE OF APPLICATION

1.1.1 Guidelines on Technical Supervision of Ships under Construction¹ are applied in technical supervision during construction of ships subject to technical supervision of Russian Maritime Register of Shipping² and have been developed in elaboration of Section 13, Part I "General Regulations for Technical Supervision" of the Rules for Technical Supervision during Construction of Ships and Manufacture of Materials and Products for Ships³.

1.1.2 The provisions of this Section may apply with due regard to the details and differences in the processes of ship's construction inherent in the country of the Register technical supervision, and/or specific shipyard.

1.1.3 The Guidelines are intended for the RS experts and surveyors, designers and shipbuilders.

1.1.4 Provisions related to surveys and testing associated with technical supervision of the materials and products applied during construction, as well as to the welders' certification and welding procedure approval are given in Part III "Technical Supervision during Manufacture of Materials" and Part IV "Technical Supervision during Manufacture of Products" of the Rules for Technical Supervision.

1.1.5 The requirements of the Guidelines apply in full to the Russian Navy auxiliary vessels with regard to specific requirements given in Section 4 of the Guidelines on Technical Supervision during Design and Construction of Auxiliary Vessels of the Russian Navy.

1.1.6 Requirements for technical supervision during construction of nuclear ships and floating facilities, and nuclear support vessels are given in the Guidelines on Technical Supervision during Construction of Nuclear Ships and Floating Facilities, Nuclear Support Vessels, Manufacture of Materials and Products.

1.2 TERMS AND DEFINITIONS

1.2.1 Terms, definitions and abbreviations related to the general terminology applied in the Register normative documents are given in Section 1, Part I "General Regulations for Technical Supervision" of the Rules for Technical Supervision. Specific terms and definitions are given the relevant sections of the Guidelines.

1.3 REQUIREMENTS TO MEASURING EQUIPMENT USED IN SURVEYS

1.3.1 Measuring equipment, which the RS surveyors rely on to make decisions affecting classification or statutory certification, shall be individually identified and calibrated to the recognized national or international standards.

1.3.2 The RS surveyor may accept simple measuring equipment (e.g. rulers, measuring tapes, weld gauges, micrometers) without individual identification or confirmation of calibration, provided they are of standard commercial design, properly maintained and periodically compared with other similar equipment or test pieces.

1.3.3 The RS surveyor shall satisfy himself that other equipment (e.g. tensile test machines, ultrasonic thickness measurement equipment, etc.) is calibrated to a recognized national or international standard.

1.4 REGISTER TECHNICAL SUPERVISION

1.4.1 Technical supervision during construction of the ship hull, installation and testing of machinery, equipment, arrangements and outfit is performed by the RS surveyor.

1.4.2 Technical supervision is performed by supervision of items of technical supervision according to the List of Items of Technical Supervision⁴ (refer to 13.2 and 13.3, Part I "General Regulations for Technical Supervision" of the Rules for Technical Supervision), patrol (refer to 13.4, Part I "General Regulations for Technical Supervision"

¹Hereinafter referred to as "the Guidelines".

²Hereinafter referred to as "the Register, RS".

³Hereinafter referred to as "the Rules for Technical Supervision".

⁴Hereinafter referred to as "the List".

of the Rules for Technical Supervision and review of technical documentation taking into account the provisions of the relevant sections of the Guidelines.

1.5 VERIFICATION OF TECHNICAL DOCUMENTATION

1.5.1 Prior to the survey beginning, technical documentation related to an item of technical supervision shall be submitted to the RS surveyor, including the following:

.1 a set of the RS-approved technical documentation for ship under construction, including approved by/agreed with RS amendments and/or additions;

.2 shipyard's standards agreed with RS according to 2.18, Part I "General Regulations for Technical Supervision" of the Rules for Technical Supervision and the relevant sections of the Guidelines;

.3 type production processes (or general technical requirements) related to installation of systems, arrangements, equipment and outfit;

.4 specifications, methods, detailed design documentation and other normative documents containing the data to verify the compliance with the Register requirements and related to production processes or scope and procedures of the Register technical supervision.

2 SURVEY OF HULLS OF STEEL SHIPS

2.1 GENERAL

2.1.1 This Section regulates the procedure, mode and scope of technical supervision to fit the most widespread type production processes adopted in ship's construction with use of sectional, blocked methods or the combinations thereof when the hull is constructed at the building berth with pyramidal, island or block-building technologies.

If other building methods are used or new process is implemented which are omitted in the Section, the relevant requirements shall be developed by the RS Branch Office carrying out technical supervision of the ship¹ with due regard to particular conditions of production and the specific character of an item.

2.1.2 If the items of technical supervision are fully or partially manufactured in cooperation and supplied to the shipbuilding yard as hull products, these latter are covered by the appropriate chapters of the Section with due regard to Section 2, Part IV "Technical Supervision during Manufacture of Products" of the Rules for Technical Supervision.

2.1.3 The scope of the Section requirements includes the following RS surveyor main activities:

.1 examination of the parts of the ship covered by RS rules and by applicable statutory regulations for hull construction, to obtain appropriate evidence that they have been built in compliance with the specified rules and regulations, taking account of the relevant RS-approved drawings;

.2 appraisal of the manufacturing, construction, control and qualification procedures, including welding consumables, welding procedures, welded connections and assemblies, with indication of the relevant approval tests;

.3 witnessing inspections and tests as required in the RS rules used for ship construction, including materials, welding and assembling, specifying the items to be examined and/or tested and how (e.g. by hydrostatic, hose or leak testing, non-destructive examination (testing), verification of geometry) and by whom.

2.1.4 Technical supervision during manufacture of materials and equipment used for ship construction at the firm (manufacturer) is not included in these requirements.

2.1.5 Details of requirements for hull and machinery steel forgings and castings and for normal and higher strength hull structural steel are given in 3.2, 3.7 and 3.8, Part XIII "Materials" of the Rules for the Classification and Construction of Sea-Going Ships². Acceptance of these items is verified through the survey process carried out at the firm (manufacturer) and the issuing of the appropriate certificates in compliance with 2.4, Part III "Technical Supervision during Manufacture of Materials" of the Rules for Technical Supervision.

2.1.6 Additional requirements for oil tankers and bulk carriers subject to regulation II-1/3-10 of the International Convention for the Safety of Life at Sea, 1974 (SOLAS-74), as amended, contracted for construction on or after 1 July 2016 are given in 2.11.

2.2 DEFINITIONS

2.2.1 The hull structure is defined as follows:

.1 hull envelope including all internal and external structures;

.2 superstructures, deckhouses and casings;

.3 welded foundations, e.g. main engine seatings;

.4 hatch coamings, bulwarks;

.5 all penetrations fitted and welded into bulkheads, decks and shell;

.6 the fittings of all connections to decks, bulkheads and shell, such as air pipes and ship side valves — all items covered by the International Convention on Load Lines, 1966 (LL-66), as amended;

.7 welded attachments to shell, decks and primary members, e.g. crane pedestals, bitts and bollards, but only as regards their interaction on the hull structure.

2.2.2 Reference to documents also includes electronic transmission or storage.

2.2.3 Definition of survey methods which the RS surveyor is directly involved in: patrol, review, witness.

2.2.3.1 *Patrol* is the act of checking on an independent and unscheduled basis that the applicable processes, activities and associated documentation of the shipbuilding functions identified in Table 2.5.1 conform to the RS and statutory requirements.

¹Hereinafter referred to as "the RS Branch Office".

²Hereinafter referred to as "the Rules for the Classification and Construction".

2.2.3.2 Review is the act of examining documents in order to determine traceability, identification and to confirm that processes continue to conform to the RS and statutory requirements.

2.2.3.3 Witness is the attendance at scheduled inspections in accordance with the agreed inspection and test plan or equivalent to the extent necessary to check compliance with the survey requirements.

2.2.4 Part is a product manufactured from the material of one brand without assembly.

2.2.5 Unit is a technologically complete section of the hull structure consisting of several parts.

2.2.6 Section is technologically complete, separately manufactured hull section consisting of several units and parts.

2.2.7 (Section) block is a part of the ship's hull cut off, in major cases, by the planes parallel to the midship section and sometimes by the decks, and formed by sections, units and parts.

2.2.8 Critical structural areas (refer to item 2.5 of Table 2.5.1) are locations, which have been identified from calculations to require monitoring or locations, which have been identified from the service history of similar ships or ships of the series to be sensitive to cracking, buckling or corrosion, which would impair the structural integrity of the ship.

2.2.9 Welding procedure specification (WPS) is a document compiled by the manufacturer of welded structures and containing all the necessary information on welding of a particular joint, including specifications for materials, welding method, edge preparation data and all process parameters.

2.2.10 Building berth, for the purpose of the Section, is any building berth place where the ship's hull is constructed.

2.2.11 Shipyard is a shipbuilding utility or group of shops constructing ships and manufacturing hull structures.

2.2.12 Laying-down of a ship is installation at the building berth of a base section or block (island) in section or block (island) construction respectively, or such a stage of construction at which the mass of the hull part assembled comprises at least 501 or 1 % of the design mass of all hull materials, whichever is less.

2.2.13 Launching is a launch from a building berth under the hull mass, floating in a building or flooding dock, a mechanized launch including the ship's transfer onto the water using cargo-handling means, etc.

2.3 APPLICATION

2.3.1 The Section requirements cover the hull survey of all new construction of steel ships intended for classification and for international voyages except for:

.1 those defined in regulation 1/3 of SOLAS-74 (i.e. ships of war and troopships; cargo ships of less than 500 gross tonnage; ships not propelled by mechanical means; wooden ships of primitive build; pleasure yachts not engaged in trade, and fishing vessels);

.2 high speed craft as defined in 1.3.1, Chapter 1 of the International Code of Safety for High-Speed Craft, 2000 (2000 HSC Code);

.3 mobile offshore drilling units (MODU) as defined in 1.2.1, Chapter 1 of the Code for the Construction and Equipment of Mobile Offshore Drilling Units, 2009 (2009 MODU Code).

2.3.2 These requirements cover all statutory items relevant to the hull structure and coating, i.e. Load Line and SOLAS-74 Safety Construction.

2.3.3 These requirements do not cover the manufacture of equipment, fittings and appendages regardless whether they are made inside or outside of the shipyard, examples being as follows:

.1 hatch covers;

.2 doors and ramps integral with the shell and bulkheads;

.3 rudders and rudder stock;

.4 all forgings and castings integral to the hull.

Evidence of acceptance of these items shall be provided by the RS certificates and accompanying documentation from the firm (manufacturer) and verified at the shipyard.

2.3.4 These requirements apply to the installation into the ship, welding and testing of the following:

.1 items listed in 2.3.3;

.2 equipment forming part of the watertight and weathertight integrity of the ship.

2.3.5 These requirements apply to the hull structures and coating constructed at any of the following:

.1 shipyard facilities;

.2 sub-contractors at the shipyard facilities;

.3 sub-contractors at their own facilities or at other remote locations.

2.3.6 Provisions of this Section may apply to the hulls of the ships and floating facilities specified in 2.3.1.1 – 2.3.1.3, as well as to the ships with aluminum alloy hulls, as far as it is practicable and in cases when it is regulated by other Register normative documents.

2.4 QUALIFICATION AND ACTIVITY MONITORING OF RS PERSONNEL

2.4.1 The RS surveyor shall confirm through patrol, review and witness as defined in 2.2.3.1 – 2.2.3.3 that the ships are built using the RS-approved plans in accordance with the relevant RS and statutory requirements. The RS surveyor shall be qualified to be able to carry out the tasks and procedures shall be in place to ensure that his/her activities are monitored. Details are specified in Instruction for Activity Monitoring of RS Surveyors and RHO Experts and Procedure for Training and Qualification Maintenance of RS Engineering-Technical Personnel.

2.5 SURVEY OF THE HULL STRUCTURE

2.5.1 Table 2.5.1 provides a list of surveyable items for the hull structure and coating covered by the requirements of the Section, including:

.1 description of the shipbuilding functions;

.2 RS and statutory survey requirements;

.3 survey method required for classification;

.4 relevant RS and statutory requirement references;

.5 documentation to be available for the RS surveyor during construction;

.5.1 the shipyard shall provide the surveyors access to documentation required by classification, this includes documentation retained by the shipyard or other third parties

.5.2 the list of documents approved or reviewed by RS for the specific new construction are as follows:

plans and supporting documents;

examination and testing plans;

NDT plans;

welding consumable details;

welding procedure specifications;

welding plan or details;

welders' qualification records;

NDT operator's qualification records;

.6 documents to be inserted into the Ship Construction File (SCF) (refer to 2.10);

.7 a list of specific activities which are relevant to the shipbuilding functions. This list is not exhaustive and may be modified to reflect the construction facilities or specific ship type.

2.5.2 Evidence is also to be made available, as required, by the shipyard, to the RS surveyor whilst the construction process proceeds to prove that the material and equipment supplied to the ship has been built or manufactured under survey relevant to the RS and statutory requirements.

2.5.3 Additional comments and explanations related to surveys of the items of technical supervision listed in Table 2.5.1 are given in 2.12.

2.6 REVIEW OF SHIPYARD CONSTRUCTION FACILITIES

2.6.1 The RS surveyor shall familiarize with the shipyard's construction facilities, management processes and safety for review in compliance with the requirements of Table 2.5.1 prior to any steelwork or construction taking place in the following circumstances:

.1 where RS has none or no recent experience of the construction facilities (typically after a one year lapse) or when significant new infrastructure has been added;

Table 2.5.1

Hull Survey Requirements

No. Item	Shipbuilding function	Survey Requirements for Classification	Survey Method required for Classification	Reference*	Statutory requirements and relevant reference	Documentation available to RS surveyor during construction	Documentation for ship construction file	Specific activities	RS proposals for the project
1	Welding:								
1.1	welding consumables	classification approved separately at the manufacturer. (i.e. RS tested and approved at the firm (manufacturer))	review approval status and patrol, verify storage, handling and treatment in accordance with the firm (manufacturer's) requirements	IACS UR No. W17. Section 4.1 IACS Rec. No. 47. Section 4 of Part XIV of the Rules for the Classification and Construction		consumable specification, and approval status, copies of Certificate of Approval for Welding Consumables (COCM), delivery notes, certificates for ancillary materials, packing for materials. Handling and delivery records of welding consumables	not required	<p>identify consumables against approved list</p> <p>verify temporary and permanent storage facilities</p>	<p>e.g. kept dry, covered, where applicable heated. Perform drying of electrodes and welding fluxes according to the manufacturer's specification. Results for control of materials' handling, treatment and use shall be recorded in accordance with the shipyard's established order</p>
								verify traceability	e.g. random batch number checking
1.2	welders' qualification	qualified welders welding of hull structures shall be carried out by the qualified welders certified with the Welder Approval Test Certificate (C/C)	review of welder certification and patrol	Section 3.1 IACS Rec. No. 47. Section 5, Part XIV of the Rules for the Classification and Construction. Section 4, Part III of the Rules for Technical Supervision		shipyard's records with individual's identification	not required	verify welder qualification standard, (availability of C/C, validity terms, welder approval range as per welding positions, welders' identification)	

Table 2.5.1 — continued

No. Item	Shipbuilding function	Survey Requirements for Classification	Survey Method required for Classification	Reference*	Statutory requirements and relevant reference	Documentation available to RS surveyor during construction	Docu- menta- tion for ship con- struction file	Specific activities	RS proposals for the project
1.3	welding — mechanical properties (welding procedures)	all weld joint configurations, positions and materials to be covered by weld procedures (TTIC), approved by RS or by another IACS member available	documentation review and patrol	IACS UR No.W28. Section 3.2 Rec. IACS Rec. No. 47. Section 6 of Part III of the Rules for Technical Supervision		approved Table of the ship’s hull welding, approved hull structural drawings, Welding Procedure Approval Test Certificate (COTTIC), welding procedure speci- fications (WPS)	not required	verify that WPS are available at relevant workstations	
		RS witnesses all new weld procedure qualification tests carried out in the shipyard	witness					review of technical documentation on manufacture of hull structures aimed at identification of welding procedure and their correlation with the approved CTIC and COTTIC at the shipyard	
								CTIC review and approval developed during implementation of new welding procedures	
								participation in tests of the welded joints test pieces and sample tests with approval of weld procedures	
1.3a	welding equipment	correctly calibrated and maintained	patrol and review			plans, schedules of machinery and e q u i p m e n t maintenance and calibration, records	not required	verify in cooperation with the committed personnel of the shipyard condition of welding equipment and machinery	
								verify competence of the personnel performing calibration	
								verify calibration carried out in accordance with the firm (manufacturer's) recom- mendations	
								verify calibration in accordance with maintenance schedule	
1.3b	welding environment	satisfactory environment	patrol	Section 2 IACS Rec. No. 47. Chapter 2.1, Part XIV of the Rules for the Clas- sification and Construction		operational inst- ructions on perfor- ming welding works	not required	verify welding areas clean, dry, well lit	
								confirm relevant measures taken for any pre or post heat treatment, drying of surfaces prior to welding	
								verify welding consumables used and fluxes are protected against adverse environmental conditions and adequately prepared prior to use	

Table 2.5.1 — continued

No. Item	Shipbuilding function	Survey Requirements for Classification	Survey Method required for Classification	Reference*	Statutory requirements and relevant reference	Documentation available to RS surveyor during construction	Documentation for ship construction file	Specific activities	RS proposals for the project
1.3c	welding supervision	sufficient number of skilled personnel available at the shipyard, trained and certified by the competent body to carry out welded joint inspection and their quality assessment	review and patrol	Section 2.3, 3.3, IACS Rec. No. 47, IACS Rec. No. 20, Section 3 of Part XIV, Rules for the Classification and Construction				verify supervision is effective (patrols of weld procedures and weld joint testing efficiency by the shipbuilder)	
1.4	welding — surface discontinuities	substantially free from significant indications, satisfactory profile and size	visual examination, surface detection techniques, review of documents and patrol of operator	IACS Rec. No. 47, IACS Rec. No. 20, Part XIV of the Rules for the Classification and Construction		shipbuilder's and agreed standards containing criteria for weld joint quality assessment: _____, and Rules, as applicable, welding and NDT plans, NDT reports, operator qualifications	not required	identify workstations where NDT is carried out, e.g. panel line butt welds, castings into hull structure verify that NDT is carried out in accordance with approved plans, where applicable verify suitability of NDT methods verify that operators suitably qualified particularly where sub-contractors have been employed verify that NDT is carried out according to the acceptable process review of NDT records	
1.5	welding — embedded discontinuities	NDT is to be carried out by qualified operators capable of ensuring that welds are substantially free from significant indications	radiography and ultrasonic testing, review of documents and patrol of operator, examination of films	IACS Rec. No. 47, IACS Rec. No. 20 Chapters 3.2 and 3.3 of Part XIV of the Rules for the Classification and Construction		shipbuilders and agreed standards, containing criteria for weld quality assessment: _____, and Rules as applicable, welding and NDT plans, NDT reports, Operator qualifications. Approved plan of weld control and table of hull welding No. _____	not required	Identify of workstations where NDT is carried out, e.g. panel line butt welds, castings into hull structure verify NDT carried out in accordance with approved plans, where applicable verify suitability of NDT methods verify that operators are suitably qualified particularly where sub-contractors have been employed verify that records have been completed and are in accordance with recognized standards, e.g. IQI and sensitivity recorded	

Table 2.5.1 — continued

No. Item	Shipbuilding function	Survey Requirements for Classification	Survey Method required for Classification	Reference*	Statutory requirements and relevant reference	Documentation available to RS surveyor during construction	Documentation for ship construction file	Specific activities	RS proposals for the project
								verify that reports and radiographs have been evaluated correctly by the shipbuilder. Systematic review of radiographs carried out by the Surveyor verify equipment calibration satisfactory and in accordance with (firm) manufacturer's and agreed standards requirements verify NDT is carried out according to the acceptable process (according to agreed standards)	
2	Steel preparation and fit up:								
2.1	surface preparation, marking and cutting	traceability and acceptability of material, check of steel plates & profiles, materials type, scantling identification, testing marks	patrol	Sections 4, 5 IACS Rec. No. 47		material certificates, shipbuilder's marking/cutting production documents at the workstage — documents retained at the facility	not required	verify stockyard storage satisfactory verify material traceability, e.g. stamping identification against material certification, archiving of records verify transfer marking to new piece parts after treatment line verify shotblasting and primer coating for compliance with the shipbuilder's standard verify suitability of primer verify that steel grades can be identified verify machinery adjusted to maintain within IACS or firm (manufacturer's) recommendations verify accuracy of marking and cutting verify storage of piece parts	
2.2	straightening	approval of straightening methods/procedures against deformation	patrol and review	Section 6 IACS Rec. No. 47 2.1.15, Part XIV of the Rules for the Classification and Construction		shipbuilder's standards agreed with RS, procedures/technological processes approved by/agreed with RS	not required	verify that straightening processes are approved for the grade and type of steel, e.g. tmcp, z plate applied during construction verify that plates and sections are within approved tolerances	

Table 2.5.1 — continued

No. Item	Shipbuilding function	Survey Requirements for Classification	Survey Method required for Classification	Reference*	Statutory requirements and relevant reference	Documentation available to RS surveyor during construction	Documentation for ship construction file	Specific activities	RS proposals for the project
2.3	forming	maintain material properties acceptance of forming method against improper deformations	patrol	IACS Rec. No. 47		RS agreed ship-builder's procedure for hot forming	not required	verify that temperature control is exercised by the operator during hot forming	
								verify that suitable methods of temperature control are available when forming special steels and materials	
								verify that forming processes are acceptable	
2.4	conformity with alignment/fit up/gap criteria	verify mutual positioning and edge preparation of details to be connected for compliance with the agreed standards, CIIC and approved drawings	patrol	Sections 7, 8, 9 IACS Rec. No. 47, 2.2.1 Part XIV of the Rules for the Classification and Construction, The ship-builder's standards agreed with RS		shipbuilder's standards agreed with RS, CIIC, approved drawings, Table of welding	not required	verify the processes to ensure satisfactory fit up and alignment at all workstations	
								verify that edge preparations are reinstated where lost during fitting operations	
								verify remedial procedures are in place to compensate for wide gaps and alignment deviations	
2.5	conformity for critical areas, when defined, with alignment/fit up or weld configuration	verify mutual positioning and edge preparation of details to be connected for compliance with the agreed standards, CIIC and approved drawings	witness and review	Sections 7, 8, 9 IACS Rec. No. 47, 2.2.1 Part XIV of the Rules for the Classification and Construction, the shipbuilder's standards agreed with RS, Special instructions in the approved drawings		shipbuilder's standards agreed with RS, CIIC, approved drawings or a standard, Table of welding, shipyard's records	approved plans of critical areas if applicable	verify that the information relevant to the latest approved drawings is available at the workstations (yard facilities)	
								verify the processes to ensure satisfactory fit up and alignment at all workstations (yard facilities)	
								verify that edge preparations are reinstated where lost during fitting operations	
								verify remedial procedures are in place to compensate for wide gaps and alignment deviations	
3	Steelwork process, e.g. subassembly, block, grand and mega block assembly, preerection and erection, closing plates	compliance with approved drawings, visual examination of welding and material, check alignment and deformations	patrol of the steelwork process and witness of the completed item	Sections 6, 7, 8 IACS Rec. No. 47 Part II, XIV of the Rules for the Classification and Construction	1.1.6 Part II of the Rules	approved plans, shipbuilders inspection records, Shipbuilders and recognized standards and Rules as applicable, construction plan (steelwork subdivision)		verify that the information relevant to the latest versions of approved drawings are available at the workstations (yard facilities), working drawings comply with the latest version of approved drawings	
								verify that correct weld sizes have been adopted	
								verify operation of the welding processes at the different work stages is satisfactory	
								verify that piece parts are identifiable	
								verify that fit ups are within recognised tolerances	

Table 2.5.1 — continued

No. Item	Shipbuilding function	Survey Requirements for Classification	Survey Method required for Classification	Reference*	Statutory requirements and relevant reference	Documentation available to RS surveyor during construction	Documentation for ship construction file	Specific activities	RS proposals for the project
								verify that correct welding requirements specified in reference 1 of this Table have been adopted verify processes for closing plates etc. are acceptable confirm that steelwork is in accordance with the approved plan	
4	Remedial work and alteration	welding, check against deformation, alignment	review shipbuilder's records and witness	Section 9 IACS Rec. No. 47		permanent record of shipyard surveyable items (notices, flow-chart of deviations, bearer's notices, etc. on effects elimination and hanges to ship configuration)		verify that records have been maintained on recording of significant deviations from the approved documentation (miscut openings/trimming of framing members for pipe tunnels/cable runs, equipment installation, etc.) verify that all deviations brought to the attention of the RS by the shipbuilder and pertaining to the classification are approved by RS	
5	Tightness testing, including leak and hose testing, hydro-pneumatic testing	absence of leaks	patrols of preparation and testing processes, witness	UR IACS S14 Appendix 1 to Part II of the Rules for the Classification and Construction	Regulation II-1/11 of SOLAS, as amended	approved plan of testing the hull for watertightness, shipbuilder's inspection records	approved plan of testing the hull for watertightness	confirm that tank testing is carried out in accordance with the approved plan confirm the acceptability of methods used to carry out leak testing confirm that correct test pressures maintained for leak, hose and hydro and hydropneumatic testing and the testing results are satisfactory verify that adequate records of the testing results have been maintained	
6	Structural testing	structural adequacy of the compartments and tanks design	review and witness of the test	UR IACS S14 Appendix 1 to Part II of the Rules for the Classification and Construction	Regulation II-1/11 of SOLAS, as amended	approved plan of testing the hull for watertightness, shipbuilder's inspection records on testing performed	approved plan of testing the hull for watertightness	confirm that tank testing is carried out in accordance with the approved plan confirm that correct test pressures maintained for testing are satisfactory (with the approved plan testing the hull for watertightness) verify that adequate records of the tank testing results have been maintained	

Table 2.5.1 — continued

No. Item	Shipbuilding function	Survey Requirements for Classification	Survey Method required for Classification	Reference*	Statutory requirements and relevant reference	Documentation available to RS surveyor during construction	Documentation for ship construction file	Specific activities	RS proposals for the project
7	Corrosion protection system (coatings, cathodic protection, cathodic protection systems with impressed current except for coating system subject to PSPC)	salt water ballast tanks with boundaries formed by the hull envelope, and also bulk carrier hold internal surfaces, coamings and hatch covers shall have an efficient protective coating. Safety aspects of cathodic protection systems to be dealt with separately	review and report on builder's & manufacturer's documentation	UR IACS Z8, UR IACS Z9, UI IACS SC122, UR IACS F1 1.2.5.1 and 3.3.5.1 of Part II of the Rules for the Classification and Construction	Regulation II-1/3-2 of SOLAS, as amended	firm (manufacturer's) and builder's specification	corrosion protection specifications	verify that applied coatings are approved and review records of application verify that adequate records have been maintained and copied to the ship construction file	
	application antifouling systems		review	1.2.5.2, Part II of the Rules for the Classification and Construction	AFS-Convention	painting specification	coating specification and manufacturer's declaration	verify that adequate records have been maintained and copied to the ship construction file	
7.1	application of protective coatings for dedicated seawater ballast tanks in all types of ships and double-side skin spaces of bulk carriers subject to PSPC	monitor implementation of the coating inspection requirements	documentation review and patrolling	UI IACS SC223 Chapter 3.2 of Part III and Chapter 2.15, Part V of the Rules for Technical Supervision	Regulation II-1/3-2 of International Convention SOLAS-74, as amended	surface preparation and coating processes agreement signed by the shipyard, shipowner and coating manufacturer (the Tripartite Agreement)	Coating Technical File (CTF)	verify that applied coatings are approved and review records of application in accordance with Chapter 7 of Annex to IMO MSC.215(82).	

Table 2.5.1 — continued

No. Item	Shipbuilding function	Survey Requirements for Classification	Survey Method required for Classification	Reference*	Statutory requirements and relevant reference	Documentation available to RS surveyor during construction	Documentation for ship construction file	Specific activities	RS proposals for the project
8	Installation, welding and testing of the following:								
8.1	hatch covers	tightness and securing	witness	IACS Rec. 14, UR IACS S14 Appendix 1 to Part II, including 7.10, Part III of the Rules for the Classification and Construction	Reg. 13, 14, 15 and 16 of the International Convention on Load Lines 1966	approved drawing with proper information on covers. approved plan of testing the hull for watertightness. Shipbuilder's testing reports	details of equipment forming part of the watertight and weather-tight integrity of the ship, structural drawings	confirm leak test of hatch covers confirm feasible cover operation and proper securing test	
8.2	doors and ramps integral with the shell and bulkheads	tightness and securing	witness	UR IACS S14 Appendix 1 to Part II of the Rules for the Classification and Construction	Regulation II - 1/18 International Convention SOLAS-74, as amended, Regulations 12 and 21 of International Convention on Load Lines 1966	approved plan of testing the hull for watertightness, shipbuilder's inspection records on testing performed	details of equipment forming part of the watertight and weather-tight integrity of the ship, structural drawings	confirm leak tests confirm feasible cover operation and proper securing test confirm safety device proper operation ensure correct maintenance logs/manuals supplied with the ship construction file	

Table 2.5.1 — continued

No. Item	Shipbuilding function	Survey Requirements for Classification	Survey Method required for Classification	Reference*	Statutory requirements and relevant reference	Documentation available to RS surveyor during construction	Docu- menta- tion for ship con- struction file	Specific activities	RS proposals for the project
8.3	rudders	fitting	witness	UR IACS S14 Appendix 1 to Part II of the Rules for the Classification and Construc- tion		approved drawings, shipbuilder's inspec- tion records	details required, structural drawings	confirm alignment and mounting and fitting up to the connection to the tiller	
								confirm function tests	
								verify fitting of pintles and all securing bolts	
								verify all fit up records including all clearances maintained and placed into ship construction file	
8.4	forgings and castings	compliance with approved drawings, visual examination of welding and material, check alignment and deformations	patrol of the process and witness of the completed item	IACS UR No. W7, W8 3.7 and 3, Part XIII of the Rules for the Classification and Construc- tion		approved plans, shipbuilder's inspec- tion records, ship- builder's and recog- nised standards, and Rules as applicable, construction plan (steel- work sub-division)	copies of certifi- cates of forgings and castings	verify casting and forgings against material certificate	
								verify that correct welding and fit up requirements specified in reference 1, 2.4 and 2.5 of this Table have been adopted	
								verify that material certificates are included in the ship construction file	
	appendages							verify that correct welding and fit up requirements specified in reference 1, 2.4 and 2.5 of this Table have been adopted	
8.5	equipment forming the watertight and weathertight integrity of the ship, e.g. (overboard discharges, air pipes, ventilators, etc.)	tightness and securing	witness	4.4 and 21.4, Part VIII of the Rules	Regulation II-1/16 and II-1/16-1 of International Convention SOLAS-74, as amended; Regulations 17, 18, 19, 20, 22, 23 of ILLC'66 International Convention on Load Lines 1966	approved plan of testing the hull for watertightness, shipbuilder's inspection records	details required	verify that correct welding and fit up requirements specified in reference 1, 2.4 and 2.5 of this Table have been adopted	
								verify compliance with Convention on Load Lines 1966 as amended — i.e. all fittings in accordance with the record of freeboard assignment	
				UR IACS P3				verify air pipes, vents etc closing device are approved type	
								verify material certificates for overboard discharges where applicable	
								verify record of freeboard assignment and all material certificates included in the ship construction file	

Table 2.5.1 — continued

No. Item	Shipbuilding function	Survey Requirements for Classification	Survey Method required for Classification	Reference*	Statutory requirements and relevant reference	Documentation available to RS surveyor during construction	Documentation for ship construction file	Specific activities	RS proposals for the project
	freeboard marks and draft marks	within allowable tolerances and in accordance with the freeboard assignment	witness	UI IACS LL4 2.3.3 Rules on Load Lines for the Sea-Going Ships	Regulations 4, 5, 6, 7 and 8 of International Convention on Load Lines 1966	approved load line drawings, shipbuilder's records	details required	verify freeboard marks in accordance with load line assignment verify draft marks in accordance with the agreed tolerances specified by the builder unless more onerous flag state requirements	
	principal dimensions	within allowable tolerances	review and witness	IACS Rec. No. 47		shipbuilder's records	details required	verify principal dimensions in accordance with recognised standard verify dimensions included in ship construction file	
	safety construction certification	no outstanding imperfections or defects	witness		Regulation I/7 or I/10 Internal Convention SOLAS-74, as amended, as appropriate			verify that Administration requirements have been incorporated into the hull structure	

* IACS recommendations are not mandatory requirements.
 Additional explanations to items of Table 2.5.1, refer to 2.12.

Shipbuilder's name	
Project	
Project duration	
Kick off meeting date	
Representing builder	
Representing RS	

.2 where there has been a significant management or personnel re-structuring having an impact on the ship construction process; or

.3 where the shipyard contracts to construct a ship of a different type or substantially different in design.

2.6.2 Based on review results of construction facilities of the shipyard and its sub-contractors using their own construction facilities, the RS surveyor issues the Shipyard Construction Facilities Review Record (form 6.3.19 Z23).

2.7 SURVEY PLANNING

2.7.1 Prior to commencement of surveys for any newbuilding project, the RS Branch Office shall discuss with the shipyard at a kick-off meeting the items listed in Table 2.5.1. The purpose of the meeting is to review and agree how the list of specific RS surveyors' activities relating to the ship construction process and shown in Table 2.5.1 shall be addressed. The meeting shall take into account the shipyard construction facilities and ship type, including the list of proposed subcontractors. A Record (Minutes) of the meeting (form 322-01) shall be made, based upon the contents of Table 2.5.1 (Table 2.5.1 may be used as the record with comments made into the appropriate column and attached to the Record). If the RS Branch Office has nominated the RS surveyor for a specific newbuilding project, then the surveyor shall attend the kick-off meeting.

The shipyard shall agree to undertake ad hoc investigations during construction as may be requested by RS where areas of concern arise and the shipyard shall agree to keep RS advised of the progress of any investigation. Whenever an investigation is undertaken, the shipyard shall be requested to agree to suspend relevant construction activities if warranted by the severity of the problem.

2.7.2 The records shall take note of specific published Administration requirements and interpretations of statutory requirements.

2.7.3 The shipyard shall be requested to advise of any changes to the activities agreed at the kick-off meeting and these shall be documented in the survey plan. E.g. if the shipyard chooses to use or change sub-contractors, or to incorporate any modifications necessitated by changes in production or inspection methods, rules and regulations, structural modifications, or in the event where increased inspection requirements are deemed necessary as a result of a substantial non-conformance or otherwise.

2.7.4 Shipbuilding quality standards for the hull structure during new construction shall be reviewed and agreed during the kick-off meeting. Structural fabrication shall be carried out in accordance with IACS Recommendation No. 47 "Shipbuilding and Repair Quality Standard" (refer to Appendix 1 to the Section), or a recognized fabrication standard which has been agreed with RS prior to the commencement of fabrication. Provisions of the particular fabrication standard submitted to the Register for review and acceptance shall be at least equivalent to that of IACS Recommendation No. 47 or shall establish more stringent performance criteria. When a contradiction between shipyard fabrication standard and IACS Recommendation No. 47 is identified during review of the standard, more stringent performance criteria for the hull construction shall be applied. The work shall be carried out in accordance with the RS rules and under technical supervision of the Register.

2.7.5 The kick-off meeting may be attended by other parties as defined in the Procedure for Supply of Information to Customers (shipowner, representative of Administration, etc.) subject to agreement by the shipyard.

2.7.6 In the event of series ship production, the requirement for a kick-off meeting in 2.7.1 may be waived for the second and subsequent ships, provided that no changes to the specific activities agreed in the kick-off meeting for the first ship are introduced. If any changes are introduced, these shall be agreed in a new dedicated meeting and documented in a record of such meeting.

2.8 EXAMINATION AND TEST PLAN FOR NEWBUILDING ACTIVITIES (LIST OF ITEMS OF TECHNICAL SUPERVISION)

2.8.1 The shipyard shall provide RS the plans of the items, which are intended to be examined and tested. These plans need not be submitted for approval and examination at the time of the kick-off meeting, however, in any case they shall be submitted to the RS surveyor prior to commencement of the relevant survey.

They shall include:

.1 proposals for the examination of completed steelwork — generally referred to as the block and section plan and shall include details of joining sections and blocks together at the pre-erection and erection stages or at other relevant stages;

- .2 proposals for fit up examinations where necessary;
 - .3 proposals for testing of the hull structure (leak and hydrostatic) as well as for all watertight and weathertight closing appliances;
 - .4 proposals for non-destructive testing;
 - .5 any other proposals specific to the ship type or to the statutory requirements.
- 2.8.2 The plans and any modifications to them shall be submitted to the RS surveyor in sufficient time to allow review before the relevant survey activity commences.
- 2.8.3 Additional requirements for oil tankers and bulk carriers subject to regulation II-1/3-10 of SOLAS-74, as amended, contracted for construction on or after 1 July 2016 are given in 2.11.

2.9 PROOF OF THE CONSISTENCY OF SURVEYS

- 2.9.1 The RS Branch Office shall be able to provide evidence, e.g. through records, check lists, inspection and test records, etc. that its surveyors have complied with the requirements of the newbuilding survey planning and duly participated in the relevant activities shown in the shipyard examination and test plans (lists).
- 2.9.2 In addition, the RS surveyor shall maintain records of deficiencies found during the patrolling activities required in Table 2.5.1 and described in 2.2.3.1. Records shall include the date when deficiency was found, description of the deficiency and the date when the deficiency was cleared.
- 2.9.3 The RS Branch Office shall keep records of the results of surveys performed by means of NewBuildingRS, the software intended for electronic recording of the technical supervision process during construction of ships.
- 2.9.4 In case of dual class, another method of record keeping of the technical supervision process may be used upon agreement with the Register Head Office (RHO).

2.10 SHIP CONSTRUCTION FILE

- 2.10.1 The requirements of this Chapter are applicable to all ships except for oil tankers and bulk carriers subject to SOLAS-74 regulation II-1/3-10, for which the requirements in 2.11 shall be applied.
- 2.10.2 The shipyard shall deliver documents for the Ship Construction File (SCF). In the event that items have been provided by another party such as the shipowner and where separate arrangements have been made for document delivery which excludes the shipyard, that party has the responsibility.
- The Ship Construction File (SCF) shall be reviewed for content in accordance with the requirements of 2.10.3.
- 2.10.3 It is recognized that the purpose of documents held in the Ship Construction File (SCF) on board the ship, shall facilitate inspection (survey) and repair and maintenance, and, therefore, shall include in addition to documents listed in Table 2.5.1, but not be limited to:
- .1 as-built structural drawings including scantling details, material details, and, as applicable, wastage allowances, location of butts and seams, cross section details and locations of all partial and full penetration welds, areas identified for close attention and rudders (refer to Part III "Additional Surveys of Ships Depending on Their Purpose and Hull Material" of the Rules for the Classification Surveys of Ships in Service¹);
 - .2 manuals required for classification and statutory requirements, e.g. loading and stability, bow doors and inner doors and side shell doors and stem doors — operations and maintenance manuals (refer to 7.4 and 7.15, Part III "Equipment, Arrangements and Outfit" of the Rules for the Classification and Construction);
 - .3 Ship Structure Access Manual, as applicable;
 - .4 copies of the RS certificates on forgings and castings welded into the hull (refer to 3.7 and 3.8, Part XIII "Materials" of the Rules for the Classification and Construction);
 - .5 details of equipment forming part of the watertight and weathertight integrity of the ship;
 - .6 tank testing plan, including details of the test requirements (refer to Appendix 1 to Part II "Hull" of the Rules for the Classification and Construction);
 - .7 corrosion protection specifications (refer to 1.2.5.1 and 3.3.5.1, Part II "Hull" of the Rules for the Classification and Construction; 5.2.2.3.2 of Part III "Additional Surveys of Ships Depending on Their Purpose and Hull Material" of the Rules for the Classification Surveys);

¹Hereinafter referred to as "the Rules for the Classification Surveys".

.8 details for the in-water survey, if applicable, information for divers, clearances measurements instructions, etc. tank and compartment boundaries;

.9 docking plan and details of all penetrations normally examined at dry docking;

.10 Coating Technical File, for ships subject to compliance with the IMO Performance Standard for Protective Coatings (PSPC) (refer to IMO resolution MSC.215(82)) as the RS requirement under Part XVIII "Common Structural Rules for Double Hull Oil Tankers" and Part XIX "Common Structural Rules for Bulk Carriers" of the Rules for the Classification and Construction, as well as 2.12.7 of the Guidelines).

**2.11 REQUIREMENTS FOR OIL TANKERS AND BULK CARRIERS SUBJECT TO SOLAS CHAPTER II-1
PART A-1 REGULATION 3-10.**

GOAL-BASED SHIP CONSTRUCTION STANDARDS FOR BULK CARRIERS AND OIL TANKERS

2.11.1 Examination and test plan for new building activities.

2.11.1.1 The shipbuilder shall provide plans of the items which are intended to be examined and tested in accordance with the RS rules in a document known as the Survey Plan, taking into account the ship type and design. This Survey Plan shall be reviewed at the time of the kick-off meeting, and shall include:

.1 a set of requirements, including specifying the extent and scope of the construction surveys and identifying areas that need special attention during the surveys, to ensure compliance of construction with mandatory ship construction standards including:

.1.1 types of surveys (visual, non-destructive examination, etc.) depending on location, materials, welding, casting, coatings, etc.;

.1.2 establishment of a construction survey schedule for all assembly stages from the kick-off meeting, through all major construction phases, up to delivery;

.1.3 inspection/survey plan, including provisions for critical areas identified during design approval;

.1.4 inspection criteria for acceptance;

.1.5 interaction with shipyard, including notification and documentation of survey results;

.1.6 correction procedures to remedy construction defects;

.1.7 list of items that would require scheduling or formal surveys;

.1.8 determination and documentation of areas that need special attention throughout ship's life, including criteria used in making the determination;

.2 a description of the requirements for all types of testing during survey, including test criteria.

2.11.2 Design transparency.

2.11.2.1 For ships subject to compliance with IMO resolutions MSC.287(87), MSC.290(87), MSC.296(87) and IMO circular MSC.1/Circ.1343, readily available documentation shall include the main goal-based parameters and all relevant design parameters that may limit the operation of the ship.

2.11.3 Ship Construction File (SCF).

2.11.3.1 A Ship Construction File (SCF) with specific information on how the functional requirements of the Goal-Based Ship Construction Standards for Bulk Carriers and Oil Tankers have been applied in the ship design and construction shall be provided upon delivery of a new ship, and kept on board the ship and/or ashore and updated as appropriate throughout the ship's service. The contents of SCF shall conform to the requirements below.

2.11.3.1.1 The following design specific information shall be included in SCF:

.1 areas requiring special attention throughout the ship's life (including critical structural areas);

.2 all design parameters limiting the operation of a ship;

.3 any alternatives to the rules, including structural details and equivalency calculations;

.4 as-built drawings and information which are verified to incorporate all alterations approved by the Register or Administration during the construction process including scantling details, material details, location of butts and seams, cross section details and locations of all partial and full penetration welds;

.5 net (renewal) scantlings for all the structural constituent parts, as built scantlings and voluntary addition thicknesses;

.6 minimum hull girder section modulus along the length of the ship which shall be maintained through-out the ship's life, including cross section details such as the value of the area of the deck zone and bottom zone, the renewal value for the neutral axis zone;

.7 a listing of materials used for the construction of the hull structure, and provisions for documenting changes to any of the above during the ship's service life;

.8 copies of the RS certificates on forgings and castings welded into the hull (refer to 3.7 and 3.8, Part XIII "Materials" of the Rules for the Classification and Construction);

.9 details of equipment forming part of the watertight and weathertight integrity of the ship;

.10 tank testing plan including details of the test requirements (refer to Appendix 1 to Part II "Hull" of the Rules for the Classification and Construction);

.11 details for the in-water survey, when applicable, information for divers, clearances measurements instructions, etc. tank and compartment boundaries;

.12 docking plan and details of all penetrations normally examined at dry docking;

.13 Coating Technical File (CTF), for ships subject to compliance with the IMO Performance Standard for Protective Coatings (PSPC¹).

2.11.3.1.2 The details of information to be included in SCF are given in Table 2.11.3.1.2. This information shall be kept on board the ship and/or ashore and updated as appropriate throughout the ship's life in order to facilitate safe operation, maintenance, survey, repair and emergency measures.

2.11.3.1.3 It shall be noted that parts of the content of SCF may be subject to various degrees of restricted access and that such documentation may be appropriately kept ashore.

2.11.3.1.4 SCF shall include the list of documents constituting SCF and all information listed in Table 2.11.3.1.2, which is required for a ship's safe operation, maintenance, survey, repair and in emergency situations. Details of specific information that is not considered to be critical to safety might be included directly or by reference to other documents.

2.11.3.1.5 When developing SCF, all of the columns in Table 2.11.3.1.2 shall be reviewed to ensure that all necessary information has been provided.

2.11.3.1.6 It may be possible to provide information listed in IMO resolution MSC.287(87) under more than one Tier II functional requirement as a single item within SCF, for example, the Coating Technical File required by the PSPC is relevant for both "Coating life" and "Survey during construction".

Note. Tier II items mean the functional requirements included in the International Goal-Based Ship Construction Standards for Bulk Carriers and Oil Tankers (GBS), adopted by IMO resolution MSC.287(87).

2.11.3.1.7 SCF shall remain with the ship and, in addition, be available to RS and Administration throughout the ship's life. Where information not considered necessary to be on board is stored ashore, procedures to access this information shall be specified in the onboard SCF. The intellectual property provisions within the SCF shall be duly complied with.

2.11.3.1.8 SCF shall be updated throughout the ship's life at any major event, including, but not limited to, substantial repair and conversion, or any modification to the ship structure.

2.11.3.2 SCF shall be reviewed, at the time of new building, in accordance with the requirements of 2.11.3.1.1 and 2.11.3.1.2, and the normal storage location shall be distinguished.

Note. "Review" means the examination of SCF that is carried out by the RS surveyor, at the end of the newbuilding process, in order to confirm that drawings/documents required under this Chapter, and the possible additional drawings/documents provided by the shipyard as per the SCF list of drawings/documents are present in the copies of SCF stored on board the ship and in the shore archive.

The "review" shall not be intended as an assessment of the drawings/documents in order to verify their compliances with the applicable rules/regulations.

2.11.3.2.1 For SCF stored on board the ship, the RS surveyor shall verify that the information is placed on board the ship, upon completion of the ship construction.

2.11.3.2.2 For SCF stored in the shore archive, the RS surveyor shall verify that the information is stored in the shore archive by examining the list of information included in the shore archive, upon completion of the ship construction.

2.11.4 Determination of number of surveyors.

2.11.4.1 RS shall assign adequate number of suitable qualified surveyors for newbuilding projects according to the construction progress of each ship to meet appropriate coverage of the examination and testing activities as agreed in the Survey Plan.

¹Performance Standard for Protective Coatings for Dedicated Seawater Ballast Tanks in all Types of Ships and Double-Side Skin Spaces of Bulk Carriers, adopted by IMO resolution MSC.215(82), as amended and Performance Standard for Protective Coatings for Cargo Oil Tanks of Crude Oil Tankers adopted by IMO resolution MSC.288(87), as amended.

Table 2.11.3.1.2

List of information to be included in the Ship Construction File (SCF)

	Example documents	Normal storage location	Nos.	Tier II items	Information to be included
3 Structural strength					
3.1	General design	applied RS rules (date and revision)	applied design method alternative to the RS rules and subject structure(s)	SCF-specific	on board ship
3.2	Deformation and failure modes	applied alternative to the RS rules calculating conditions and results;	allowable loading pattern	capacity plan loading manual	on board ship on board ship
3.3	Ultimate strength	assumed loading conditions operational restrictions due to structural strength	maximum allowable hull girder bending moment and shear force maximum allowable cargo density or storage factor	trim and stability booklet loading instrument instruction manual operation and maintenance manuals strength calculation	on board ship on board ship on board ship on shore archive
3.4	Safety margins	strength calculation results gross hull girder section modulus minimum hull girder section modulus along the length of the ship to be maintained throughout the ship's life, including cross section details such as the value of the area of the deck zone and bottom zone, the renewal value for the neutral axis zone gross scantlings of structural constituent parts net scantlings of structural constituent parts, as built scantlings and voluntary addition thicknesses hull form	bulky output of strength calculation plan showing highly stressed areas (e.g. critical structural areas) prone to yielding and/or buckling structural drawings rudder and stern frame structural details of typical members hull form information indicated in key construction plans hull form data stored within an onboard computer necessary for trim and stability and longitudinal strength calculations	areas prone to yielding and/or buckling general arrangement plan key construction plans rudder and rudder stock plans structural details yard plans dangerous area plan lines plan or	on board ship on board ship on board ship on board ship on shore archive on board ship on shore archive

Table 2.11.3.1.2 — continued

	Further explanation of the content	Example documents	Normal storage location	Nos.	Tier II items
			applied design method alternative to the RS rules and subject structures	equivalent	on board ship
4	Fatigue life	applied RS rules (date and revision) applied alternative to the RS rules calculating conditions and results assumed loading conditions fatigue life calculation results	assumed loading conditions and rates bulky output of fatigue life calculation plan showing areas (e.g. critical structural areas) prone to fatigue	SCF-specific structural details fatigue life calculation areas prone to fatigue	on board ship on board ship on shore archive on board ship
5	Residual strength	applied RS rules (date and revision)		SCF-specific	on board ship
6	Protection against corrosion				
6.1	Coating life	coated areas and target coating life and other measures for corrosion protection in holds, cargo and ballast tanks, other structure-integrated deep tanks and void spaces	plans showing areas (e.g. critical structural areas) prone to excessive corrosion	SCF-specific	on board ship
6.2	Corrosion addition	specification for coating and other measures for corrosion protection in holds, cargo and ballast tanks, other structure-integrated deep tanks and void spaces gross scantlings of structural constituent parts net scantlings of structural constituent parts, as built scantlings and voluntary addition thicknesses		Coating Technical File required by PSPC areas prone to excessive corrosion key construction plans	on board ship on board ship on board ship
7	Structural redundancy	applied RS rules (date and revision)		SCF-specific	on board ship
8	Watertight and weathertight integrity	applied RS rules (date and revision) key factors for watertight and weathertight integrity	details of equipment forming part of the watertight and weathertight integrity	SCF-specific structural details of hatch covers, doors and other closings integral with the shell and bulkheads	on board ship on board ship
9	Human element considerations	list of ergonomic design principles applied to ship structure design to enhance safety during operations, inspections and maintenance of ship		SCF-specific	on board ship
10	Design transparency	applied RS rules (date and revision) applicable industry standards for design transparency and IP protection reference to part of SCF information kept ashore		intellectual property provisions summary, location and access procedure for part of SCF information on shore	on board ship on board ship

Table 2.11.3.1.2 — continued

	Information to be included	Further explanation of the content	Example documents	Normal storage location	Nos.
CONSTRUCTION					
11	Construction quality procedures	applied construction quality standard	recognized national or international construction quality standard	SCF-specific	on board ship
12	Survey during construction	survey regime applied during construction (to include all owner and class scheduled inspections during construction) information on non-destructive examination	applied RS rules (date and revision) copies of certificates of forgings and castings welded into the hull	SCF-specific tank testing plan non-destructive testing plan Coating Technical File required by PSPC	on board ship on board ship on board ship on board ship
IN-SERVICE CONSIDERATIONS					
13	Survey and maintenance	<p>maintenance plans specific to the structure of the ship where higher attention is called for</p> <p>preparations for survey</p> <p>gross hull girder section modulus</p> <p>minimum hull girder section modulus along the length of the ship to be maintained throughout the ship's life, including cross section details such as the value of the area of the deck zone and bottom zone, the renewal value for the neutral axis zone</p> <p>gross scantlings of structural constituent parts</p> <p>net scantlings of structural constituent parts, as built scantlings and voluntary addition thicknesses</p> <p>hull form</p>	<p>plan showing highly stressed areas (e.g. critical structural areas) prone to yielding, buckling, fatigue and/or excessive corrosion</p> <p>arrangement (docking plan) and details of all penetrations normally examined at drydocking</p> <p>details for dry-docking</p> <p>details for in-water survey</p> <p>hull form information indicated in key construction plans</p>	<p>SCF-specific</p> <p>operation and maintenance manuals (e.g. hatch covers and doors)</p> <p>docking plan</p> <p>dangerous area plan</p> <p>Ship Structure Access Manual</p> <p>Means of access to other structure-integrated deep tanks</p> <p>Coating Technical File required by PSPC</p> <p>key construction plans</p> <p>rudder and rudder stock</p> <p>structural details</p> <p>yard plans</p> <p>lines plan</p> <p>or equivalent</p>	<p>on board ship</p> <p>on board ship</p> <p>on board ship</p> <p>on board ship</p> <p>on board ship</p> <p>on board ship</p> <p>on board ship</p> <p>on board ship</p> <p>on board ship</p> <p>on board ship</p> <p>on board ship</p> <p>on shore archive</p> <p>on shore archive</p> <p>on board ship</p>

Table 2.11.3.1.2 — continued

Tier II	items	Information to be included	Further explanation of the content	Example documents	Normal storage location
14	Structural accessibility	means of access to holds, cargo and ballast tanks and other structure-integrated deep tanks	plans showing arrangement and details of means of access	Ship Structure Access Manual means of access to other structure-integrated deep tanks	on board ship on board ship
RECYCLING CONSIDERATIONS					
15	Recycling	identification of all materials that were used in construction and may need special handling due to environmental and safety concerns	list of materials used for the construction of the hull structure	SCF-specific	on board ship
<p>Notes: 1. "SCF-specific" means documents to be developed especially to meet the requirements of these GBS guidelines (MSC.1/Circ.1343).</p> <p>2. "Key construction plans" means plans such as midship section, main oil tight and water tight transverse bulkheads, construction profiles/plans, shell expansions, forward and aft sections in cargo tank (or hold) region, engine-room construction, forward construction and stern construction drawings.</p> <p>3. "Yard plans" means a full set of structural drawings, which include scantling information of all structural members.</p> <p>4. "Hull form" means a graphical or numerical representation of the geometry of the hull. Examples shall include the graphical description provided by a lines plan and the numerical description provided by the hull form data stored within an onboard computer.</p> <p>5. "Lines plan" means a special drawing which is dedicated to show the entire hull form of a ship.</p> <p>6. "Equivalent (to Lines plan)" means a set of information of hull form to be indicated in key construction plans for SCF purposes. Sufficient information shall be included in the drawings to provide the geometric definition to facilitate the repair of any part of the hull structure.</p> <p>7. "Normal storage location" means a standard location where each SCF information item shall be stored. However, those items listed as being on board in the Table above shall be on board as a minimum to ensure that they are transferred with the ship on a change of owner.</p> <p>8. "Shore archive" shall be operated in accordance with applicable international standards.</p>					

2.12 ADDITIONAL EXPLANATIONS AND COMMENTS TO SOME ITEMS OF TABLE 2.5.1 (IN BRACKETS)

2.12.1 Inspection of materials in use (items 1.1, 2.1, 3).

2.12.1.1 The proper use of hull materials in accordance with a ship's technical design approved is subject to the Register control.

2.12.1.2 Provision shall be made for an accurate system for inspection of material supplied to the shipyard, for parts marking including cases when the material used lacks the per sheet marking in manufacturing.

The shipyard's document on a procedure for recording, storage and use of materials shall be presented to the RS Branch Office. That procedure shall provide an opportunity to present to the RS surveyor a certificate for the metal of which parts of the hull are manufactured at any stage of its construction.

2.12.1.3 In survey according to the List, the RS surveyor inspects the materials used at a particular item of technical supervision, at that the following shall be checked:

.1 availability of the RS certificate or supplier's certificates witnessed by the RS surveyor for plates, sheets, strips, sections, bars, pipes, castings and forgings or cast and forged products. Welding consumables (electrodes, wire, fluxes, etc.) shall be accompanied with the documents confirming their testing and RS approval at the firm (manufacturer);

.2 compliance of the material with particulars of a certificate and/or supplier's certificate;

.3 compliance of material brands with the requirements of the RS-approved design.

2.12.1.4 At patrol, the RS surveyor checks the practiced procedure for recording, storage and use of materials.

2.12.1.5 In survey according to the List and in performance of periodical inspections, the RS surveyor shall make sure in the absence of metal defects like cracks, exfoliations, cavities, blisters, scabs, fissures, rolled-in scale, etc. To reveal internal flaws, the surveyor can, if justified, require checking the metal with use of non-destructive or other techniques.

2.12.1.6 Where it is impossible to identify material and where defects are detected, or where material is not in compliance with the requirements of a drawing, rules and recognized standards, or documents for material are lacking or inadequate, and etc., the surveyor shall prevent its use for a given structure or permit the elimination of defects according to the agreed procedure and demand additional check tests and analyses, and changes in the procedure for material inspection in the shipyard.

2.12.2 Welder qualification (item 1.2).

2.12.2.1 The welders may be admitted to perform welding of items under the RS technical supervision, having drawing up a Welder Approval Test Certificate (CJC) (form 7.1.30), granting the right for performing the relevant types of welding of those materials required to fabricate structures subject to technical supervision by the Register.

2.12.2.2 A possibility of recognition of welder's qualification records issued by another classification society or duly authorized competent authority shall be determined in each particular case by the RS Branch Office to an extent sufficient to confirm their compliance with the requirements of Section 4, of Part III "Technical Supervision during Manufacture of Materials" of the Rules for Technical Supervision. The results of considering the above mentioned documents and confirmation of possible admission for welders shall be issued as a Report (form 6.3.29).

2.12.2.3 Upon agreement with the RS Branch Office (or at approval of design documentation of the ship under construction), the welders who passed approval tests in compliance with the international (ISO 9606, ASME Sec. IX, ANSI/AWS D1.1) and/or national standards are permitted to perform welding operations.

2.12.3 Testing of welding procedures (paras 1.3, 1.3b, 1.3c, 2.4, 2.5, 3).

2.12.3.1 Prior to any checks of welded joints the RS surveyor shall mandatorily ascertain that the welding procedure specifications (WPS), available at the shipyard and RS approved, cover all weld joint configurations/types applied in the RS approved project (indicated in the approved drawings and/or hull welding table). Otherwise, the RS Branch Office shall notify the shipyard of the necessity to start the procedure of approval of joint welding procedures without the approved welding procedure specifications (WPS) in accordance with the provisions of Section 6 of Part III "Technical Supervision during Manufacture of Materials" of the Rules for Technical Supervision.

2.12.3.2 During surveys as per the List and in performance of periodical inspections, the surveyor shall make sure that all welding works are performed in accordance with the approved WPS. The structural requirements for the WPS shall be verified for compliance with the actual condition of welded joints as well as provisions of the RS approved project.

2.12.3.3 The main and welding consumables, design and technical parameters and also welding conditions specified in WPS shall be examined and/or validated according to Table 6.8.2.3, Section 6, Part III "Technical Supervision during Manufacture of Materials" of the Rules for Technical Supervision.

2.12.3.4 Additional requirements are given in 2.12.4 and 2.12.5.

2.12.4 Surveys of units, sections and blocks (items 1.4, 1.5, 2.2, 2.3, 2.4, 2.5, 3).

2.12.4.1 Manufacture of flat plate panels, framing girders including deep frames, sections and single units forming hull structures of the main hull, superstructures and deckhouses is subject to the Register technical supervision.

2.12.4.2 The selected production process chart for assembling and welding of hull structures, as well as assembly jigs and welding equipment is within the competence of the shipyard and it shall be specified in the relevant shipyard standard.

2.12.4.3 In construction of series-built ship's hulls specified in 2.3.6, the RS Branch Office may recognize sufficient to restrict itself to periodical examinations of completed sections and single units without their submitting to the RS surveyor for survey according to the List. The resolution concerning sufficiency of periodical examinations of completed sections and single units without submitting them as per the List shall be issued in the form of the report with participation of the RS Branch Office, shipyard and other parties concerned (upon the shipyard agreement). The report shall contain the technical justification of the resolution, confirming positive experience of technical supervision during construction of sister ships.

2.12.4.4 The scope of survey for units, sections, blocks shall be made prior to the ship construction commencement compliant to 2.8. The shipyard shall submit the scheme of hull division into sections and blocks as well as production sequence of the assembly and welding operations to the RS Branch Office for agreement of survey scope.

2.12.4.5 The sections subject to survey under the List shall only be submitted after the fully completed assembly and welding, apart from the operations provided by the welding procedure at a later stage, such as:

- individual components of a hull structure;
- parts of hull outfitting and/or welded attachments;
- cutouts, etc.

The above fact shall be indicated in the shipyard document for the completed section (block) or by another adopted way so that the shipyard's technical control body may present and the surveyor may check the fulfilment of incomplete works in due time.

2.12.4.6 The blocks to be surveyed according to the List shall be submitted complete and fit for the hull construction directly at the building berth.

To the sites of blocks manufacture the sections and single units shall be conveyed fully completed, accepted by the shipyard's technical control body and, if specified by the List, surveyed by the Register. With the parallel performance of the hull and assembly works, the blocks may be presented at two steps; the possibility and scope of each step shall be agreed with the RS surveyor regarding the necessary availability of access to all the hull structures.

2.12.4.7 In periodical inspections of assembly before welding, the RS surveyor checks compliance of the edge preparation of the parts to the requirements of drawings, welding tables as well as CTIC, in which the structural elements of edges shall be specified.

2.12.4.8 During any inspections of welding works performance, the RS surveyor shall make sure that welding is carried out in accordance with the production process approved by the Register. (see also para 2.12.3). In so doing, one shall regard the limiting conditions, if these are specified in technical documentation on a welding method and in the production process, including those for material brands, thicknesses, welding positions, welding directions, an ambient air temperature, etc.

2.12.4.9 During any inspections the RS surveyor shall make sure that the welding defects, if any, are within the permissible limits specified in the agreed quality standards.

Where defects are regular, the surveyor shall require from the shipyard the elimination of their causes and develop measures for defects rectification.

2.12.4.10 The RS surveyor shall control the conformity with the applicable requirements for welding given in Section 2, Part XIV "Welding" of the Rules for the Classification and Construction. The RS surveyor is entitled to require the additional inspection of welding quality from the shipyard if welding is executed under adverse conditions.

2.12.4.11 The RS surveyor shall control timely (once in 6 months) submission by the shipyard of the information on percentage of welded joint defects according to 3.3.6, Part XIV "Welding" of the Rules for the Classification and Construction and require an increase in the number of controlled weld lengths by 10 % if the percentage of defects is more than 5.

2.12.4.12 Sections and/or blocks manufactured at another subcontractor shall be subject to the Register survey prior to delivery to the shipyard and shall be supplied with the Register appropriate documents (refer also to Section 2 "Hull" of Part IV "Technical Supervision during Manufacture of Products" of the Rules for Technical Supervision).

2.12.5 Hull survey at the building birth (item 3).

2.12.5.1 Scope of survey at the building birth shall be defined prior to the ship construction according to 2.8.

2.12.5.2 Sections and blocks shall be conveyed to the building berth fully completed, accepted by the shipyard's technical control body and surveyed by the RS surveyor.

2.12.5.3 Hull survey during its construction at the building berth includes inspections of all the hull structures in the sequence of the approved construction process and specified in the agreed List. Special consideration shall be paid to the mounting couplings.

2.12.5.4 To survey are presented hull spaces (including compartments, tanks, etc.) according to the List and scheme of spaces after completion of assembly, welding, riveting and straightening, and having fitted all the outfitting components related to the equipment, etc. being joined directly to hull structures.

2.12.5.4.1 Single outfitting components may be ignored by agreement with the RS surveyor, but the missing components shall be specified in the shipyard's document on the availability of the item of supervision to be submitted to the Register for survey. The RS surveyor in his/her conclusion states the conditions for the follow-up control over fitting the lacking outfitting components.

2.12.5.4.2 Following the survey of a space by the RS surveyor, any working associated with thermal cutting, chipping, welding and riveting may be performed with the surveyor's consent and approval provided they do not effect structure strength or tightness.

2.12.5.5 In periodical inspections during the ship's hull construction at the building berth, the RS surveyor checks the sequence of operations to prevent excess stresses and deformations of the hull, monitors checking the hull position at the building berth; and its compliance with the agreed standards.

2.12.5.6 When executing the joints, the sequence of operations and quality shall be under control.

2.12.5.7 Cutting-out of holes and welding of structures into the closed contour shall be performed according to RS-approved drawings and/or the production processes or standards agreed with the Register.

The shipyard shall submit to the RS Branch Office for approval the scheme of temporary cutouts, the practice of their execution and of the subsequent quality control.

2.12.6 Hull tightness and structural testing (items 5, 6).

2.12.6.1 Hull testing for leakproofness and structural tests shall be carried out and witnessed by the Surveyor, and as a rule, once a space or structure is fully prepared for testing, filled with a medium to the head (pressure) set and checked by the shipyard's technical control body in compliance with the RS-approved test procedure to be developed according to Appendix 1 to Part II "Hull" of the Rules for the Classification and Construction.

2.12.6.2 In periodical inspections, the RS surveyor checks the availability of spaces (compartments, structures) for testing, verifies the procedure and sequence of basic operations during preliminary, major and check tests (both prior to and in the process of test submitting by the shipyard's technical control body), the test conditions, validity of tightness estimation and checks the defects elimination.

2.12.7 Hull protection against corrosion, coatings (items 7, 7.1).

2.12.7.1 General concept of technical supervision during application of protective coatings.

2.12.7.1.1 In general, technical supervision during application of protective coatings shall be carried out based on the Register-approved specification of protective coatings being submitted in the scope of plan approval documentation of the ship under construction.

2.12.7.1.2 Subject to technical supervision are protective coatings listed in the Nomenclature of Items of the Register Technical Supervision¹ and submitted together with the documents to prove their manufacture under the Register technical supervision (refer also to 6.5, Part XIII "Materials", 2.1.1.6, 2.1.1.7, Part VI "Fire Protection" of the Rules for the Classification and Construction and 3.1.1, Part III "Technical Supervision during Manufacture of Materials" of the Rules for Technical Supervision).

2.12.7.1.3 Technical supervision of surface preparation and application of protective coating shall be carried out by the RS surveyor mainly by visual examination during periodical inspections and verification of the data specified on the packing, in the documents confirming manufacture of coating materials under the Register technical supervision, on the protective coating specifications, records of work completion.

The records mean the documents issued by the shipyard and/or its subcontractors and confirming the completion of work on surface preparation for protective coating application. The Final Inspection Report may be used as such record (the recommended form is given in Appendix 2 to this Section).

2.12.7.1.4 Technical documentation of the coating system used, the scheme for the selection, application, maintenance of the coating system, as well as inspection reports on surface preparation for protective coating application shall be kept in the RS Branch Office.

2.12.7.2 Technical supervision of protective coatings for ballast tanks in compliance with the Performance Standard for Protective Coatings (PSPC) adopted by IMO resolution MSC.215(82).

2.12.7.2.1 Technical supervision during application of protective coatings for ballast tanks in compliance with PSPC shall be carried out based on surface preparation and coating processes agreement signed by the shipyard, shipowner and coating manufacturer² and approved by the Register (refer to 3.2.3, Part III "Technical Supervision during Manufacture of Materials" of the Rules for Technical Supervision), the Coating Technical File (CTF)

¹Hereinafter referred to "the RS Nomenclature".

²Hereinafter referred to "the Tripartite Agreement").

(refer to 3.2.2.2 and 3.2.4, Part III "Technical Supervision during Manufacture of Materials" of the Rules for Technical Supervision), as well as technical specifications of protective coatings approved by the Register in the scope of plan approval documentation of ship under construction.

Prior to commencement of works, the Tripartite Agreement and CTF shall be agreed with the RS Branch Office.

2.12.7.2.2 In compliance with PSPC CTF consists of the following:

- .1** copy of a Type Approval Certificate for the coating system;
- .2** copy of documentation defining the coating properties, composition and characteristics (Technical Data Sheet), technical conditions, specifications, technological regulations, instructions or descriptions, etc. as appropriate);
- .3** shipyard work records of coating application, including:
 - applied actual space and area of each compartment, m²;
 - applied coating system;
 - time of coating, thickness, number of layers, etc.;
 - ambient condition during coating; and
 - method of surface preparation;
- .4** procedures for inspection and repair of coating system during ship construction;
- .5** coating log issued by the coating inspector, stating that the coating was applied in accordance with the specifications to the satisfaction of the coating supplier representative and specifying deviations from the specifications (examples of daily log and non-conformity report are given in PSPC);
- .6** shipyard's inspection report on the surface preparation for coating application verified by the coating inspector including:

- completion date of inspection;
- result of inspection;
- remarks (if given);
- coating inspector signature;

.7 procedures for in-service maintenance and repair of coating system (in compliance with the documents specified in 3.1.2.2.5, Part III "Technical Supervision during Manufacture of Materials" of the Rules for Technical Supervision).

2.12.7.2.3 Any deviations in the procedure relative to the PSPC noted during the review shall be raised with the shipyard, which is responsible for identifying and implementing the corrective actions.

2.12.7.2.4 To ensure compliance with the PSPC requirements, the surface preparation and coating application shall be inspected by qualified coating inspectors) certified to "NACE¹. Coating Inspector Level II", "FROSIO². Coating Inspector Level III" or equivalent as verified by the Register (refer to 3.2.9, Part III "Technical Supervision during Manufacture of Materials" of the Rules for Technical Supervision). The information on the coating inspectors qualification may be recorded in the Tripartite Agreement.

2.12.7.2.5 During the CTF review and technical supervision during application of protective coatings for ballast tanks in compliance with PSPC, the RS surveyor shall perform the following:

- .1** check that the documentation specified in 2.12.7.2.2.2 and the Type Approval Certificate comply with PSPC;
- .2** check that the coating identification on representative containers is consistent with the coating identified in the documentation specified in 2.12.7.2.2.2 and the Type Approval Certificate;
- .3** check that the coating inspector is qualified in accordance with 2.12.7.2.4;
- .4** check that the coating inspector's reports of surface preparation and the coating's application indicate compliance with the manufacturer's documentation specified in 2.12.7.2.2.2 and the Type Approval Certificate;
- .5** by periodical inspections monitor implementation of the coating inspection requirements of the coatings subject to inspection (refer to 3.2.10.1, Part III "Technical Supervision during Manufacture of Materials" of the Rules for Technical Supervision and item 7.1 of Table 2.5.1 of the Guidelines);
- .6** any deviations from PSPC shall be raised initially with the coating inspector, who is responsible for identifying and implementing the corrective actions. Moreover, in the event that corrective actions are not acceptable to the Register or in the event that corrective actions are not closed out then the shipyard shall be informed;
- .7** a Passenger Ship Safety Certificate or Cargo Ship Safety Certificate or Cargo Ship Safety Construction Certificate, as appropriate, shall not be issued until all required corrective actions have been closed to the satisfaction of the Register.

2.12.7.3 Technical supervision of protective coatings for cargo tanks of crude oil tankers of 5000 t deadweight and over, in compliance with Performance Standard for Protective Coatings for Cargo Oil Tanks of Crude Oil Tankers (PSPC-COT) adopted by IMO resolution MSC.288(87).

¹NACE – National Association of Corrosion Engineers.

²FROSIO – Norwegian Professional Council for Education and Certification of Inspectors for Surface Treatment.

2.12.7.3.1 Technical supervision during application of protective coatings for oil tanker ballast tanks in compliance with PSPC-COT is carried out based on the Tripartite Agreement and the Register-approved (refer to 3.3.3, Part III "Technical Supervision during Manufacture of Materials" of the Rules for Technical Supervision) CTF (refer to 3.3.4 Part III "Technical Supervision during Manufacture of Materials" of the Rules for Technical Supervision), as well as technical specifications of protective coatings approved by the Register in the scope of plan approval documentation of ship under construction (refer to 2.12.7.1.1 of the Guidelines).

Prior to commencement of works, the Tripartite Agreement and CTF shall be agreed with the RS Branch Office.

2.12.7.3.2 CTF consists of the documents similar to those indicated in 2.12.7.2.2 but applicable to PSPC-COT.

2.12.7.3.3 To ensure compliance with the PSPC requirements, the surface preparation and coating application shall be inspected by qualified coating inspector(s) certified to "NACE. Coating Inspector Level II", "FROSIO. Coating Inspector Level III" or equivalent as verified by the Register (refer to 3.3.9, Part III "Technical Supervision during Manufacture of Materials" of the Rules for Technical Supervision). The information on the coating inspectors qualification may be recorded in the Tripartite Agreement.

2.12.7.3.4 During the CTF review and technical supervision during application of protective coatings in compliance with PSPC, the RS surveyor shall perform the following:

.1 check that the documentation specified in 2.12.7.2.2.2 and the Type Approval Certificate comply with PSPC-COT;

.2 check that the coating identification on representative containers is consistent with the coating identified in the documentation specified in 2.12.7.2.2.2 and the Type Approval Certificate;

.3 check that the coating inspector is qualified in accordance with 2.12.7.3.3;

.4 check that the coating inspector's reports of surface preparation and the coating's application indicate compliance with the manufacturer's documentation specified in 2.12.7.2.2.2 and the Type Approval Certificate;

.5 by periodical inspections monitor the compliance with the requirements to coating inspection (refer to 3.3.10, Part III "Technical Supervision during Manufacture of Materials" of the Rules for Technical Supervision).

2.12.7.3.5 In respect of PSPC-COT the requirements shall be applied similar to those specified in 2.12.7.2.3 and 2.12.7.2.6.

2.12.7.3.6 Cargo Ship Safety Certificate or Cargo Ship Safety Construction Certificate shall not be issued until all required corrective actions have been closed to the satisfaction of the Register.

2.12.7.4 Technical supervision of protective coatings for cargo spaces, hatch coamings and hatch covers of bulk carriers.

2.12.7.4.1 The requirement applies to the technical supervision of protective coatings specified in 3.3.5.1, Part II "Hull" of the Rules for the Classification and Construction.

2.12.7.4.2 Technical supervision shall be carried out in compliance with the general concept of technical supervision during application of protective coatings specified in 2.12.7.1.

2.12.7.4.3 In the records of work completion on surface preparation and protective coating application the information shall be stated in the scope recommended by the Final Inspection Report (refer to Appendix 2 to this Section).

2.12.7.5 Technical supervision of anti-fouling coatings of ship hulls.

2.12.7.5.1 Technical supervision during application of anti-fouling coatings of ship hulls shall be carried out in compliance with 19.16.

2.12.7.6 Technical supervision during cathodic protection.

2.12.7.6.1 For ships constructed in compliance with IACS Common Structural Rules for Bulk Carriers and Oil Tankers when attaching the sacrificial anodes additionally the requirements of para 2, Section 4, Chapter 3, Part 1 of Part XVIII "Common Structural Rules for Bulk Carriers and Oil Tankers" of the Rules for the Classification and Construction shall be met.

2.12.8 Hull availability for launching (items 1.4, 1.5, 3, 4, 5, 6, 7, 7.1, 8.2, 8.3, 8.5).

2.12.8.1 The hull launch shall be carried out with the ship's readiness corresponding to the agreed construction process. If hull works or/and works on bottom-and-side fittings or/and azimuth thrusters installation are incomplete, the opportunity and conditions of launching shall be checked, for which purpose the shipyard shall submit to the RS surveyor the technical substantiation.

2.12.8.2 The building berth, dock, etc. preparation, launch performance with due regard to longitudinal and local strength, as well as the documents on the ship's expected design trim after launching (i.e. heel, trim and midship draught) are within the shipyard's responsibility and not subject to the Register technical supervision.

2.12.8.3 Prior to launching, the shipyard shall finally check the hull position on the building berth, its dimensions, the presence of hull deformations with measurements of their values, and to make other checks in compliance with the agreed standards. The results obtained are used for monitoring as-built deformations of the hull, and also for the receipt of data needed for filling in the ship's documents, for which purpose the scope of dimensions checking shall be agreed with the RS Branch Office.

Deviations for the main dimensions of the hull shall not exceed the limits specified in the agreed standards.

2.12.8.4 Prior to the ship launching, the RS surveyor shall make sure that assembly, welding, straightening and testing for tightness, painting of the underwater hull, installation of bottom-and-side fittings and azimuth thrusters in the scope of pre-launching readiness are completed, and detected defects are rectified and checked.

2.12.8.5 The RS surveyor examines the underwater hull to make sure that damages and deformations, openings, protruding temporary parts, etc., which may cause the hull damages or flooding, are lacking.

The presence of single temporary parts of the launching cradle being removed afloat may be allowed.

2.12.8.6 Drawing-up of the check results of the ship launching readiness, as well as conditions of remaining classification in case of deficiencies/requirements for the underwater hull shall be performed by the RS surveyor in the form of a Check List of the Ship Launching Readiness (form 322-08) (Check List example is given in Appendix 3 to this Section).

2.12.8.6.1 The RS surveyor shall require the submission for survey of the underwater hull in a dock if a ship was launched when the Register requirements were available for the proper condition of items of the RS technical supervision prior to the ship launching, has damages of the underwater hull during launching or a leakage is found, serious reasons are identified or available for potential inadmissible defects at the underwater hull after outfitting and trials or due to other reasons.

In substantiated cases, on agreement with the RS Branch Office, examination of the underwater hull in a dock may be replaced by the survey without docking using the contemporary technical means.

2.12.9 Surveys after launching (items 3, 4, 5, 6, 8.1, 8.2, 8.5).

2.12.9.1 In the hull outfit afloat, the installation of single structures of the hull, superstructures, deck-houses, etc., unless these are mounted on the building berth, the joining of hull parts after their separate launching, as well as the performance of other works with hull structures are subject to technical supervision.

2.12.9.2 The joining of hull parts afloat shall be carried out according to the RS-agreed procedure.

2.12.9.2.1 In inspections during the hull joining afloat, the RS surveyor shall make sure that:

- .1 hull parts are thoroughly aligned in the centerplane;
- .2 in welding of the erection joint, the position of one part related to another is monitored;
- .3 welding is performed as approved and in accordance with the RS-approved process, its quality is checked by the shipyard's technical control body after each run.

2.12.9.2.2 Survey of field joints.

2.12.9.2.2.1 When afloat, field joints are submitted to the RS surveyor after completion of assembly and welding.

Depending on the joining procedure, production conditions and results of periodical inspections, the RS surveyor may require to submit other operations and works or documents on their workmanship.

2.12.9.2.2.2 The assembly of the joint fully prepared for welding, assembly for welding of associated parts and units in way of the field joint are checked by an external examination.

2.12.9.2.2.3 The measurements are made to check the adjustment of parts by check lines and also in way of field joints.

2.12.9.2.2.4 Non-destructive testing and tightness testing of connection joints are effected according to the RS-approved diagrams.

2.12.9.3 Surveys during laying of solid ballast.

2.12.9.3.1 The material, quantity and locations for laying solid ballast are checked for compliance with the RS-approved design. The ballast shall be laid in its standard locations only after hull tightness tests.

2.12.9.3.1.1 The ballast shall be made as metal or concrete bars (slabs) apiece or as a concrete (concrete-metal) homogeneous mixture. Use of unspecified metallic waste, crushed (quarry) stone, etc. as ballast is not allowed.

2.12.9.3.1.2 The metallic filler used for ferroconcrete mixtures shall consist of equally shaped and sized elements (e.g. metallic shot) facilitating their uniform distribution in the concrete mixture.

2.12.9.3.2 Prior to laying, the ballast shall be weighed: apiece, by batches for each place of laying or in a measuring tank for the liquid concrete mixture. Hull structures in way of ballast placement shall be thoroughly cleaned, and for the piece-ballast also painted.

The piece-ballast shall be secured so as to prevent its shifting in service. The ballast surface in way of its placement shall be protected against the penetration of moisture to the plating and framing under the ballast. The concrete mixture shall be compacted and completely fill the entire volume provided.

2.12.9.3.3 In surveying the laid ballast, the RS surveyor verifies the scheme of its laying, the scheme approval, the document of the shipyard's technical control body on ballast laying and weighing according to laying places and/or on the quantity of concrete mixture laid according to the scheme, as well as, in external examination, verifies the compliance of the laying place with the scheme, the quantity, level and workmanship of the concrete mixture surface (absence of cracks, separations from metal, cavities and irregularities) and of waterproofing for the places of piece-ballast laying. The liquid concrete mixture shall be placed considering its mass change due to a drying loss.

2.12.9.3.4 At patrol the RS surveyor checks the cleaning and/or painting of places for ballast laying, its weighing (check weighing shall be witnessed by the surveyor, an error therewith shall be within ± 1 %) and the quality of placement (uniformity, compaction of the concrete mixture, securing of the piece-ballast) and waterproofing.

The RS surveyor shall make sure that the data on quantity and laying places of solid ballast are given in the ship records and Stability Booklet.

2.12.10 Load line surveys (item 8.5).

2.12.10.1 The correct marking of the load line on ship's sides according to the RS-approved drawings developed in line with the freeboard calculation as per the Load Line Rules for Sea-Going Ships¹ or International Convention on Load Lines, 1966 (LL-66), as amended is checked.

2.12.10.2 When confirming the load line marking according to the RS-approved design, the RS surveyor shall check the fulfilment of the structural requirements of the approved design and the Register rules with regard to the following:

- .1** doors in end bulkheads of enclosed superstructures and in trunks of machinery spaces;
- .2** cargo and other hatches, hatches of machinery space trunks, hatches of boiler spaces, smoke funnels, manholes, scuttles, ventilation and air pipes located on open decks;
- .3** scuppers, sea outlets and inlets of pipelines with their valves, gate valves and drives;
- .4** freeing ports;
- .5** bulwark, guard rails and life lines;
- .6** gangways or underdeck passages;
- .7** special structural requirements in assignment of the timber freeboard.

The above conditions for assigning the load line shall be indicated by the RS surveyor in the Record of Conditions of Assignment of Load Lines (form 6.7.3).

2.12.10.3 Where the design specifies doubled load lines for the ship, the RS surveyor checks their correct marking on ship's sides according to the RS-approved drawings.

2.12.10.4 Checking the load line, the RS surveyor shall take into account the results of the ship's inclining/weighing test. In so doing, if the stability verification results in the change of the previously-approved freeboard value, the issue of a load line position is reviewed by the RS Branch Office.

2.12.10.5 Load line parts may be of superimposed type, punched or indicated by the other way agreed with the Register. Superimposed parts shall be welded all around or tightly attached with rivets. The cutting-out of a parts contour with a chisel is not allowed. The lines shall be plainly visible and provide an opportunity to control the freeboard value within ± 2 mm. A tolerance for the accuracy of parts fitting is ± 1 mm. The load line parts are painted white or yellow on a dark background or black on a light background.

2.12.10.6 Refer also to the requirements in 19.6.

¹Hereinafter referred to as "the Load Line Rules".

No. 47 Shipbuilding and Repair Quality Standard

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(Rev.1

1999)

(Rev.2

Dec 2004)

(Rev.3,

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Aug 2008)

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Oct 2010)

(Rev.6

May 2012)

(Rev.7

June 2013)

(Rev.8

Oct 2017)

Part A Shipbuilding and Remedial Quality Standard for New Construction

Part B Repair Quality Standard for Existing Ships

**No.
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PART A

SHIPBUILDING AND REMEDIAL QUALITY STANDARDS FOR NEW CONSTRUCTION

- 1. Scope**
- 2. General requirements for new construction**
- 3. Qualification of personnel and procedures**
 - 3.1 Qualification of welders
 - 3.2 Qualification of welding procedures
 - 3.3 Qualification of NDE operators
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 - 8.2 Typical fillet weld plate edge preparation (manual welding and semi-automatic welding)
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 - 8.5 Distance between welds
- 9. Remedial**
 - 9.1 Typical misalignment remedial
 - 9.2 Typical butt weld plate edge preparation remedial (manual welding and semi-automatic welding)
 - 9.3 Typical fillet weld plate edge preparation remedial (manual welding and semi-automatic welding)
 - 9.4 Typical fillet and butt weld profile remedial (manual welding and semi-automatic welding)
 - 9.5 Distance between welds remedial
 - 9.6 Erroneous hole remedial
 - 9.7 Remedial by insert plate
 - 9.8 Weld surface remedial
 - 9.9 Weld remedial (short bead)

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REFERENCES

1. IACS Recommendation No.76 "Bulk Carriers - Guidelines for Surveys, Assessment and Repair of Hull Structure"
2. TSCF "Guidelines for the inspection and maintenance of double hull tanker structures"
3. TSCF "Guidance manual for the inspection and condition assessment of tanker structures"
4. IACS UR W7 "Hull and machinery steel forgings"
5. IACS UR W8 "Hull and machinery steel castings"
6. IACS UR W11 "Normal and higher strength hull structural steels"
7. IACS UR W13 "Thickness tolerances of steel plates and wide flats"
8. IACS UR W14 "Steel plates and wide flats with specified minimum through thickness properties ("Z" quality)"
9. IACS UR W17 "Approval of consumables for welding normal and higher strength hull structural steels"
10. IACS UR W28 "Welding procedure qualification tests of steels for hull construction and marine structures"
11. Annex I to IACS UR Z10.1 "Hull surveys of oil tankers", Z10.2 "Hull surveys of bulk carriers", Z10.3 "Hull Surveys of Chemical Tankers", Z10.4 "Hull Surveys of Double Hull Oil Tankers" and Z10.5 "Hull Surveys of Double-Skin Bulk Carriers"
12. IACS UR Z23 "Hull survey for new construction"
13. IACS Recommendation No. 12 "Guidelines for surface finish of hot rolled plates and wide flats"
14. IACS Recommendation No. 20 "Non-destructive testing of ship hull steel welds"
15. IACS Recommendation No.96 "Double Hull Oil Tankers- Guidelines for Surveys, Assessment and Repair of Hull Structures"
16. IACS Recommendation No.55 "General Dry Cargo Ships- Guidelines for Surveys, Assessment and Repair of Hull Structures"
17. IACS Recommendation No.84 "Container Ships- Guidelines for Surveys, Assessment and Repair of Hull Structures"

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1. Scope

It is intended that these standards provide guidance where established and recognized shipbuilding or national standards accepted by the Classification Society do not exist.

1.1 This standard provides guidance on shipbuilding quality standards for the hull structure during new construction and the remedial standard where the quality standard is not met.

Whereas the standard generally applies to

- conventional merchant ship types,
- parts of hull covered by the rules of the Classification Society,
- hull structures constructed from normal and higher strength hull structural steel,

the applicability of the standard is in each case to be agreed upon by the Classification Society.

The standard does generally not apply to the new construction of

- special types of ships as e.g. gas tankers
- structures fabricated from stainless steel or other, special types or grades of steel

1.2 In this standard, both a "Standard" range and a "Limit" range are listed. The "Standard" range represents the target range expected to be met in regular work under normal circumstances. The "Limit" range represents the maximum allowable deviation from the "Standard" range. Work beyond the "Standard" range but within the "Limit" range is acceptable. In cases where no 'limit' value is specified, the value beyond the 'standard' range may be accepted subject to the consideration of the Classification Society.

1.3 The standard covers typical construction methods and gives guidance on quality standards for the most important aspects of such construction. Unless explicitly stated elsewhere in the standard, the level of workmanship reflected herein will in principle be acceptable for primary and secondary structure of conventional designs. A more stringent standard may however be required for critical and highly stressed areas of the hull, and this is to be agreed with the Classification Society in each case. In assessing the criticality of hull structure and structural components, reference is made to ref. [1], [2], [3], [11], [15], [16] and [17].

1.4 Details relevant to structures or fabrication procedures not covered by this standard are to be approved by the Classification Society on the basis of procedure qualifications and/or recognized national standards.

1.5 For use of this standard, fabrication fit-ups, deflections and similar quality attributes are intended to be uniformly distributed about the nominal values. The shipyard is to take corrective action to improve work processes that produce measurements where a skew distribution is evident. Relying upon remedial steps that truncate a skewed distribution of the quality attribute is unacceptable.

2. General requirements for new construction

2.1 In general, the work is to be carried out in accordance with the Classification Society rules and under the supervision of the Surveyor to the Classification Society.

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2.2 Welding operations are to be carried out in accordance with work instructions accepted by the Classification Society.

2.3 Welding of hull structures is to be carried out by qualified welders, according to approved and qualified welding procedures and with welding consumables approved by the Classification Society, see Section 3. Welding operations are to be carried out under proper supervision by the shipbuilder. The working conditions for welding are to be monitored by the Classification Society in accordance with UR Z23 [12].

3. Qualification of personnel and procedures

3.1 Qualification of welders

3.1.1 Welders are to be qualified in accordance with the procedures of the Classification Society or to a recognized national or international standard. Recognition of other standards is subject to submission to the Classification Society for evaluation. Subcontractors are to keep records of welders qualification and, when required, furnish valid approval test certificates.

3.1.2 Welding operators using fully mechanized or fully automatic processes need generally not pass approval testing provided that the production welds made by the operators are of the required quality. However, operators are to receive adequate training in setting or programming and operating the equipment. Records of training and operation experience shall be maintained on individual operator's files and records, and be made available to the Classification Society for inspection when requested.

3.2 Qualification of welding procedures

Welding procedures are to be qualified in accordance with UR W28 (ref. A10) or other recognized standard accepted by the Classification Society.

3.3 Qualification of NDE operators

Personnel performing non-destructive examination for the purpose of assessing quality of welds in connection with new construction covered by this standard, are to be qualified in accordance with Classification Society rules or to a recognized international or national qualification scheme. Records of operators and their current certificates are to be kept and made available to the Surveyor for inspection.

4. Materials

4.1 Materials for Structural Members

All materials, including weld consumables, to be used for the structural members are to be approved by the Classification Society as per the approved construction drawings and meet the respective IACS Unified Requirements [4], [5], [6], [7], [8] and [9]. Additional recommendations are contained in the following paragraphs.

All materials used should be manufactured at a works approved by the Classification Society for the type and grade supplied.

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4.2 Surface Conditions

4.2.1 Definitions

Minor Imperfections: Pitting, rolled-in scale, indentations, roll marks, scratches and grooves
 Defects: Cracks, shells, sand patches, sharp edged seams and minor imperfections exceeding the limits of table 1
 Depth of Imperfections or defects: The depth is to be measured from the surface of the product

4.2.2 Acceptance without remedies

Minor imperfections, in accordance with the nominal thickness (t) of the product and the limits described in Table 1, are permissible and may be left as they are.

Imperfection surface area Ratio(%)	15~20%	5~15%	0~5%
t < 20 mm	0.2 mm	0.4 mm	0.5 mm
20 mm ≤ t < 50 mm	0.2 mm	0.6 mm	0.7 mm
50 mm ≤ t	0.2 mm	0.7 mm	0.9 mm

Table 1 Limits for depth of minor imperfection, for acceptance without remedies

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Imperfection surface area Ratio (%) is obtained as influenced area / area under consideration (i.e. plate surface area) x 100%.

For isolated surface discontinuities, influenced area is obtained by drawing a continuous line which follows the circumference of the discontinuity at a distance of 20 mm. (Figure 1)

For surface discontinuities appearing in a cluster, influenced area is obtained by drawing a continuous line which follows the circumference of the cluster at a distance of 20 mm. (Figure 2)

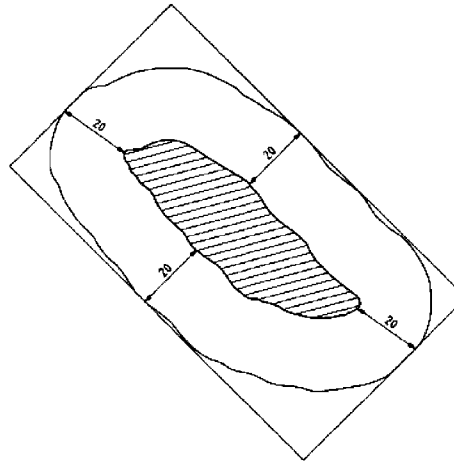


Figure 1 - Determination of the area influenced by an isolated discontinuity
(Ref. Nr. EN 10163-1:2004+AC:2007 E)

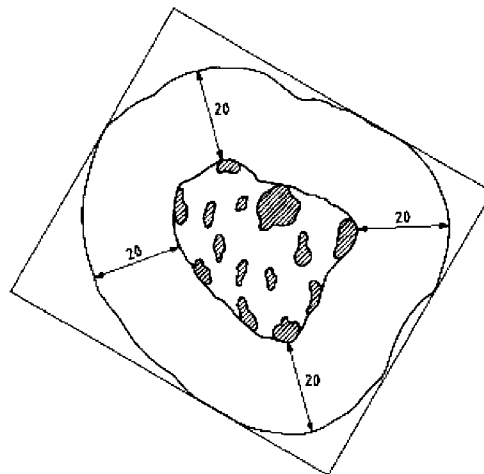


Figure 2 - Determination of the area influenced by clustered discontinuities
(Ref. Nr. EN 10163-1:2004+AC:2007 E)

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4.2.3 Remedial of Defects

Defects are to be remedied by grinding and/or welding in accordance with IACS Rec.12 [12].

4.2.4 Further Defects

4.2.4.1 Lamination

Investigation to be carried out at the steelmill into the cause and extent of the detected laminations. Severe lamination is to be remedied by local insert plates. The minimum breadth or length of the plate to be replaced is to be:

- 1600 mm for shell and strength deck plating in way of cruciform or T-joints,
- 800 mm for shell, strength deck plating and other primary members,
- 300 mm for other structural members.

Local limited lamination may be remedied by chipping and/or grinding followed by welding in accordance with sketch (a). In case where the local limited lamination is near the plate surface, the remedial may be carried out as shown in sketch (b). For limitations see paragraph 4.2.2.



4.2.4.2 Weld Spatters

Loose weld spatters are to be removed by grinding or other measures to clean metal surface (see Table 9.13), as required by the paint system, on:

- shell plating
- deck plating on exposed decks
- in tanks for chemical cargoes
- in tanks for fresh water and for drinking water
- in tanks for lubricating oil, hydraulic oil, including service tanks

5. Gas Cutting

The roughness of the cut edges is to meet the following requirements:

Free Edges:

	Standard Limit	
Strength Members	150 µm	300 µm
Others	500 µm	1000 µm

Welding Edges:

	Standard Limit	
Strength Members	400 µm	800 µm
Others	800 µm	1500 µm

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6. Fabrication and fairness

- 6.1 Flanged longitudinals and flanged brackets (see Table 6.1)
- 6.2 Built-up sections (see Table 6.2)
- 6.3 Corrugated bulkheads (see Table 6.3)
- 6.4 Pillars, brackets and stiffeners (see Table 6.4)
- 6.5 Maximum heating temperature on surface for line heating (see Table 6.5)
- 6.6 Block assembly (see Table 6.6)
- 6.7 Special sub-assembly (see Table 6.7)
- 6.8 Shape (see Table 6.8 and 6.9)
- 6.9 Fairness of plating between frames (see Table 6.10)
- 6.10 Fairness of plating with frames (see Table 6.11)
- 6.11 Preheating for welding hull steels at low temperature (See Table 6.12)

7. Alignment

The quality standards for alignment of hull structural components during new construction are shown in Tables 7.1, 7.2 and 7.3. The Classification Society may require a closer construction tolerance in areas requiring special attention, as follows:

- Regions exposed to high stress concentrations
- Fatigue prone areas
- Detail design block erection joints
- High tensile steel regions

8. Welding Joint Details

Edge preparation is to be qualified in accordance with UR W28 (ref. A10) or other recognized standard accepted by the Classification Society.

Some typical edge preparations are shown in Table 8.1, 8.2, 8.3, 8.4 and 8.6 for reference.

- 8.1 Typical butt weld plate edge preparation (manual and semi-automatic welding) for reference - see Table 8.1 and 8.2
- 8.2 Typical fillet weld plate edge preparation (manual and semi-automatic welding) for reference - see Table 8.3 and 8.4
- 8.3 Butt and fillet weld profile (manual and semi-automatic welding) - see Table 8.5
- 8.4 Typical butt weld plate edge preparation (Automatic welding) for reference - see Table 8.6
- 8.5 Distance between welds - see Table 8.7

9. Remedial

All the major remedial work is subject to reporting by shipbuilder to the Classification Society for approval in accordance with their work instruction for new building.

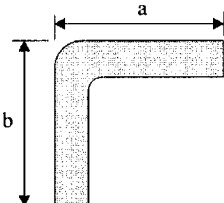
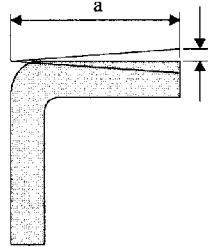
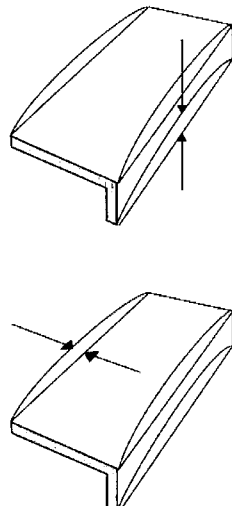
Some typical remedial works are shown in Tables 9.1 to 9.13.

- 9.1 Typical misalignment remedial - see Tables 9.1 to 9.3
- 9.2 Typical butt weld plate edge preparation remedial (manual and semi-automatic welding) - see Table 9.4 and 9.5
- 9.3 Typical fillet weld plate edge preparation remedial (manual and semi-automatic welding) - see Tables 9.6 to 9.8
- 9.4 Typical fillet and butt weld profile remedial (manual and semi-automatic welding) - see Table 9.9

No. 47 (cont)	9.5	Distance between welds remedial - see Table 9.10
	9.6	Erroneous hole remedial - see Table 9.11
	9.7	Remedial by insert plate - see Table 9.12
	9.8	Weld surface remedial - see Table 9.13
	9.9	Weld remedial (short bead) - see Table 9.14

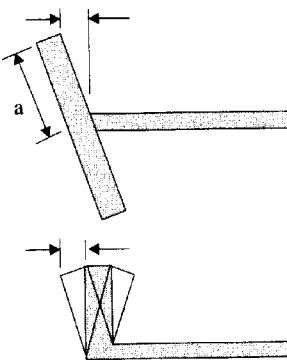
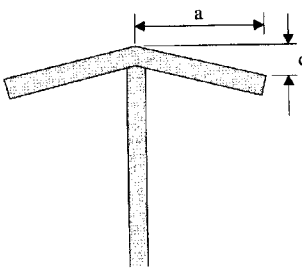
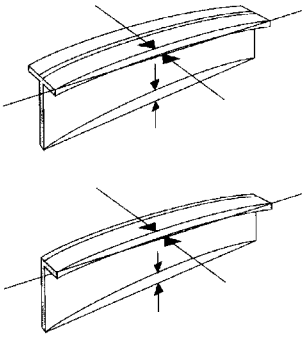
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TABLE 6.1 – Flanged Longitudinals and Flanged Brackets

Detail	Standard	Limit	Remarks
<p>Breadth of flange</p>  <p>compared to correct size</p>	± 3 mm	± 5 mm	
<p>Angle between flange and web</p>  <p>compared to template</p>	± 3 mm	± 5 mm	per 100 mm of a
<p>Straightness in plane of flange and web</p> 	± 10 mm	± 25 mm	per 10 m

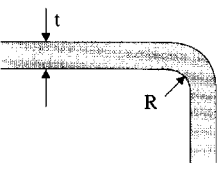
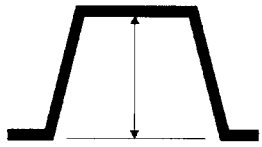
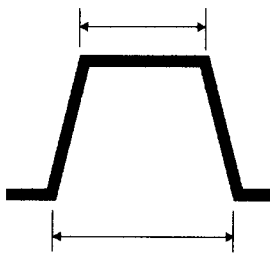
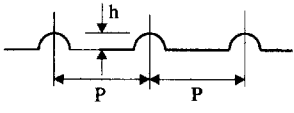
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TABLE 6.2 – Built Up Sections

Detail	Standard	Limit	Remarks
<p>Frames and longitudinal</p> 	$\pm 1.5 \text{ mm}$	$\pm 3 \text{ mm}$	per 100 mm of a
<p>Distortion of face plate</p> 	$d \leq 3 + a/100 \text{ mm}$	$d \leq 5 + a/100 \text{ mm}$	
<p>Distortion in plane of web and flange of built up longitudinal frame, transverse frame, girder and transverse web.</p> 	$\pm 10 \text{ mm}$	$\pm 25 \text{ mm}$	per 10 m in length

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TABLE 6.3 – Corrugated Bulkheads

Detail	Standard	Limit	Remarks
<p>Mechanical bending</p> 	$R \geq 3t$ mm $R \geq 4.5t$ mm for CSR ships ^{Note 1}	$2t$ mm ^{Note 2}	Material to be suitable for cold flanging (forming) and welding in way of radius
<p>Depth of corrugation</p> 	± 3 mm	± 6 mm	
<p>Breadth of corrugation</p> 	± 3 mm	± 6 mm	
<p>Pitch and depth of swedged corrugated bulkhead compared with correct value</p> 	$h : \pm 2.5$ mm Where it is not aligned with other bulkheads $P : \pm 6$ mm Where it is aligned with other bulkheads $P : \pm 2$ mm	$h : \pm 5$ mm Where it is not aligned with other bulkheads $P : \pm 9$ mm Where it is aligned with other bulkheads $P : \pm 3$ mm	

Notes:

- For CSR Bulk Carriers built under the “Common Structural Rules for Bulk Carriers” with the effective dates of 1 July 2010 and 1 July 2012, the standard is $R \geq 2t$ mm.

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2. For CSR ships, the allowable inside bending radius of cold formed plating may be reduced provided the following requirements are complied with.

When the inside bending radius is reduced below 4.5 times the as-built plate thickness, supporting data is to be provided. The bending radius is in no case to be less than 2 times the as-built plate thickness. As a minimum, the following additional requirements are to be complied with:

a) For all bent plates:

- 100% visual inspection of the bent area is to be carried out.
- Random checks by magnetic particle testing are to be carried out.

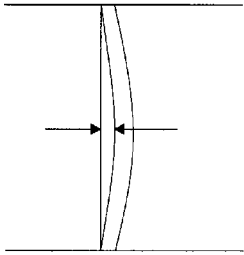
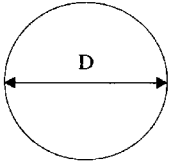
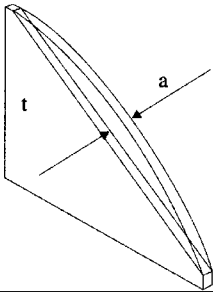
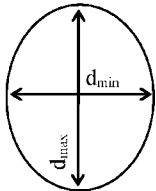
b) In addition to a), for corrugated bulkheads subject to lateral liquid pressure:

- The steel is to be of Grade D/DH or higher.

The material is impact tested in the strain-aged condition and satisfies the requirements stated herein. The deformation is to be equal to the maximum deformation to be applied during production, calculated by the formula $t_{as-built} / (2r_{bdg} + t_{as-built})$, where $t_{as-built}$ is the as-built thickness of the plate material and r_{bdg} is the bending radius. One sample is to be plastically strained at the calculated deformation or 5%, whichever is greater and then artificially aged at 250°C for one hour then subject to Charpy V-notch testing. The average impact energy after strain ageing is to meet the impact requirements specified for the grade of steel used.

No.
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(cont)

TABLE 6.4 – Pillars, Brackets and Stiffeners

Detail	Standard	Limit	Remarks
Pillar (between decks) 	4 mm	6 mm	
Cylindrical structure diameter (pillars, masts, posts, etc.) 	$\pm D/200 \text{ mm}$ max. + 5 mm	$\pm D/150 \text{ mm}$ max. 7.5 mm	
Tripping bracket and small stiffener, distortion at the part of free edge 	$a \leq t/2 \text{ mm}$	t	
Ovality of cylindrical structure 		$d_{\max} - d_{\min} \leq 0.02 \times d_{\max}$	

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(cont)

TABLE 6.5 – Maximum Heating Temperature on Surface for Line Heating

Item		Standard	Limit	Remarks
Conventional Process AH32-EH32 & AH36-EH36	Water cooling just after heating	Under 650°C		
	Air cooling after heating	Under 900°C		
	Air cooling and subsequent water cooling after heating	Under 900°C (starting temperature of water cooling to be under 500°C)		
TMCP type AH36-EH36 (Ceq. >0.38%)				
TMCP type AH32-DH32 & AH36-DH36 (Ceq. ≤ 0.38%)	Water cooling just after heating or air cooling	Under 1000°C		
TMCP type EH32 & EH36 (Ceq. ≤ 0.38%)	Water cooling just after heating or air cooling	Under 900°C		
NOTE:				
$Ceq = C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Ni + Cu}{15} (\%)$				

**No.
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(cont)

TABLE 6.6 – Block Assembly

Item	Standard	Limit	Remarks
Flat Plate Assembly			
Length and Breadth	± 4 mm	± 6 mm	
Distortion	± 10 mm	±20mm	
Squareness	± 5 mm	±10mm	
Deviation of interior members from plate	5 mm	10mm	
Curved plate assembly			
Length and Breadth	± 4 mm	± 8 mm	measured along the girth
Distortion	± 10 mm	± 20 mm	
Squareness	± 10 mm	± 15 mm	
Deviation of interior members from plate	5 mm	10 mm	
Flat cubic assembly			
Length and Breadth	± 4 mm	± 6 mm	
Distortion	± 10 mm	± 20 mm	
Squareness	± 5 mm	± 10 mm	
Deviation of interior members from plate	5 mm	10 mm	
Twist	± 10 mm	± 20 mm	
Deviation between upper and lower plate	± 5 mm	± 10 mm	
Curved cubic assembly			
Length and Breadth	± 4 mm	± 8 mm	measured along with girth
Distortion	± 10 mm	± 20 mm	
		± 15 mm	

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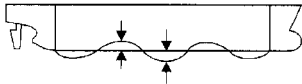
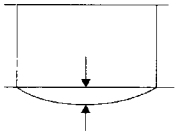
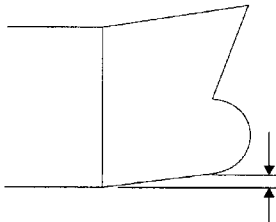
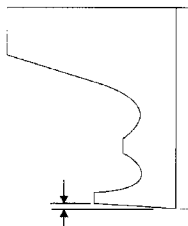
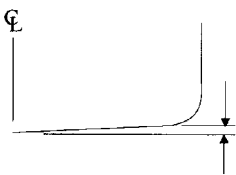
Squareness	$\pm 10 \text{ mm}$	$\pm 10 \text{ mm}$	
Deviation of interior members from plate	$\pm 5 \text{ mm}$	$\pm 25 \text{ mm}$	
Twist	$\pm 15 \text{ mm}$	$\pm 15 \text{ mm}$	
Deviation between upper and lower plate	$\pm 7 \text{ mm}$		

TABLE 6.7 – Special Sub-Assembly

Item	Standard	Limit	Remarks
Distance between upper/lower gudgeon	$\pm 5 \text{ mm}$	$\pm 10 \text{ mm}$	
Distance between aft edge of boss and aft peak bulkhead	$\pm 5 \text{ mm}$	$\pm 10 \text{ mm}$	
Twist of sub-assembly of stern frame	5 mm	10 mm	
Deviation of rudder from shaft center line	4 mm	8 mm	
Twist of rudder plate	6 mm	10 mm	
Flatness of top plate of main engine bed	5 mm	10 mm	
Breadth and length of top plate of main engine bed	$\pm 4 \text{ mm}$	$\pm 6 \text{ mm}$	
<p>NOTE:</p> <p>Dimensions and tolerances have to fulfill engine and equipment manufacturers' requirements, if any.</p>			

**No.
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TABLE 6.8 – Shape

Detail	Standard	Limit	Remarks
Deformation for the whole length 	$\pm 50 \text{ mm}$		per 100 m against the line of keel sighting
Deformation for the distance between two adjacent bulkheads 	$\pm 15 \text{ mm}$		
Cocking-up of fore body 	$\pm 30 \text{ mm}$		The deviation is to be measured from the design line.
Cocking-up of aft-body 	$\pm 20 \text{ mm}$		
Rise of floor amidships 	$\pm 15 \text{ mm}$		The deviation is to be measured from the design line.

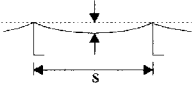
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TABLE 6.9 – Shape

Item	Standard	Limit	Remarks
Length between perpendiculars	$\pm L/1000$ mm where L is in mm		Applied to ships of 100 metre length and above. For the convenience of the measurement the point where the keel is connected to the curve of the stem may be substituted for the fore perpendicular in the measurement of the length.
Moulded breadth at midship	$\pm B/1000$ mm where B is in mm		Applied to ships of 15 metre breadth and above, measured on the upper deck.
Moulded depth at midship	$\pm D/1000$ mm where D is in mm		Applied to ships of 10 metre depth and above, measured up to the upper deck.

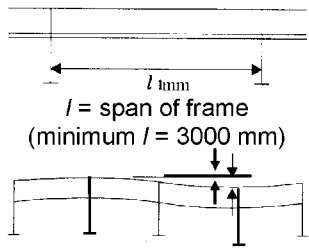
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TABLE 6.10 – Fairness of Plating Between Frames

Item		Standard	Limit	Remarks
Shell plate	Parallel part (side & bottom shell)	4 mm	8 mm	
	Fore and aft part	5 mm		
Tank top plate		4 mm		
Bulkhead	Longl. Bulkhead Trans. Bulkhead Swash Bulkhead	6 mm		
Strength deck	Parallel part	4 mm	8 mm	
	Fore and aft part	6 mm	9 mm	
	Covered part	7 mm	9 mm	
Second deck	Bare part	6 mm	8 mm	
	Covered part	7 mm	9 mm	
Forecastle deck poop deck	Bare part	4 mm	8 mm	
	Covered part	6 mm	9 mm	
Super structure deck	Bare part	4 mm	6 mm	
	Covered part	7 mm	9 mm	
House wall	Outside wall	4 mm	6 mm	
	Inside wall	6 mm	8 mm	
	Covered part	7 mm	9 mm	
Interior member (web of girder, etc)		5 mm	7 mm	
Floor and girder in double bottom		5 mm	8 mm	

**No.
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(cont)

TABLE 6.11 – Fairness of Plating with Frames

Item		Standard	Limit	Remarks
Shell plate	Parallel part	$\pm 2 // 1000 \text{ mm}$	$\pm 3 // 1000 \text{ mm}$	$l = \text{span of frame (mm)}$ To be measured between on trans. space (min. $l = 3000 \text{ mm}$)
	Fore and aft part	$\pm 3 // 1000 \text{ mm}$	$\pm 4 // 1000 \text{ mm}$	
Strength deck (excluding cross deck) and top plate of double bottom	-	$\pm 3 // 1000 \text{ mm}$	$\pm 4 // 1000 \text{ mm}$	
Bulkhead	-		$\pm 5 // 1000 \text{ mm}$	
Accommodation above the strength deck and others	-	$\pm 5 // 1000 \text{ mm}$	$\pm 6 // 1000 \text{ mm}$	
 <p>To be measured between one trans. space.</p>				

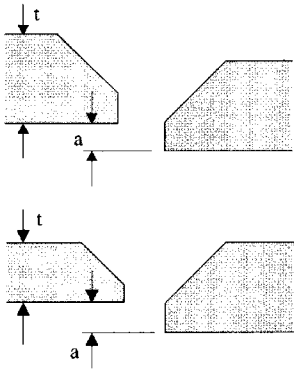
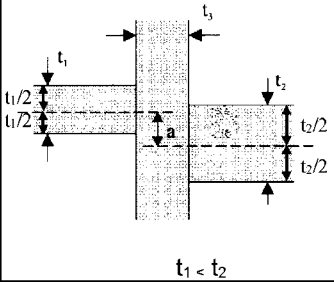
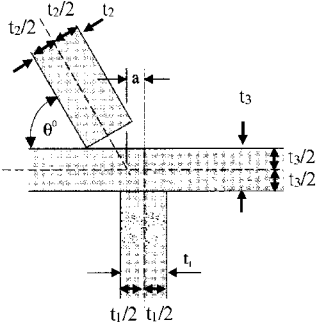
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TABLE 6.12 – Preheating for welding hull steels at low temperature

Item		Standard		Limit	Remarks
		Base metal temperature needed preheating	Minimum preheating temperature		
Normal strength steels	A, B, D, E	Below -5 °C	20 °C ¹⁾		
Higher strength steels (TMCP type)	AH32 – EH32 AH36 – EH36	Below 0 °C			
Higher strength steels (Conventional type)		Below 0 °C			
(Note) 1) This level of preheat is to be applied unless the approved welding procedure specifies a higher level.					

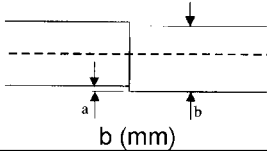
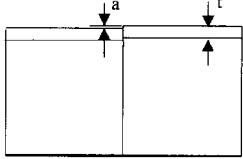
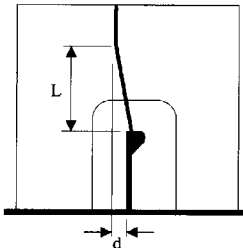
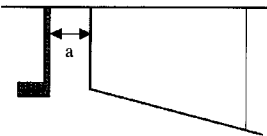
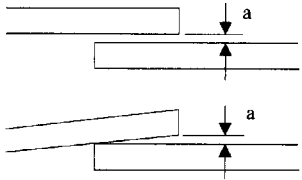
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TABLE 7.1 – Alignment

Detail	Standard	Limit	Remarks
<p>Alignment of butt welds</p> 		$a \leq 0.15t$ strength member $a \leq 0.2t$ other but maximum 4.0 mm	t is the lesser plate thickness
<p>Alignment of fillet welds</p>  <p>$t_1 < t_2$</p>		Strength member and higher stress member: $a \leq t_1/3$ Other: $a \leq t_1/2$	Alternatively, heel line can be used to check the alignment. Where t_3 is less than t_1 , then t_3 should be substituted for t_1 in the standard.
<p>Alignment of fillet welds</p> 		Strength member and higher stress member: $a \leq t_1/3$ Other: $a \leq t_1/2$	Alternatively, heel line can be used to check the alignment. Where t_3 is less than t_1 , then t_3 should be substituted for t_1 in the standard.

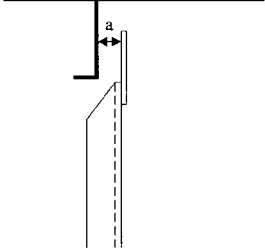
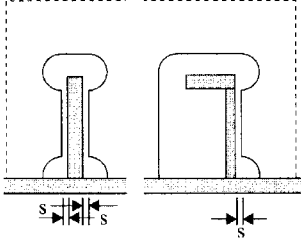
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TABLE 7.2 – Alignment

Detail	Standard	Limit	Remarks
<p>Alignment of flange of T-longitudinal</p> 	<p>Strength member $a \leq 0.04b$ (mm)</p>	$a = 8.0$ mm	
<p>Alignment of height of T-bar, L-angle bar or bulb</p> 	<p>Strength member $a \leq 0.15t$ Other $a \leq 0.20t$</p>	$a = 3.0$ mm	
<p>Alignment of panel stiffener</p> 	$d \leq L/50$		
<p>Gap between bracket/intercostal and stiffener</p> 	$a \leq 2.0$ mm	$a = 3.0$ mm	
<p>Alignment of lap welds</p> 	$a \leq 2.0$ mm	$a = 3.0$ mm	

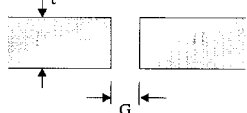
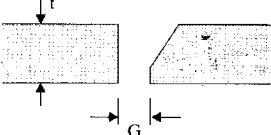
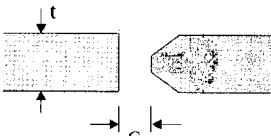
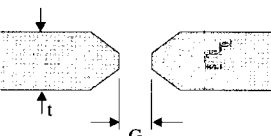
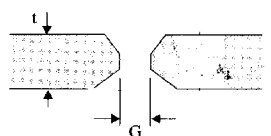
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TABLE 7.3 – Alignment

Detail	Standard	Limit	Remarks
<p>Gap between beam and frame</p> 	$a \leq 2.0 \text{ mm}$	$a = 5.0 \text{ mm}$	
<p>Gap around stiffener cut-out</p> 	$s \leq 2.0 \text{ mm}$	$s = 3.0 \text{ mm}$	

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TABLE 8.1 – Typical Butt Weld Plate Edge Preparation (Manual Welding and Semi-Automatic Welding) for Reference

Detail	Standard	Limit	Remarks
<p>Square butt $t \leq 5 \text{ mm}$</p> 	$G \leq 3 \text{ mm}$	$G = 5 \text{ mm}$	see Note 1
<p>Single bevel butt $t > 5 \text{ mm}$</p> 	$G \leq 3 \text{ mm}$	$G = 5 \text{ mm}$	see Note 1
<p>Double bevel butt $t > 19 \text{ mm}$</p> 	$G \leq 3 \text{ mm}$	$G = 5 \text{ mm}$	see Note 1
<p>Double vee butt, uniform bevels</p> 	$G \leq 3 \text{ mm}$	$G = 5 \text{ mm}$	see Note 1
<p>Double vee butt, non-uniform bevel</p> 	$G \leq 3 \text{ mm}$	$G = 5 \text{ mm}$	see Note 1

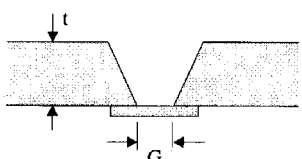
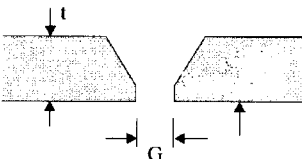
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NOTE 1

Different plate edge preparation may be accepted or approved by the Classification Society in accordance with UR W28 (ref. A10) or other recognized standard accepted by the Classification Society.

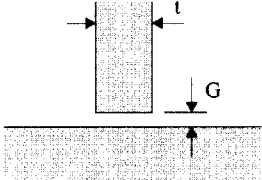
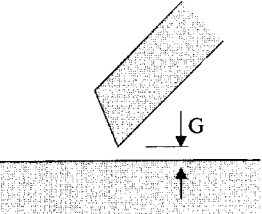
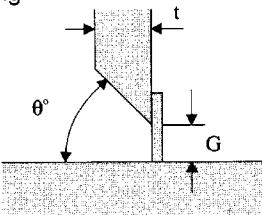
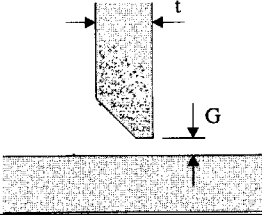
For welding procedures other than manual welding, see paragraph 3.2 Qualification of weld procedures.

TABLE 8.2 – Typical Butt Weld Plate Edge Preparation (Manual Welding and Semi-Automatic Welding) for Reference

Detail	Standard	Limit	Remarks
<p>Single Vee butt, one side welding with backing strip (temporary or permanent)</p> 	$G = 3 \text{ to } 9 \text{ mm}$	$G = 16 \text{ mm}$	see Note 1
<p>Single vee butt</p> 	$G \leq 3 \text{ mm}$	$G = 5 \text{ mm}$	see Note 1
<p>NOTE 1</p> <p>Different plate edge preparation may be accepted or approved by the Classification Society in accordance with UR W28 (ref. A10) or other recognized standard accepted by the Classification Society.</p> <p>For welding procedures other than manual welding, see paragraph 3.2 Qualification of welding procedures.</p>			

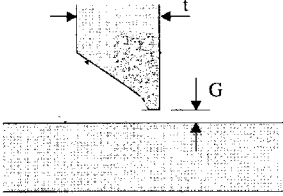
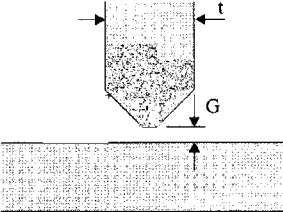
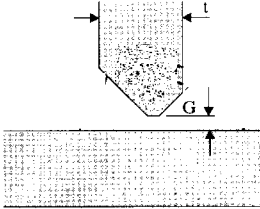
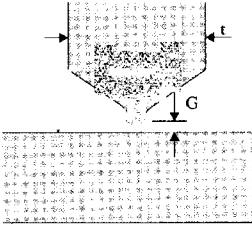
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Table 8.3 – Typical Fillet Weld Plate Edge Preparation (Manual Welding and Semi-Automatic Welding) for Reference

Detail	Standard	Limit	Remarks
Tee Fillet 	$G \leq 2 \text{ mm}$	$G = 3 \text{ mm}$	see Note 1
Inclined fillet 	$G \leq 2 \text{ mm}$	$G = 3 \text{ mm}$	see Note 1
Single bevel tee with permanent backing 	$G \leq 4 \text{ to } 6 \text{ mm}$ $\theta^\circ = 30^\circ \text{ to } 45^\circ$	$G = 16 \text{ mm}$	Not normally for Strength member also see Note 1
Single bevel tee 	$G \leq 3 \text{ mm}$		see Note 1
NOTE 1 Different plate edge preparation may be accepted or approved by the Classification Society in accordance with UR W28 (ref. A10) or other recognized standard accepted by the Classification Society. For welding procedures other than manual welding, see paragraph 3.2 Qualification of welding procedures.			

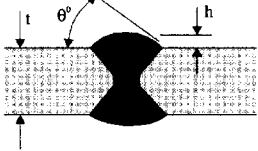

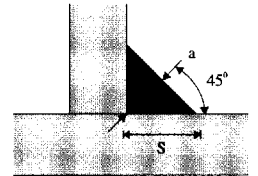
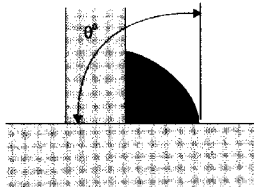
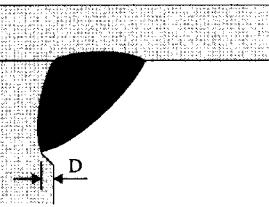
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Table 8.4 – Typical Fillet Weld Plate Edge Preparation (Manual Welding and Semi-Automatic Welding) for Reference

Detail	Standard	Limit	Remarks
<p>Single 'J' bevel tee</p> 	$G = 2.5 \text{ to } 4 \text{ mm}$		see Note 1
<p>Double bevel tee symmetrical $t > 19 \text{ mm}$</p> 	$G \leq 3 \text{ mm}$		see Note 1
<p>Double bevel tee asymmetrical $t > 19 \text{ mm}$</p> 	$G \leq 3 \text{ mm}$		see Note 1
<p>Double 'J' bevel tee symmetrical</p> 	$G = 2.5 \text{ to } 4 \text{ mm}$		see Note 1
<p>NOTE 1 Different plate edge preparation may be accepted or approved by the Classification Society in accordance with UR W28 (ref. A10) or other recognized standard accepted by the Classification Society. For welding procedures other than manual welding, see paragraph 3.2 Qualification of welding procedures.</p>			

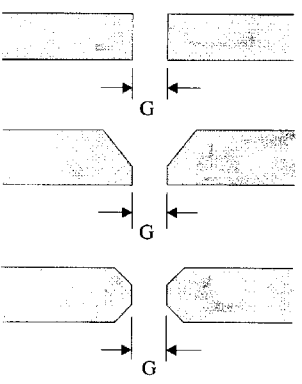
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Table 8.5 – Butt And Fillet Weld Profile (Manual Welding and Semi-Automatic Welding)

Detail	Standard	Limit	Remarks
<p>Butt weld toe angle</p> 	$\theta \leq 60^\circ$ $h \leq 6 \text{ mm}$	$\theta \leq 90^\circ$	
<p>Butt weld undercut</p> 		$D \leq 0.5 \text{ mm}$ for strength member $D \leq 0.8 \text{ mm}$ for other	
<p>Fillet weld leg length</p>  <p>s = leg length; a = throat thickness</p>		$s \geq 0.9s_d$ $a \geq 0.9a_d$ over short weld lengths	s_d = design s a_d = design a
<p>Fillet weld toe angle</p> 		$\theta \leq 90^\circ$	In areas of stress concentration and fatigue, the Classification Society may require a lesser angle.
<p>Fillet weld undercut</p> 		$D \leq 0.8 \text{ mm}$	

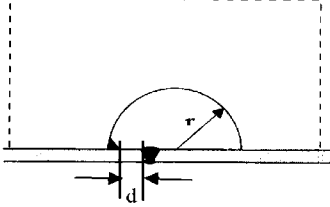
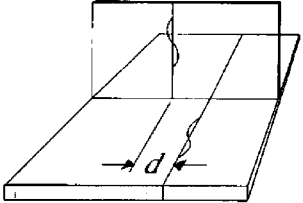
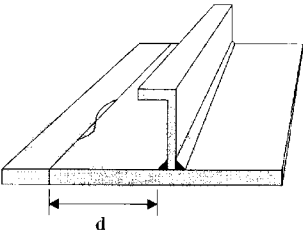
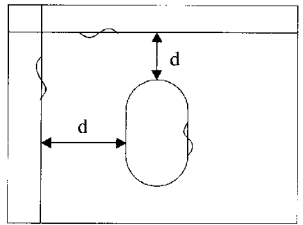
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Table 8.6 – Typical Butt Weld Plate Edge Preparation (Automatic welding) for Reference

Detail	Standard	Limit	Remarks
<p>Submerged Arc Welding (SAW)</p> 	$0 \leq G \leq 0.8 \text{ mm}$	$G = 2 \text{ mm}$	See Note 1.
<p>NOTE 1</p> <p>Different plate edge preparation may be accepted or approved by the Classification Society in accordance with UR W28 (ref. A10) or other recognized standard accepted by the Classification Society.</p> <p>For welding procedures other than manual welding, see paragraph 3.2 Qualification of welding procedures.</p>			

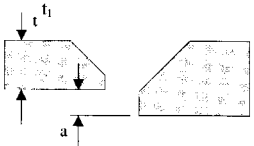
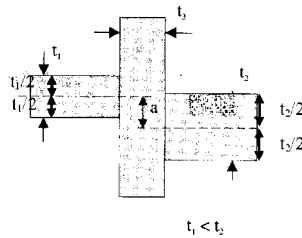
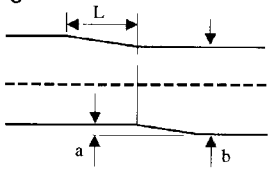
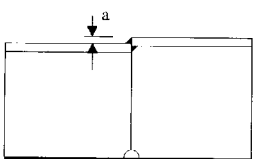
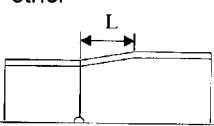
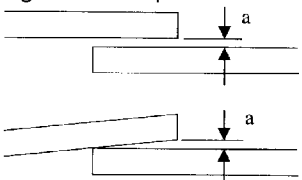
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Table 8.7 – Distance Between Welds

Detail	Standard	Limit	Remarks
<p>Scallops over weld seams</p> 		<p>for strength member $d \geq 5\text{mm}$</p> <p>for other $d \geq 0\text{mm}$</p>	The "d" is to be measured from the toe of the fillet weld to the toe of the butt weld.
<p>Distance between two butt welds</p> 		$d \geq 0\text{ mm}$	
<p>Distance between butt weld and fillet weld</p> 		<p>for strength member $d \geq 10\text{ mm}$</p> <p>for other $d \geq 0\text{ mm}$</p>	The "d" is to be measured from the toe of the fillet weld to the toe of the butt weld.
<p>Distance between butt welds</p> 	<p>for cut-outs $d \geq 30\text{ mm}$</p>		
	<p>for margin plates $d \geq 300\text{ mm}$</p>	150 mm	

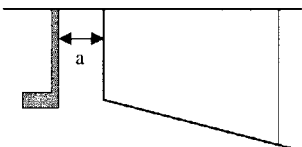
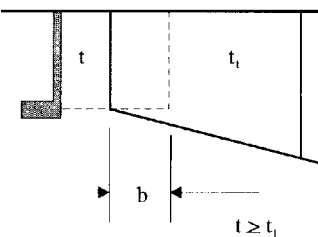
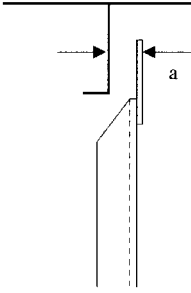
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Table 9.1 – Typical Misalignment Remedial

Detail	Remedial Standard	Remarks
<p>Alignment of butt joints</p> 	<p>Strength member $a > 0.15t_1$ or $a > 4$ mm release and adjust</p> <p>Other $a > 0.2t_1$ or $a > 4$ mm release and adjust</p>	<p>t_1 is lesser plate thickness</p>
<p>Alignment of fillet welds</p>  <p>$t_1 < t_2$</p>	<p>Strength member and higher stress member $t_1/3 < a \leq t_1/2$ - generally increase weld throat by 10%</p> <p>$a > t_1/2$ - release and adjust over a minimum of 50a</p> <p>Other $a > t_1/2$ - release and adjust over a minimum of 30a</p>	<p>Alternatively, heel line can be used to check the alignment.</p> <p>Where t_3 is less than t_1 then t_3 should be substituted for t_1 in standard</p>
<p>Alignment of flange of T-longitudinal</p> 	<p>When $0.04b < a \leq 0.08b$, max 8 mm: grind corners to smooth taper over a minimum distance $L = 3a$</p> <p>When $a > 0.08b$ or 8 mm: release and adjust over a minimum distance $L = 50a$</p>	
<p>Alignment of height of T-bar, L-angle bar or bulb</p> 	<p>When $3 \text{ mm} < a \leq 6 \text{ mm}$: build up by welding</p> <p>When $a > 6 \text{ mm}$: release and adjust over minimum $L = 50a$ for strength member and $L = 30a$ for other</p> 	
<p>Alignment of lap welds</p> 	<p>$3 \text{ mm} < a \leq 5 \text{ mm}$: weld leg length to be increased by the same amount as increase in gap in excess of 3 mm</p> <p>$a > 5 \text{ mm}$: members to be re-aligned</p>	

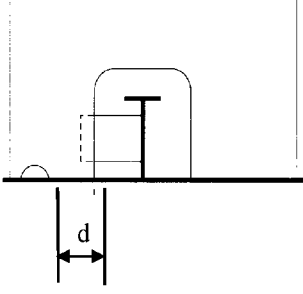
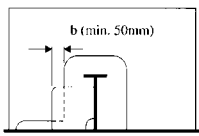
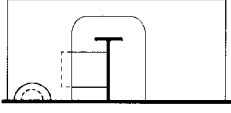
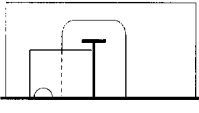
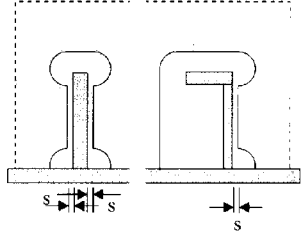
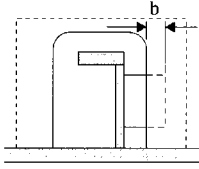
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Table 9.2 – Typical Misalignment Remedial

Detail	Remedial Standard	Remarks
<p>Gap between bracket/intercostal and stiffener</p> 	<p>When $3 \text{ mm} < a \leq 5 \text{ mm}$: weld leg length to be increased by increase in gap in excess of 3 mm</p>	
	<p>When $5 \text{ mm} < a \leq 10 \text{ mm}$: chamfer 30° to 40° and build up by welding with backing</p>	
	<p>When $a > 10 \text{ mm}$: increase gap to about 50 mm and fit collar plate</p>  <p>$b = (2t + 25) \text{ mm, min. } 50 \text{ mm}$</p>	
<p>Gap between beam and frame</p> 	<p>$3 \text{ mm} < a \leq 5 \text{ mm}$: weld leg length to be increased by the same amount as increase in gap in excess of 3 mm</p> <p>$a > 5 \text{ mm}$ release and adjust</p>	

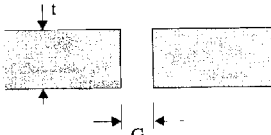
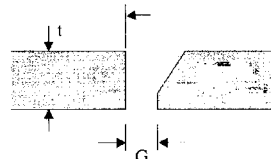
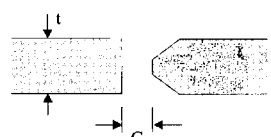
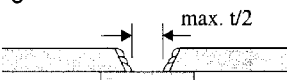
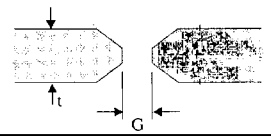
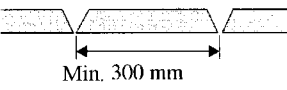
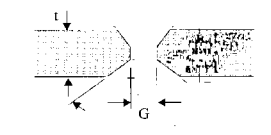
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TABLE 9.3 – Misalignment Remedial

Detail	Remedial standard	Remarks
<p>Position of scallop</p> 	<p>When $d < 75$ mm web plate to be cut between scallop and slot, and collar plate to be fitted</p>  <p>Or fit small collar over scallop</p>  <p>Or fit collar plate over scallop</p> 	
<p>Gap around stiffener cut-out</p> 	<p>When $3 \text{ mm} < s \leq 5 \text{ mm}$ weld leg length to be increased by the same amount as increase in gap in excess of 2 mm</p> <p>When $5 \text{ mm} < s \leq 10 \text{ mm}$ nib to be chamfered and built up by welding</p> <p>When $s > 10 \text{ mm}$ cut off nib and fit collar plate of same height as nib</p>  <p>$20 \text{ mm} \leq b \leq 50 \text{ mm}$</p>	

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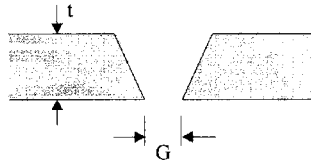
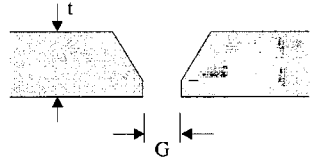
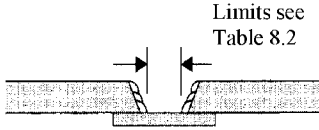
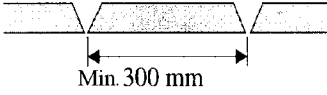
TABLE 9.4 – Typical Butt Weld Plate Edge Preparation Remedial (Manual Welding and Semi-Automatic Welding)

Detail	Remedial standard	Remarks
<p>Square butt</p> 	<p>When $G \leq 10$ mm chamfer to 45° and build up by welding</p> <p>When $G > 10$ mm build up with backing strip; remove, back gouge and seal weld; or, insert plate, min. width 300 mm</p>	
<p>Single bevel butt</p> 	<p>When $5 \text{ mm} < G \leq 1.5t$ (maximum 25 mm) build up gap with welding on one or both edges to maximum of $0.5t$, using backing strip, if necessary.</p> <p>Where a backing strip is used, the backing strip is to be removed, the weld back gouged, and a sealing weld made.</p>	
<p>Double bevel butt</p> 	 <p>Different welding arrangement by using backing material approved by the Classification Society may be accepted on the basis of an appropriate welding procedure specification.</p>	
<p>Double vee butt, uniform bevels</p> 	<p>When $G > 25$ mm or $1.5t$, whichever is smaller, use insert plate, of minimum width 300 mm</p> 	
<p>Double vee butt, non-uniform bevel</p> 		

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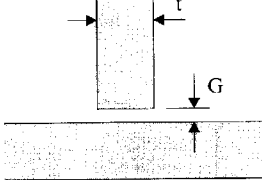
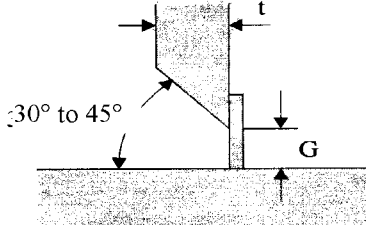
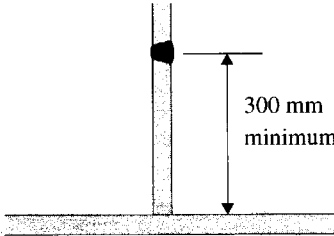
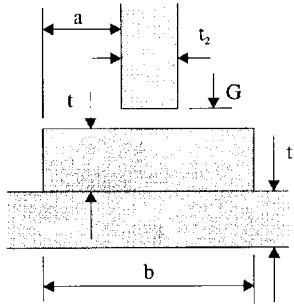
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TABLE 9.5 – Typical Butt Weld Plate Edge Preparation Remedial (Manual Welding and Semi-Automatic Welding)

Detail	Remedial Standard	Remarks
<p>Single vee butt, one side welding</p> 	<p>When $5 \text{ mm} < G \leq 1.5t \text{ mm}$ (maximum 25 mm), build up gap with welding on one or both edges, to "Limit" gap size preferably to "Standard" gap size as described in Table 8.2.</p> <p>Where a backing strip is used, the backing strip is to be removed, the weld back gouged, and a sealing weld made.</p>	
<p>Single vee butt</p> 	<p>Different welding arrangement by using backing material approved by the Classification Society may be accepted on the basis of an appropriate welding procedure specification.</p>  <p>Limits see Table 8.2</p> <p>When $G > 25 \text{ mm}$ or $1.5t$, whichever is smaller, use insert plate of minimum width 300 mm.</p>  <p>Min. 300 mm</p>	

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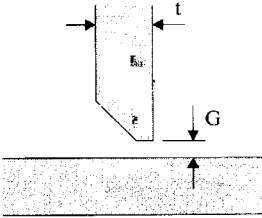
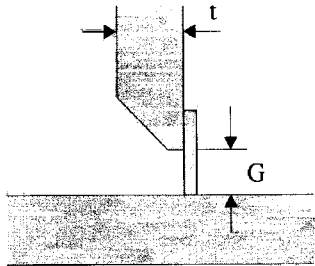
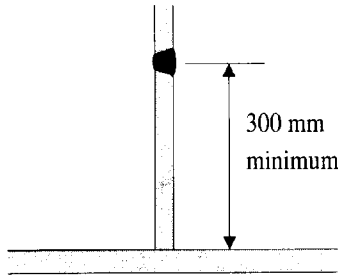
TABLE 9.6 – Typical Fillet Weld Plate Edge Preparation Remedial (Manual Welding and Semi-Automatic Welding)

Detail	Remedial standard	Remarks
<p>Tee Fillet</p> 	<p>$3 \text{ mm} < G \leq 5 \text{ mm}$ – leg length increased to Rule leg + (G-2)</p> <p>$5 \text{ mm} < G \leq 16 \text{ mm}$ or $G \leq 1.5t$ - chamfer by 30° to 45°, build up with welding, on one side, with backing strip if necessary, grind and weld.</p>  <p>$G > 16 \text{ mm}$ or $G > 1.5t$ use insert plate of minimum width 300 mm</p> 	
<p>Liner treatment</p> 	<p>$t_2 \leq t \leq t_1$ $G \leq 2 \text{ mm}$ $a = 5 \text{ mm} + \text{fillet leg length}$</p>	<p>Not to be used in cargo area or areas of tensile stress through the thickness of the liner</p>

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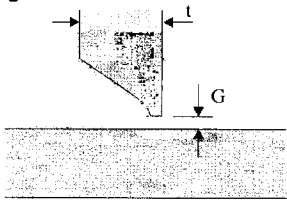
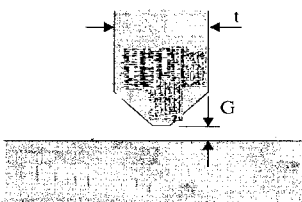
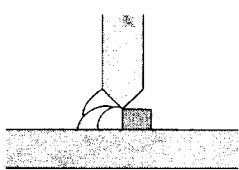
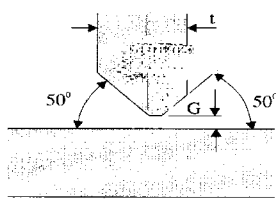
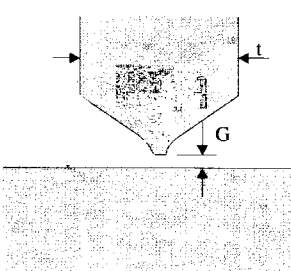
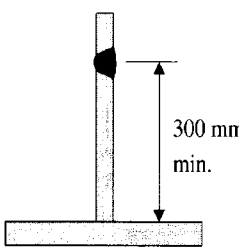
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TABLE 9.7 – Typical Fillet Weld Plate Edge Preparation Remedial (Manual Welding and Semi-Automatic Welding)

Detail	Remedial standard	Remarks
<p>Single bevel tee</p> 	<p>$3 \text{ mm} < G \leq 5 \text{ mm}$ build up weld</p>	
	<p>$5 \text{ mm} < G \leq 16 \text{ mm}$ - build up with welding, with backing strip if necessary, remove backing strip if used, back gouge and back weld.</p> 	
	<p>$G > 16 \text{ mm}$ new plate to be inserted of minimum width 300 mm</p> 	

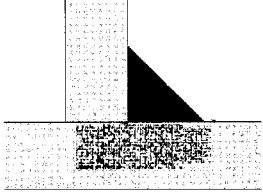
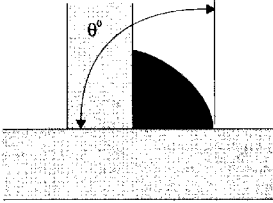
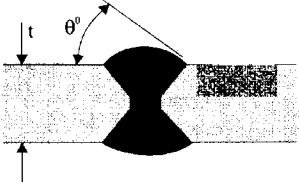

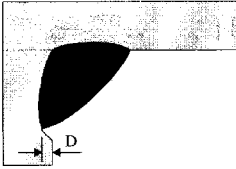
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TABLE 9.8 – Typical Fillet Weld Plate Edge Preparation Remedial (Manual Welding and Semi-Automatic Welding)

Detail	Remedial standard	Remarks
<p>Single 'J' bevel tee</p> 	as single bevel tee	
<p>Double bevel tee symmetrical</p> 	<p>When $5 \text{ mm} < G \leq 16 \text{ mm}$ build up with welding using ceramic or other approved backing bar, remove, back gouge and back weld.</p> 	
<p>Double bevel tee asymmetrical</p> 		
<p>Double 'J' bevel symmetrical</p> 		
	<p>When $G > 16 \text{ mm}$-insert plate of minimum height 300 mm to be fitted.</p> 	

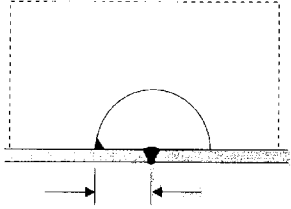
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TABLE 9.9 – Typical Fillet and Butt Weld Profile Remedial (Manual Welding and Semi-Automatic Welding)

Detail	Remedial standard	Remarks
<p>Fillet weld leg length</p> 	<p>Increase leg or throat by welding over</p>	<p>Minimum short bead to be referred Table 9.14</p>
<p>Fillet weld toe angle</p> 	<p>$\theta > 90^\circ$ grinding, and welding, where necessary, to make $\theta \leq 90^\circ$</p>	
<p>Butt weld toe angle</p> 	<p>$\theta > 90^\circ$ grinding, and welding, where necessary, to make $\theta \leq 90^\circ$</p>	
<p>Butt weld undercut</p> 	<p>For strength member, where $0.5 < D \leq 1$ mm, and for other, where $0.8 < D \leq 1$ mm, undercut to be ground smooth (localized only) or to be filled by welding</p> <p>Where $D > 1$ mm undercut to be filled by welding</p>	
<p>Fillet weld undercut</p> 	<p>Where $0.8 < D \leq 1$ mm undercut to be ground smooth (localized only) or to be filled by welding</p> <p>Where $D > 1$ mm undercut to be filled by welding</p>	

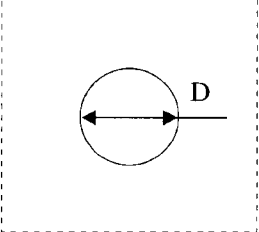
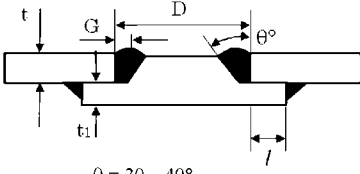
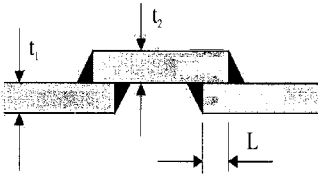
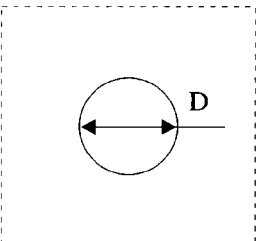
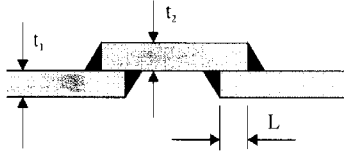
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TABLE 9.10 – Distance Between Welds Remedial

Detail	Remedial standard	Remarks
<p>Scallops over weld seams</p> 	<p>Hole to be cut and ground smooth to obtain distance</p>	

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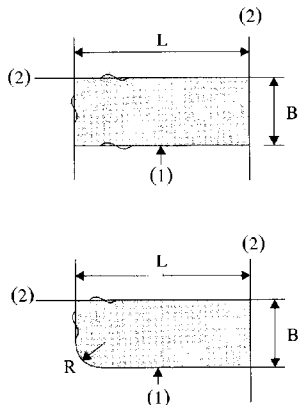
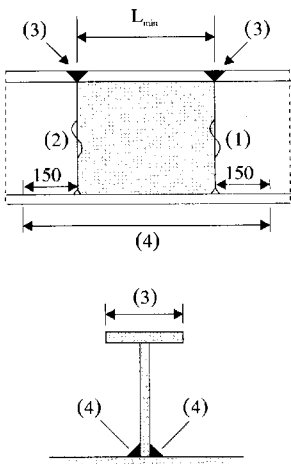
TABLE 9.11 – Erroneous Hole Remedial

Detail	Remedial standard	Remarks
<p>Holes made erroneously $D < 200$ mm</p> 	<p>Strength member open hole to minimum 75 mm dia., fit and weld spigot piece</p>  <p> $\theta = 30 - 40^\circ$ $G = 4 - 6$ mm $1/2t \leq t_1 \leq t$ $l = 50$ mm </p> <p>Or open hole to over 300 mm and fit insert plate</p>	<p>Fillet weld to be made after butt weld</p> <p>The fitting of spigot pieces in areas of high stress concentration or fatigue is to be approved by the Classification Society.</p>
	<p>Other open hole to over 300 mm and fit insert plate</p> <p>Or fit lap plate</p>  <p> $t_1 = t_2$ $L = 50$ mm, min </p>	
<p>Holes made erroneously $D \geq 200$ mm</p> 	<p>Strength member open hole and fit insert plate</p>	
	<p>Other open hole to over 300 mm and fit insert plate</p> <p>Or fit lap plate</p>  <p> $t_1 = t_2$ $L = 50$ mm, min </p>	

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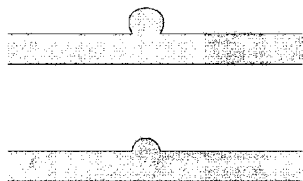
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TABLE 9.12 – Remedial by Insert Plate

Detail	Remedial standard	Remarks
<p>Remedial by insert plate</p> 	<p>$L = 300 \text{ mm minimum}$</p> <p>$B = 300 \text{ mm minimum}$</p> <p>$R = 5t \text{ mm}$ 100mm minimum</p> <p>(1) seam with insert piece is to be welded first</p> <p>(2) original seam is to be released and welded over for a minimum of 100 mm.</p>	
<p>Remedial of built section by insert plate</p> 	<p>$L_{\min} \geq 300 \text{ mm}$</p> <p>Welding sequence (1) → (2) → (3) → (4)</p> <p>Web butt weld scallop to be filled during final pass (4)</p>	

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(cont)

TABLE 9.13 – Weld Surface Remedial

Detail	Remedial standard	Remarks
<p>Weld spatter</p> 	<ol style="list-style-type: none"> 1. Remove spatter observed before blasting with scraper or chipping hammer, etc. 2. For spatter observed after blasting: <ol style="list-style-type: none"> a) Remove with a chipping hammer, scraper, etc. b) For spatter not easily removed with a chipping hammer, scraper, etc., grind the sharp angle of spatter to make it obtuse. 	<p>In principle, no grinding is applied to weld surface.</p>
<p>Arc strike (HT steel, Cast steel, Grade E of mild steel, TMCP type HT steel, Low temp steel)</p>	<p>Remove the hardened zone by grinding or other measures such as overlapped weld bead etc.</p>	<p>Minimum short bead to be referred Table 9.14</p>

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TABLE 9.14 – Welding Remedial by Short Bead

Detail	Remedial standard	Remarks
Short bead for remedying scar (scratch)	<p>a) HT steel, Cast steel, TMCP type HT steel ($C_{eq} > 0.36\%$) and Low temp steel ($C_{eq} > 0.36\%$)</p> <p>Length of short bead ≥ 50 mm</p> <p>b) Grade E of mild steel</p> <p>Length of short bead ≥ 30 mm</p> <p>c) TMCP type HT steel ($C_{eq} \leq 0.36\%$) and Low temp steel ($C_{eq} \leq 0.36\%$)</p> <p>Length of short bead ≥ 10 mm</p>	Preheating is necessary at $100 \pm 25^{\circ}\text{C}$
Remedying weld bead	<p>a) HT steel, Cast steel, TMCP type HT steel ($C_{eq} > 0.36\%$) and Low temp steel ($C_{eq} > 0.36\%$)</p> <p>Length of short bead ≥ 50 mm</p> <p>b) Grade E of mild steel</p> <p>Length of short bead ≥ 30 mm</p> <p>c) TMCP type HT steel ($C_{eq} \leq 0.36\%$) and Low temp steel ($C_{eq} \leq 0.36\%$)</p> <p>Length of short bead ≥ 30 mm</p>	

NOTE:

1. When short bead is made erroneously, remove the bead by grinding.

$$2. \text{ Ceq} = \text{C} + \frac{\text{Mn}}{6} + \frac{\text{Cr} + \text{Mo} + \text{V}}{5} + \frac{\text{Ni} + \text{Cu}}{15} (\%)$$

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Repair Quality Standard for Existing Ships

**No.
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(cont)

Part B - Shipbuilding and Repair Quality Standard for Existing Ships

CONTENTS:

- 1. Scope**
- 2. General requirements to repairs and repairers**
- 3. Qualification of personnel**
 - 3.1 Qualification of welders
 - 3.2 Qualification of welding procedures
 - 3.3 Qualification of NDE operators
- 4. Materials**
 - 4.1 General requirements to materials
 - 4.2 Equivalency of material grades
- 5. General requirements to welding**
 - 5.1 Correlation of welding consumables to hull structural steels
 - 5.2 General requirements to preheating and drying out
 - 5.3 Dry welding on hull plating below the waterline of vessels afloat
- 6. Repair quality standard**
 - 6.1 Welding, general
 - 6.2 Renewal of plates
 - 6.3 Doubler on plates
 - 6.4 Renewal of internals/stiffeners
 - 6.5 Renewal of internals/stiffeners - transitions inverted angles/bulb profiles
 - 6.6 Application of Doubling Straps
 - 6.7 Welding of pitting corrosion
 - 6.8 Welding repairs of cracks

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REFERENCES

1. IACS Recommendation 76 "Bulk Carriers - Guidelines for Surveys, Assessment and Repair of Hull Structure"
2. TSCF "Guidelines for the inspection and maintenance of double hull tanker structures"
3. TSCF "Guidance manual for the inspection and condition assessment of tanker structures"
4. IACS UR W11 "Normal and higher strength hull structural steels"
5. IACS UR W17 "Approval of consumables for welding normal and higher strength hull structural steels"
6. Annex I to IACS Z10.1 "Hull surveys of oil tankers", Z10.2 "Hull surveys of bulk carriers", Z10.3 "Hull Surveys of Chemical Tankers", Z10.4 "Hull Surveys of Double Hull Oil Tankers" and "Z10.5 Hull Surveys of Double-Skin Bulk Carriers"
7. IACS UR Z3 "Voyage repairs and maintenance"
8. IACS Recommendation 12 "Guidelines for surface finish of hot rolled steel plates and wide flats"
9. IACS Recommendation 20 "Non-destructive testing of ship hull steel welds"
10. IACS Recommendation No.96 "Double Hull Oil Tankers - Guidelines for Surveys, Assessment and Repair of Hull Structures"
11. IACS Recommendation No.55 "General Dry Cargo Ships - Guidelines for Surveys, Assessment and Repair of Hull Structures"
12. IACS Recommendation No.84 "Container Ships - Guidelines for Surveys, Assessment and Repair of Hull Structures"

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1. Scope

1.1 This standard provides guidance on quality of repair of hull structures. The standard covers permanent repairs of existing ships.

Whereas the standard generally applies to

- conventional ship types,
- parts of hull covered by the rules of the Classification Society,
- hull structures constructed from normal and higher strength hull structural steel, the applicability of the standard is in each case to be agreed upon by the Classification Society.

The standard does generally not apply to repair of

- special types of ships as e.g. gas tankers
- structures fabricated from stainless steel or other, special types or grades of steel

1.2 The standard covers typical repair methods and gives guidance on quality standard on the most important aspects of such repairs. Unless explicitly stated elsewhere in the standard, the level of workmanship reflected herein will in principle be acceptable for primary and secondary structure of conventional design. A more stringent standard may however be required for critical and highly stressed areas of the hull, and is to be agreed with the Classification Society in each case. In assessing the criticality of hull structure and structural components, reference is made to ref. [1], [2], [3], [6], [10], [11] and [12].

1.3 Restoration of structure to the original standard may not constitute durable repairs of damages originating from insufficient strength or inadequate detail design. In such cases strengthening or improvements beyond the original design may be required. Such improvements are not covered by this standard, however it is referred to [1], [2], [3], [6], [10], [11] and [12].

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2. General requirements for repairs and repairers

2.1 In general, when hull structure covered by classification is to be subjected to repairs, the work is to be carried out under the supervision of the Surveyor to the Classification Society. Such repairs are to be agreed prior to commencement of the work.

2.2 Repairs are to be carried out by workshops, repair yards or personnel who have demonstrated their capability to carry out hull repairs of adequate quality in accordance with the Classification Society's requirements and this standard.

2.3 Repairs are to be carried out under working conditions that facilitate sound repairs. Provisions are to be made for proper accessibility, staging, lighting and ventilation. Welding operations are to be carried out under shelter from rain, snow and wind.

2.4 Welding of hull structures is to be carried out by qualified welders, according to approved and qualified welding procedures and with welding consumables approved by the Classification Society, see Section 3. Welding operations are to be carried out under proper supervision of the repair yard.

2.5 Where repairs to hull which affect or may affect classification are intended to be carried out during a voyage, complete repair procedure including the extent and sequence of repair is to be submitted to and agreed upon by the Surveyor to the Classification Society reasonably in advance of the repairs. See [7].

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3. Qualification of personnel

3.1 Qualification of welders

3.1.1 Welders are to be qualified in accordance with the procedures of the Classification Society or to a recognised national or international standard, e.g. EN 287, ISO 9606, ASME Section IX, ANSI/AWS D1.1. Recognition of other standards is subject to submission to the Classification Society for evaluation. Repair yards and workshops are to keep records of welders qualification and, when required, furnish valid approval test certificates.

3.1.2 Welding operators using fully mechanised or fully automatic processes need generally not pass approval testing, provided that production welds made by the operators are of the required quality. However, operators are to receive adequate training in setting or programming and operating the equipment. Records of training and production test results shall be maintained on individual operator's files and records, and be made available to the Classification Society for inspection when requested.

3.2 Qualification of welding procedures

Welding procedures are to be qualified in accordance with the procedures of the Classification Society or a recognised national or international standard, e.g. EN288, ISO 9956, ASME Section IX, ANSI/AWS D1.1. Recognition of other standards is subject to submission to the Classification Society for evaluation. The welding procedure should be supported by a welding procedure qualification record. The specification is to include the welding process, types of electrodes, weld shape, edge preparation, welding techniques and positions.

3.3 Qualification of NDE operators

3.3.1 Personnel performing non destructive examination for the purpose of assessing quality of welds in connection with repairs covered by this standard, are to be qualified in accordance with the Classification Society rules or to a recognised international or national qualification scheme. Records of operators and their current certificates are to be kept and made available to the Surveyor for inspection.

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4. Materials

4.1 General requirements for materials

4.1.1 The requirements for materials used in repairs are in general the same as the requirements for materials specified in the Classification Society's rules for new constructions, (ref. B4).

4.1.2 Replacement material is in general to be of the same grade as the original approved material. Alternatively, material grades complying with recognised national or international standards may be accepted by the Classification Societies provided such standards give equivalence to the requirements of the original grade or are agreed by the Classification Society. For assessment of equivalency between steel grades, the general requirements and guidelines in Section 4.2 apply.

4.1.3 Higher tensile steel is not to be replaced by steel of a lesser strength unless specially approved by the Classification Society.

4.1.4 Normal and higher strength hull structural steels are to be manufactured at works approved by the Classification Society for the type and grade being supplied.

4.1.5 Materials used in repairs are to be certified by the Classification Society applying the procedures and requirements in the rules for new constructions. In special cases, and normally limited to small quantities, materials may be accepted on the basis of alternative procedures for verification of the material's properties. Such procedures are subject to agreement by the Classification Society in each separate case.

4.2 Equivalency of material grades

4.2.1 Assessment of equivalency between material grades should at least include the following aspects;

- heat treatment/delivery condition
- chemical composition
- mechanical properties
- tolerances

4.2.2 When assessing the equivalence between grades of normal or higher strength hull structural steels up to and including grade E40 in thickness limited to 50 mm, the general requirements in Table 4.1 apply.

4.2.3 Guidance on selection of steel grades to certain recognised standards equivalent to hull structural steel grades specified in Classification Societies' rules is given in Table 4.2

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Items to be considered	Requirements	Comments
Chemical composition	<ul style="list-style-type: none"> - C; equal or lower - P and S; equal or lower - Mn; approximately the same but not exceeding 1.6% - Fine grain elements; in same amount - Detoxidation practice 	The sum of the elements, e.g. Cu, Ni, Cr and Mo should not exceed 0.8%
Mechanical properties	<ul style="list-style-type: none"> - Tensile strength; equal or higher - Yield strength; equal or higher - Elongation; equal or higher - Impact energy; equal or higher at same or lower temperature, where applicable 	Actual yield strength should not exceed Classification Society Rule minimum requirements by more than 80 N/mm ²
Condition of supply	Same or better	Heat treatment in increasing order; <ul style="list-style-type: none"> - as rolled (AR) - controlled rolled (CR) - normalised (N) - thermo-mechanically rolled (TM)¹⁾ - quenched and tempered (QT)¹⁾ ¹⁾ TM- and QT-steels are not suitable for hot forming
Tolerances	<ul style="list-style-type: none"> - Same or stricter 	Permissible under thickness tolerances; <ul style="list-style-type: none"> - plates: 0.3 mm - sections: according to recognised standards

Table 4.1 Minimum extent and requirements to assessment of equivalency between normal or higher strength hull structural steel grades

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Steel grades according to Classification Societies' rules (ref.B4)							Comparable steel grades(1)			
Grade	Yield stress R _{eH} min. (N/mm ²)	Tensile strength R _m (N/mm ²)	Elongation A ₅ min. (%)	Average impact energy for t≤50mm (J, min.)		EN 10025:1990 (2) ISO 4950-2:1995	EN 10025 series:2004	ASTM A 131 GB 712-2011	JIS G 3106	
				Test temp. (°C)	L T					
A B D E	235	400-520	22	+20	- -	Fe 360B	S235JR	A	SM400B	
				0	27 20	Fe 360C	S235J0	B	SM400B,SM400C	
				-20	27 20	Fe 360D	S235J2	D	-	
				-40	27 20	-	S275NL,S275ML	E	-	
A 27 D 27 E 27	265	400-530	22	0		Fe 430C	S275J0	-	-	
				-20	27 20	Fe 430D	S275J2,S275N,S275M	-	-	
				-40		-	S275NL,S275ML	-	-	
A 32 D 32 E 32	315	440-570	22	0		-	-	AH32	SM490B,SM490C	
				-20	31 22	-	-	DH32	-	
				-40		-	-	EH32	-	
A 36 D 36 E 36	355	490-630	21	0		Fe 510C	S355J0	AH36	SM520B,SM520C	
				-20	34 24	Fe 510D,E355DD	S355J2,S355N,S355M	DH36	-	
				-40		E355E	S355NL,S355ML	EH36	-	
A 40 D 40 E 40	390	510-660	20	0		E390CC	S420N,S420M	AH40	SM570	
				-20	39 26	E390DD	S420N,S420M	DH40	-	
				-40		E390E	S420NL,S420ML	EH40	-	

Note: (1) In selecting comparable steels from this table, attention should be given to the requirements of Table 4.1 and the dimension requirements of the product with respect to Classification Society rules. Some steel grades as per national or international standard are defined with specified yield and tensile strength properties which depend on thickness. For thicknesses with tensile properties specified lower than those of the Classification Society's Rules, case-by-case consideration shall be given with regards to design requirements.

(2) EN 10025:1990 is superseded by EN10025 series.

Table 4.2 Guidance on steel grades comparable to the normal and high strength hull structural steel grades given in Classification Society rules

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5. General requirements to welding

5.1 Correlation of welding consumables with hull structural steels

5.1.1 For the different hull structural steel grades welding consumables are to be selected in accordance with IACS UR W17 (see Ref. B5).

5.2 General requirements to preheating and drying out

5.2.1 The need for preheating is to be determined based on the chemical composition of the materials, welding process and procedure and degree of joint restraint.

5.2.2 A minimum preheat of 50° C is to be applied when ambient temperature is below 0° C. Dryness of the welding zone is in all cases to be ensured.

5.2.3 Guidance on recommended minimum preheating temperature for higher strength steel is given in Table 5.1. For automatic welding processes utilising higher heat input e.g. submerged arc welding, the temperatures may be reduced by 50° C. For re-welding or repair of welds, the stipulated values are to be increased by 25° C.

Carbon equivalent ¹⁾	Recommended minimum preheat temperature (° C)		
	$t_{comb} \leq 50 \text{ mm}^{2)}$	$50 \text{ mm} < t_{comb} \leq 70 \text{ mm}^{2)}$	$t_{comb} > 70 \text{ mm}^{2)}$
$Ceq \leq 0.39$	-	50	
$Ceq \leq 0.41$	-	75	
$Ceq \leq 0.43$	-	50	100
$Ceq \leq 0.45$	50	100	125
$Ceq \leq 0.47$	100	125	150
$Ceq \leq 0.50$	125	150	175

Table 5.1 Preheating temperature

5.3 Dry welding on hull plating below the waterline of vessels afloat

5.3.1 Welding on hull plating below the waterline of vessels afloat is acceptable only on normal and higher strength steels with specified yield strength not exceeding 355 MPa and only for local repairs. Welding involving other high strength steels or more extensive repairs against water backing is subject to special consideration and approval by the Classification Society of the welding procedure.

5.3.2 Low-hydrogen electrodes or welding processes are to be used when welding on hull plating against water backing. Coated low-hydrogen electrodes used for manual metal arc welding should be properly conditioned to ensure a minimum of moisture content.

5.3.3 In order to ensure dryness and to reduce the cooling rate, the structure is to be preheated by a torch or similar prior to welding, to a temperature of minimum 5° C or as specified in the welding procedure.

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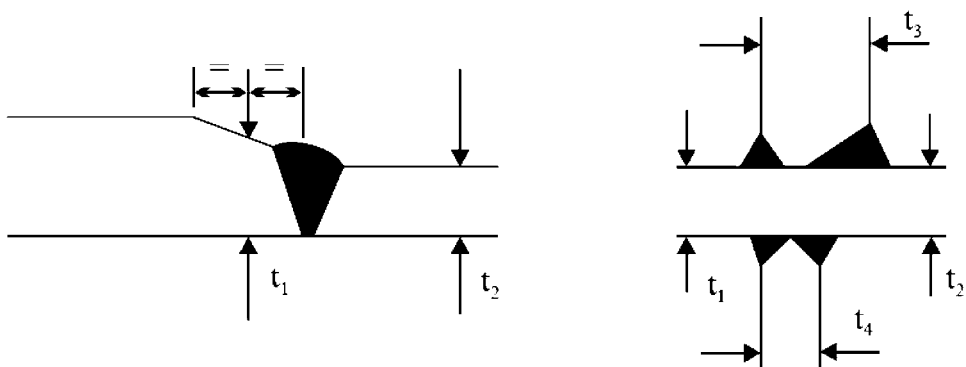
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Notes:

$$1) \quad Ceq = C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Ni + Cu}{15} (\%)$$

2) Combined thickness $t_{comb} = t_1 + t_2 + t_3 + t_4$, see figure



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6. Repair quality standard

6.1 Welding, general

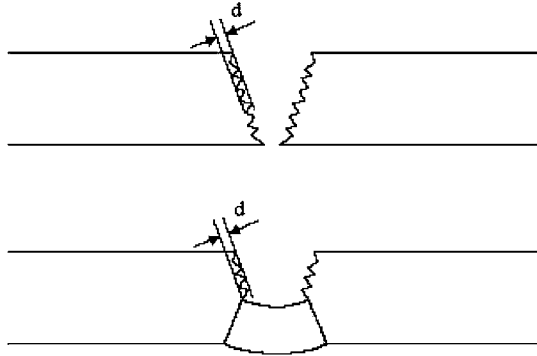


Fig 6.1 Groove roughness

Item	Standard	Limit	Remarks
Material Grade	Same as original or higher		See Section 4
Welding Consumables	IACS UR W17 (ref. B5)	Approval according to equivalent international standard	
Groove / Roughness	See note and Fig 6.1	$d < 1.5 \text{ mm}$	Grind smooth
Pre-Heating	See Table 5.1	Steel temperature not lower than 5°C	
Welding with water on the outside	See Section 5.3	Acceptable for normal and high strength steels	- Moisture to be removed by a heating torch
Alignment	As for new construction		
Weld Finish	IACS Recommendation 20 (ref. B9)		
NDE	IACS Recommendation 20 (ref. B9)	At random with extent to be agreed with attending surveyors	

Note:

Slag, grease, loose mill scale, rust and paint, other than primer, to be removed.

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6.2 Renewal of plates

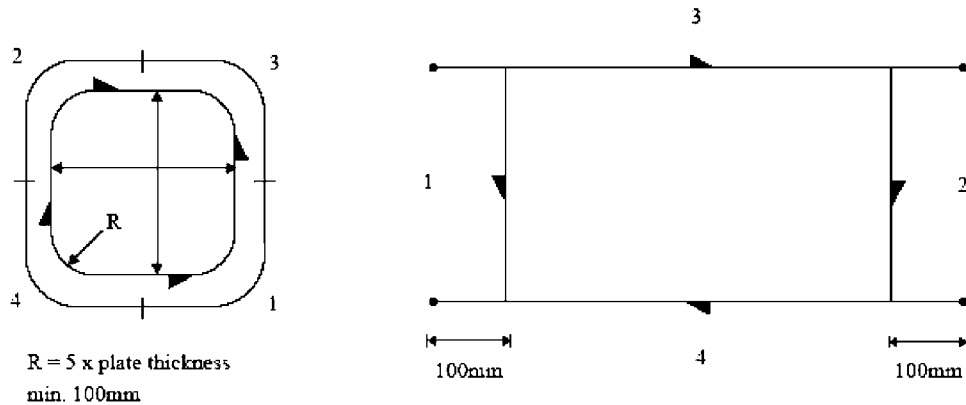


Fig 6.2 Welding sequence for inserts

Item	Standard	Limit	Remarks
Size Insert	Min. 300 x 300 mm $R = 5 \times \text{thickness}$ Circular inserts: $D_{\min} = 200 \text{ mm}$	Min. 200 x 200 mm Min $R = 100 \text{ mm}$	
Material Grade	Same as original or higher		See Section 4.
Edge Preparation	As for new construction		In case of non compliance increase the amount of NDE
Welding Sequence	See Fig 6.2 Weld sequence is $1 \rightarrow 2 \rightarrow 3 \rightarrow 4$		For primary members sequence 1 and 2 transverse to the main stress direction
Alignment	As for new construction		
Weld Finish	IACS Recommendation 20 (ref. B9)		
NDE	IACS Recommendation 20 (ref. B9)		

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6.3 Doublers on plating

Local doublers are normally only allowed as temporary repairs, except as original compensation for openings, within the main hull structure.

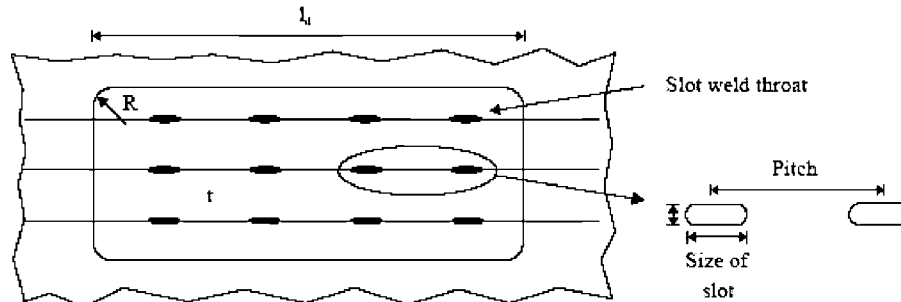


Fig 6.3 Doublers on plates

Item	Standard	Limit	Remarks
Existing Plating		General: $t \geq 5 \text{ mm}$	For areas where existing plating is less than 5 mm plating a permanent repair by insert is to be carried out.
Extent / Size	Rounded off corners.	min 300 x 300 mm $R \geq 50 \text{ mm}$	
Thickness of Doubler (td)	$td \leq tp$ (tp = original thickness of existing plating)	$td > tp/3$	
Material Grade	Same as original plate		See Section 4
Edge Preparation	As for [newbuilding] new construction		Doublers welded on primary strength members: (Le : leg length) when $t > Le + 5 \text{ mm}$, the edge to be tapered (1:4)
Welding	As for [newbuilding] new construction		Welding sequence similar to insert plates.
Weld Size (throat thickness)	Circumferencial and in slots: $0.6 \times td$		
Slot Welding	Normal size of slot: $(80-100) \times 2 \text{ td}$ Distance from doubler edge and between slots: $d \leq 15 \text{ td}$	Max pitch between slots 200 mm $d_{max} = 500 \text{ mm}$	For doubler extended over several supporting elements, see Figure 6.3
NDE	IACS Recommendation 20 (ref. B9)		

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6.4 Renewal of internals/stiffeners

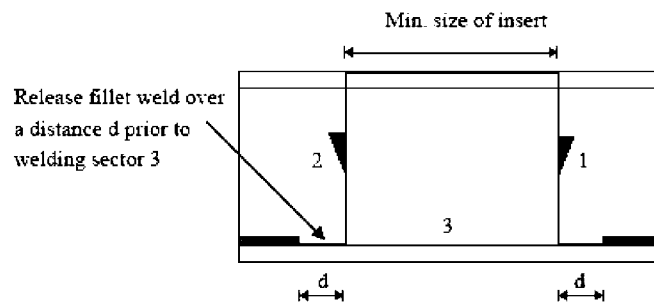


Fig 6.4 Welding sequence for inserts of stiffeners

Item	Standard	Limit	Remarks
Size Insert	Min. 300 mm	Min. 200 mm	
Material Grade	Same as original or higher		See Section 4.
Edge Preparation	As for new construction. Fillet weld stiffener web / plate to be released over min. d = 150 mm		
Welding Sequence	See Fig 6.4 Welding sequence is 1 → 2 → 3		
Alignment	As for new construction		
Weld Finish	IACS Recommendation 20 (ref. B9)		
NDE	IACS Recommendation 20 (ref. B9)		

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6.5 Renewal of internals/stiffeners – transitions inverted angle/bulb profile

The application of the transition is allowed for secondary structural elements.

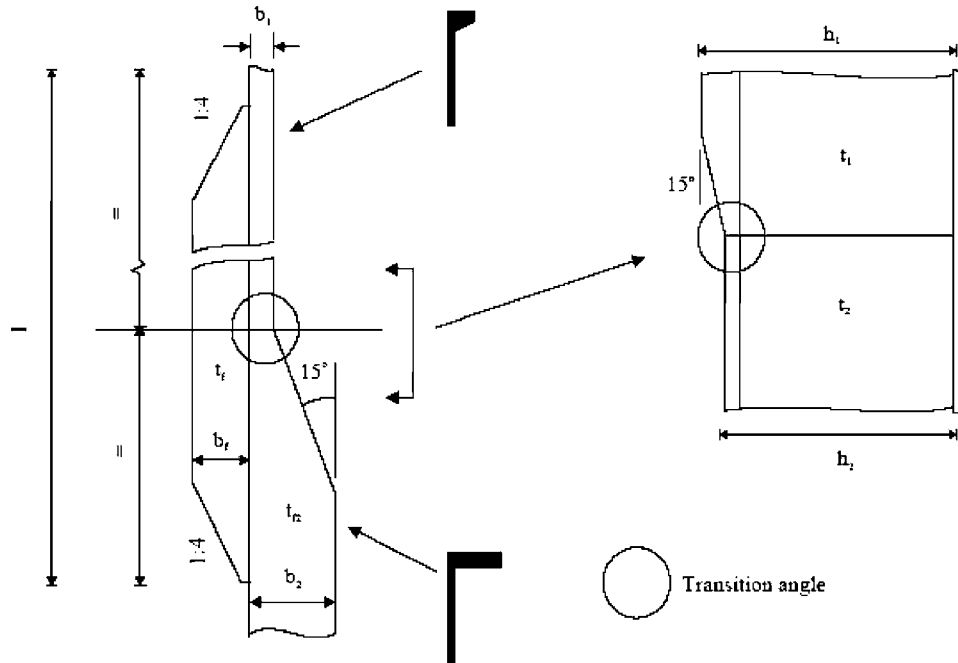


Fig 6.5 Transition between inverted angle and bulb profile

Item	Standard	Limit	Remarks
$(h_1 - h_2)$	$\leq 0.25 \times b_1$		
$ t_1 - t_2 $	2 mm		Without tapering transition.
Transition Angle	15 degrees		At any arbitrary section
Flanges	$t_f = t_{f2}$ $b_f = b_{f2}$		
Length of Flatbar	$4 \times h_1$		
Material			See Section 4.

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6.6 Application of Doubling Straps

In certain instances, doubling straps are used as a means to strengthen and reinforce primary structure. Where this has been agreed and approved, particular attention should be paid to:

- the end termination points of the straps, so that toe support is such that no isolated hard point occurs.
- in the case of application of symmetrical or asymmetrical-ended straps, the corners at the end of the tapering should be properly rounded.
- any butts between lengths of doubling straps, so that there is adequate separation of the butt weld from the primary structure below during welding, and so that a high quality root run under controlled circumstances is completed prior to completing the remainder of the weld. Ultrasonic testing should be carried out on completion to verify full penetration.

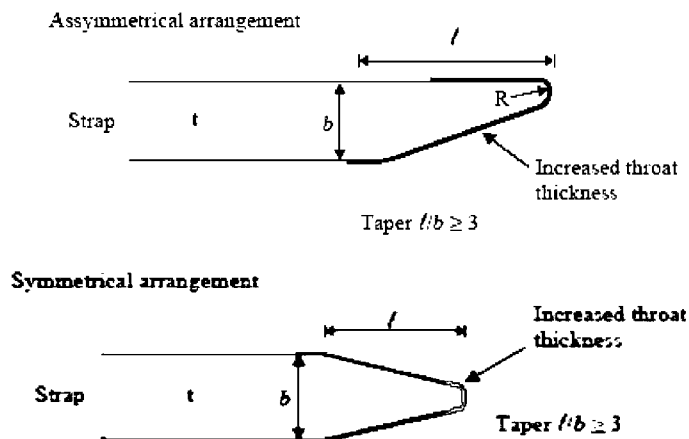


Fig 6.6 Application of Doubling Straps

Item	Standard	Limit	Remarks
Tapering	$l/b > 3$		Special consideration to be drawn to design of strap terminations in fatigue sensitive areas.
Radius	$0.1 \times b$	min 30 mm	
Material			See paragraph 2.0 General requirement to materials.
Weld Size			Depending on number and function of straps. Throat thickness to be increased 15 % toward ends.
Welding	Welding sequence from middle towards the free ends		See sketch. For welding of lengths > 1000 mm step welding to be applied.

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6.7 Welding of pitting corrosion

Notes:

Shallow pits may be filled by applying coating or pit filler. Pits can be defined as shallow when their depth is less than 1/3 of the original plate thickness.

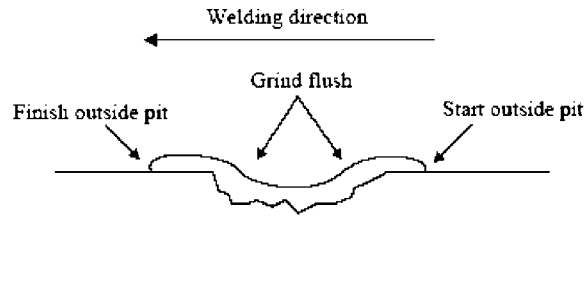


Fig 6.7 Welding of pits

Item	Standard	Limit	Remarks
Extent / Depth	Pits / grooves are to be welded flush with the original surface.	If deep pits or grooves are clustered together or remaining thickness is less than 6 mm, the plates should be renewed.	See also IACS Recommendation 12 (ref. B8)
Cleaning	Heavy rust to be removed		
Pre-Heating	See Table 5.1	Required when ambient temperature < 5°C	Always use propane torch or similar to remove any moisture
Welding Sequence	Reverse direction for each layer		See also IACS Recommendation 12 (ref. B8)
Weld Finish	IACS Recommendation 20 (ref. B9)		
NDE	IACS Recommendation 20 (ref. B9)	Min. 10% extent	Preferably MPI

Reference is made to TSCF Guidelines, Ref. B2 & B3.

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6.8 Welding repairs for cracks

In the event that a crack is considered weldable, either as a temporary or permanent repair, the following techniques should be adopted as far as practicable. Run-on and run-off plates should be adopted at all free edges.

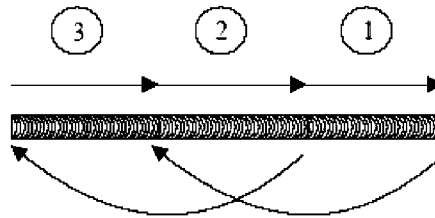


Fig 6.8.a Step back technique

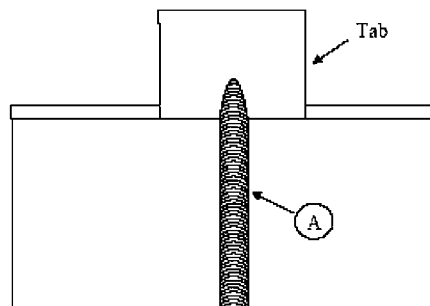


Fig 6.8.b End crack termination

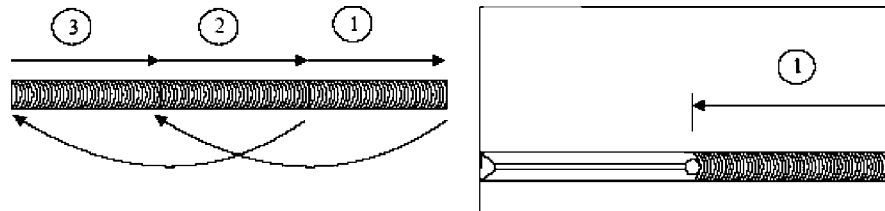


Fig 6.8.c Welding sequence for cracks with length less than 300 mm

**No.
47**
(cont)

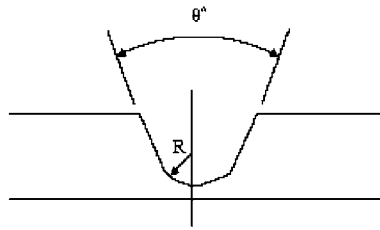


Fig 6.8.d Groove preparation (U-groove left and V-groove right)

Item	Standard	Limit	Remarks
Groove Preparation	$\theta = 45-60^\circ$ $r = 5 \text{ mm}$		For through plate cracks as for newbuilding. Also see Fig 6.8.d
Termination	Termination to have slope 1:3		For cracks ending on edges weld to be terminated on a tab see Fig 6.8.b
Extent	On plate max. 400 mm length. Vee out 50 mm past end of crack	On plate max 500 mm. Linear crack, not branched	
Welding Sequence	See Fig 6.8.c for sequence and direction	For cracks longer than 300 mm step-back technique should be used Fig 6.8.a	Always use low hydrogen welding consumables
Weld Finish	IACS Recommendation 20 (ref. B9)		
NDE	IACS Recommendation 20 (ref. B9)	100 % MP or PE of groove	100 % surface crack detection + UE or RE for butt joints

FINAL INSPECTION REPORT ON SURFACE PREPARATION FOR PROTECTIVE COATING APPLICATION

(Recommended form)

FINAL INSPECTION REPORT No. _____
on surface preparation for protective coating application _____

(object, area, in m²)**1 General information**

1.1 Name of ship _____

1.2 Shipowner _____

1.3 Shipyard _____

1.4 Place and duration of works _____

1.5 Coating system _____

(brand, type colour, number of layers, thickness, in μm , RS Certificate of Conformity No.)

1.6 Paint/Coating manufacturer _____

(name)

2 Preparation of metal rolled products surface

2.1 Work performer _____

(name)

2.2 Abrasive _____

(brand, type, firm (manufacturer))

2.2.1 Size _____ 2.2.2 Copper _____ 2.2.3 Oil _____ 2.2.4 Dust _____

2.2.5 Moisture _____ 2.2.6 Water-soluble impurities, mS/m _____

2.2.7 Storage conditions _____

2.3 Surface preparation: _____

2.3.1 Fresh water washing _____ 2.3.2 Degree of cleaning _____

2.3.3 Roughness, μm _____ 2.3.4 Oil _____ 2.3.5 Dust _____2.3.6 Water-soluble impurities, mg/m^2 _____

2.4 Environmental conditions in works performance _____

(temperature of air and steel, humidity, dew point)

2.5 Shop primer _____

(brand, type, colour, thickness, in μm)

2.5.1 Firm (Manufacturer) _____

(name)

3 Preparation of hull structures and outfitting components

3.1 Executor of work _____

(name)

3.2 Preparing of sharp edges _____ 3.3 Dimensions of holes and openings _____

3.4 Condition of welds and the adjacent zone _____

3.5 Fitting of outfitting components and protectors _____

4 Preparation of hull structures surface

4.1 Executor of work _____

(name)

4.2 Abrasive _____

(brand, type, firm (manufacturer))

4.2.1 Size _____ 4.2.2 Mohs' hardness _____ 4.2.3 Copper _____ 4.2.4 Oil _____

4.2.5 Moisture _____ 4.2.6 Dust _____ 4.2.7 Water-soluble impurities, mS/m _____

4.3 Surface preparation: _____

4.3.1 Fresh water washing _____ 4.3.2 Degree of surface cleaning _____

4.3.3 Cleanliness of damages and welds _____ 4.3.4 Dust _____

4.3.5 Oil _____ 4.3.6 Way of abrasive removal _____

4.3.7 Water-soluble contamination, mg/m^2 _____

4.3.8 Antifouling system removed, % _____

4.4 Environmental conditions in works performance ($T_{st} - T_{dew} > 3\text{ }^{\circ}\text{C}$):

Nos.	Parameters	Minimum value	Maximum value
1	Date/Time		
2	Air temperature (T_{air}), $^{\circ}\text{C}$		
3	Air humidity (RH), %		
4	Steel temperature (T_{st}), $^{\circ}\text{C}$		
5	Dew point (T_{dew}), $^{\circ}\text{C}$		

5 Coating system application

Nos.	Object	Paint and operation name ¹	Environmental conditions ($T_{st} - T_{dev} > 3\text{ }^{\circ}\text{C}$)											Thinner, %	Paint consumption, l	Batch No. and paint colour	
			Minimum					Maximum									
			Date	Time	Air		Steel	T_{dev}	Date	Time	Air		Steel				T_{dev}
					T_{air} °C	RH, %	T_{st} °C	°C			T_{air} °C	RH, %	T_{st} °C				°C
1																	
2																	
3																	
4																	
5																	
6																	
¹ List of operations: application of shop primer, strip and basic layers of coatings; curing of each coating layer and heat treatment of the finished coating.																	

5.1 Work performer _____

(name)

6 Thickness of finished coating

Nos.	Coating name ¹	Thickness, in μm								
		Specified				Actual				
		Wet layer	Dry film			Wet layer		Dry film		
			Minimum	Nominal	Maximum	Minimum	Maximum	Maximum	Average	Maximum
1	Узел									
2	Типовой									
3	метод устранения									
4	Примечания									
5										
6										

¹ List of coatings: shop primer, basic and common layers of coatings.

7 Coatings defects

7.1 Sags _____ 7.2 Curtains _____ 7.3 Orange peel _____
7.4 Craters _____ 7.5 Fish eye _____ 7.6 Wrinkling _____
7.7 Irregular gloss _____ 7.8 Dust of film _____

8 Fully cured _____
(equipment, results and standard)

9 Spark test _____
(equipment, results and standard)

The works have been carried out in accordance with the shipyard technical documentation _____
(name of document)

Agreed with the coating manufacturer _____

The Report has been executed by the painting surveyor of the organization _____
(name)

Coating inspector _____
(signature, full name and date)

Отчёт о проверке готовности спуска судна на воду
Report on the survey of ship launching readiness



РОССИЙСКИЙ МОРСКОЙ РЕГИСТР СУДОХОДСТВА
RUSSIAN MARITIME REGISTER OF SHIPPING

322-08

ЧЕК-ЛИСТ
ПРОВЕРКИ ГОТОВНОСТИ СУДНА К СПУСКУ НА ВОДУ

CHECK LIST
OF THE SHIP LAUNCHING READINESS

Строительный № _____ PC № _____
Hull № _____ RS № _____
Предполагаемый _____
Флаг _____
Prospective Flag _____
Место освидетельствования _____
Place of survey _____

Объекты технического наблюдения для определения готовности спуска судна на воду освидетельствованы должным образом, как приведено ниже

Supervision items for determination of the ship launching readiness are duly surveyed as follows

Примечания: ¹ Внести один из следующих кодов:
Notes: To enter one of following codes:

0	Нет, не соответствует No, not in compliance	2	Не применимо для судна Not applicable for this ship
1	Да, соответствует Yes, in compliance	3	Освидетельствование не завершено Part held

№	Объект освидетельствования Survey item	Результаты освидетельствования ¹ Results of survey ¹
1.	Проверка отчетной документации по испытаниям и проверкам выполненным до спуска: The reporting documentation on tests and inspections carried out before launching have been verified:	
1.1	главных размерений корпуса of hull Main Dimensions	
1.2	о выполнении работ по окраске корпуса ниже ватерлинии of work on application protective coating below waterline.	
1.3	о полном окончании работ по сборке, сварке, правке и испытаниям на непроницаемость в объеме предпусковой готовности completion of assembly, welding, straightening and testing for tightness in the scope of pre-launching readiness	
1.4	документов о выполнении неразрушающего контроля сварных швов в соответствии со схемой of the records on a welding control plan	
1.5	об установке дейдвудных труб, гребных валов, винтов и насадок, подруливающих устройств, САУС (если эти работы не предусмотрено выполнять на плаву) fitting stern tubes, propeller shafts, propellers and nozzles, thrusters, azimuth thrusters (unless these are fitted afloat)	
1.6	об установке пера руля и баллера fitting rudder blade and rudder stock	
1.7	об установке и испытаниях донно-бортовой арматуры installation and tests of outboard fittings	
1.8	об укладке твердого балласта, если таковой предусмотрен laying the solid ballast if any	
1.9	об установке забортных аппаратов и устройств и проверке на непроницаемость в местах прохода через наружную обшивку связанных с ними кабелей, труб и т. п., а также крепления к корпусу fitting outboard apparatus and arrangements, and tightness tests in ways where cables, pipes, etc. associated with these pass through the shell plating, as well as attachments to the hull	

Отчёт о проверке готовности спуска судна на воду
Report on the survey of ship launching readiness

2.	Кингстонные / ледовые ящики Sea / Ice chests	
2.1	Проверка насыщения Outfitting inspection	
2.2	Проверка установки элементов защиты от коррозии на соответствие чертежам Inspection of corrosion protection elements fitted according to drawings	
2.3	Проверка закрепления решеток Inspection of griddles locking	

3.	Эхолот Echo sounder	
3.1	проверка на непроницаемость в местах прохода через наружную обшивку связанных с эхолотом кабелей, труб и т. п. tightness tests in ways where cables, pipes, etc. associated with echo sounder pass through the shell plating etc.	
3.2	Проверка крепления к корпусу Fitting inspection to the hull	

4.	Лар Speed log	
4.1	проверка на непроницаемость в местах прохода через наружную обшивку связанных с лагом кабелей, труб и т. п. tightness tests in ways where cables, pipes, etc. associated with speed log pass through the shell plating etc.	
4.2	Проверка крепления к корпусу Fitting inspection to the hull	

5.	Спускные пробки Drain plugs	
5.1	Проверка установки Mounting inspection	
5.2	Испытания на непроницаемость Tightness test	

6.	Марки углубления и знаки грузовой марки Draught-marks and load line marks	
6.1	Проверка соответствия нанесения марок углубления чертежу Inspection of measurement of draught-marks, according to the drawing	
6.2	Проверка соответствия нанесения знаков грузовой марки чертежу Inspection of measurement of load line marks, according to the drawing	

7.	Наружная обшивка Shell plating	
7.1	Визуальный осмотр наружной обшивки ниже ватерлинии Visual inspection of shell plating below waterline	

Отчёт о проверке готовности спуска судна на воду
Report on the survey of ship launching readiness

Recommendations

№ пункта item No.	Содержание Description	Срок устранения To be dealt by

ЗАКЛЮЧЕНИЕ

В результате проведенного освидетельствования выявлено, что техническое состояние судна полностью / не полностью* соответствуют применимым требованиям для спуска на воду.

CONCLUSION

During the survey now held it was found that technical condition of vessel completely / not completely* fulfill the applicable requirements for launching.

Инженер-инспектор РС
Surveyor to RS

Инженер-инспектор РС
Surveyor to RS

Инженер-инспектор РС
Surveyor to RS

Подпись / Signature

Ф.И.О. / Name

Дата / Date

* Ненужное зачеркнуть
Delete as appropriate

SURVEY OF HULLS OF REINFORCED CONCRETE SHIPS

1 GENERAL

1.1 The provisions of this Section apply in technical supervision during construction of sea-going reinforced concrete ships, floating docks and other floating facilities according to the requirements of the Rules for the Construction of Hulls of Sea-Going Ships and Floating Facilities with Use of Reinforced Concrete.

1.2 The matters of technical supervision ignored in this Appendix shall be handled following Section 2 (with regard to 2.3.6).

1.3 Description of the basic methods for manufacturing reinforced concrete hulls and superstructures, requirements for the building berth condition, general requirements for manufacture and installation of structures, requirements for concrete and elimination of concreting defects, etc. are given in Section 4, Part I "General Requirements for Construction" of the Rules for the Construction of Hulls of Sea-Going Ships and Floating Facilities with Use of Reinforced Concrete.

1.4 Numerical criteria for hull structures during manufacture and elimination of defects given in this Section are provided for reference. Prior to commencement of construction, other quality criteria given in the recognized national or international standards may be agreed with the RS Branch Office.

2 DEFINITIONS AND EXPLANATIONS

2.1 Definitions and explanations related to the general terminology are given in Section 1, Part I "General Regulations for Technical Supervision" of the Rules for Technical Supervision. Specific terms and definitions are given in 1.2, Part I "General Requirements for Construction" of the Rules for the Construction of Hulls of Sea-Going Ships and Floating Facilities with Use of Reinforced Concrete

3 REGISTER TECHNICAL SUPERVISION

3.1 Prior to the technical supervision, the RS surveyor shall make sure that the shipyard is prepared for manufacturing ship's reinforced concrete structures:

- proper storage, record and use of building materials, notably cement, are assured;

- at any stage of construction, the shipyard shall additionally confirm the quality of material and its conformity with the RS-approved design and requirements of the Rules for the Construction of Hulls of Sea-Going Ships and Floating Facilities with Use of Reinforced Concrete;

- the laboratory can perform all the necessary tests;

- production equipment ensures the manufacture of high-quality concrete having steady parameters;

- stands, platforms, steam-curing chambers, building berths, depots provide the proper quality, the observance of production requirements and storage conditions;

- quality of reinforcing fabrics for cages is assured.

3.2 Technical supervision is performed by the RS surveyor by performing surveys according to the List based on Table 3.2 and agreed with the RS Branch Office.

Table 3.2

Nos.	Technical supervision item	Verification of technical documentation	Inspection of material	External examination	Control of dimensions	Tightness test
1	Manufacture of:					
1.1	reinforcing fabrics and cages	+	+	+	+	—
1.2	embedded parts (a splicing joint, system boxes, sockets, etc.)	+	+	+	+	+
1.3	sections (reinforcing, concrete placement, thermal treatment, concrete curing)	+ ¹	+	+	—	—
2	Preparation of the building berth	+	—	—	+	—
3	Mounting of reinforced concrete sections on the building berth	+	—	+	+	—
4	Reinforcing, butt welding, installation of connecting rods	+	+	+	+	—
5	Mounting of forms and preparation for concreting	—	—	+	+	—
6	Concreting of joints	+ ¹	+	+	—	—
7	Reinforcing and welding of monolithic areas reinforcement	+	+	+	+	—
8	Mounting of embedded parts in monolithic areas	+	+	+	+	—
9	Mounting of forms and availability for concreting of monolithic areas	—	—	+	+	—
10	Concreting of monolithic areas	+ ¹	+	+	—	—
11	Underwater structure prior to launching	+ ²	—	+	+	—
12	Tests of compartments and the entire hull prior to launching	+	—	+	—	+
13	Structure of all spaces inside the hull and hull structure above the upper deck	+	—	+	—	—
14	Tightness tests of all spaces, decks and sides	+	—	+	—	+
15	Joining hull parts afloat or in a pit	+	—	+	+	—
16	Reinforcing: welding of reinforcement in a splicing area	+	+	+	+	—
17	Preparation for concreting of the splicing area with forms in place	—	—	+	+	—
18	Concreting of the splicing area	+ ¹	+	+	—	+
19	Tightness tests of dock compartments by a test dive	+	—	+	—	+
¹ Incoming sampling of concrete and its components composition. ² Check of concrete strength by testing laboratory conclusions, for the last concreting areas in particular.						

4 SURVEYS BY LIST

4.1 Survey of sections

4.1.1 The survey of sections prior to their mounting on the building berth is carried out after removal of forms or breaking of panels off matrices, and includes:

.1 verification of documentation according to 1.5 (additionally to be checked is a scheme of defect places for each section prepared by the shipyard's technical control body);

.2 inspection of material wherein verified are the documents on the quality of original materials of sections, the data of the shipyard's technical control body or laboratory on the concrete tests performed (including those by the time of submission), as well as on other tests and analyses, and a certificate for the reinforcement and embedded parts metal;

.3 external examination wherein verified are the conformity of sections with drawings and technical documentation specified in these latter, the quality of the protective coat and surface, including the absence of defects, and also the condition of connecting rods (bending of deformed bars is not allowed).

The RS surveyor shall check surfaces by hammering. A dull sound evidences the presence of defects of which the nature is determined by stripping.

Defects mean cracks, nonconcrete parts, porosity, concrete segregation, reinforcement baring and protective coat reduction, laitance leak, etc. Cracks on concrete surface are not allowed.

Pores and cavities allowed on the surface of panels shall have the following dimensions: for internal elements (bulkheads, platforms, enclosures) — within 20 mm, up to 4 mm deep and not more than 5 mm in diameter, for the outer (bottom, sides, decks) — within 10 mm, up to 2 mm deep and not more than 5 mm in diameter, per 1 m²;

.4 measurements when drawing dimensions of a section and its main elements, as well as dimensions of the defects revealed with due regard to the tolerances, which shall not exceed those specified in Appendix 4-1 or other quality standards agreed with the RS Branch Office, are checked;

.5 if comments are lacking, the RS surveyor signs the document, which form is developed by the shipyard and agreed with the RS Branch Office.

If the List provides for the survey of the most typical sections and the technical supervision over the manufacture of the others is limited to patrol, the document of a section, which is not presented to the RS surveyor, is signed by the shipyard's technical control body only. The sections produced in cooperation for supplying another shipyard shall be presented to the surveyor signing the document.

4.2 Surveys at building berth

4.2.1 With the cast-in-place hull construction on the building berth, the technical supervision shall be effected as in sections survey.

If the hull is constructed on the building berth from sections, the survey includes the following steps:

availability for concreting;

concreting completion;

forms removal and defects rectification.

4.2.2 In survey the availability for concreting: the documents for section manufacturing, the documents of the shipyard's technical control body on checking the positions of mounted sections and the log book of functional inspections are verified; external examination wherein the correct position of a section, the quality of mounting reinforcement and embedded parts of interpanel joints and grouting areas considering the tolerances according to Appendix 12 (in so doing, the reinforcement in way of joining, if bared above the old concrete for more than half its diameter or slackened, shall be fully cleared of concrete with a minimum gap of 5 mm), the quality of concrete surface preparation, measurements after forms construction, cleanliness of joint places and the tight fit of forms to the structure to prevent the leak of laitance, is carried out. The gap between forms and the structure shall not exceed 2 mm.

4.2.3 Following concreting and forms removal, external examination and measurements similarly to 2.4.1 are carried out. The forms removal shall be performed with the permission of the shipyard's technical control body after the concrete reaches at least 50 % of the grade strength. The availability of drain holes and scuppers in framing for water and air flow is checked. Defects are noted and the quality in their rectification is checked.

4.3 Joining of hull parts afloat

4.3.1 It is allowed to join hull parts afloat from separately-built floating blocks, provided that the applied structures and process of joining the blocks in a single whole ensure strength and watertightness of the grouted hull in accordance with a design.

In supervision of joining (mating), the relevant provisions of this Section shall be followed. In addition, the RS surveyor shall draw attention to the following:

.1 accuracy in alignment of single units with due regard for coordinates throughout the height and lengthwise, for the location of bulkheads and single connecting rods affecting the parts alignment, as well as the quality in joining single hull parts;

.2 ballasting calculations of single hull areas shall be made or overloads in way of mating prevented;

.3 in joining afloat, steady positions of mated parts during welding of reinforcement and concreting of butts, as well as during the time while the butts concrete gains the required strength shall be assured. The water area shall be protected against waves effect. The shipyard shall monitor the condition of ballast, heel and trim of single parts and the hull as a whole, the mutual position of parts, etc.;

.4 other factors which can effect joining.

4.4 Inspection of defects rectification and elimination

4.4.1 Cavities of a depth equal to the protective coat thickness and over, reinforcement barings, pores, irregularities and roughness exceeding tolerances, voids, places of foreign inclusions (with rust inclusive) and concrete segregations of depth over the protective coat thickness, nonconcreted areas with the protective coat reduced by more than 2 mm, elements and parts having deviations above the permissible shall be rectified by reconcreting.

4.4.2 The elimination of concreting defects shall be carried out by mechanical removal of all the low-strength concrete (the reinforcement is rectified if needed) followed by closing the defect place with the same quality concrete that is used for concreting interpanel joints. Defects like cracks or small holes (blowholes) shall be prepared along their edges for a width sufficient for proper filling with concrete through the entire depth.

4.4.3 Rectifying defect places by reconcreting, the increased thickness, roughness and sags of concrete within -2 to $+25$ mm in ballast tanks, and within -2 to $+8$ mm on other surfaces (an outer perimeter, dry compartments, tunnels) may be ignored.

4.4.4 To eliminate small defects, epoxy plastoconcrete and also cement colloidal adhesives according to the RS-approved instruction may be used.

4.4.5 The rectification of defect places usually shall be performed prior to the mounting of a section on the building berth according to the procedure approved by the RS Branch Office.

4.4.6 The locations of the major defects or of those in the critical parts of the hull shall be given in the ship's final documentation.

5 PATROL

5.1 At patrol, the RS surveyor selectively checks the fulfilment of the following requirements:

.1 all the components of concrete mixture and reinforcement received at the shipyard are subject to the incoming inspection in the scope stipulated by the above Rules and standards. In so doing, the amount of clay and dust-like particles in sand is not to exceed 1 % and in broken stone, 0,5 % in mass; reinforcement shall be cleaned of rust and scale, grease stains, dirt, paint, cement film, etc.;

.2 the mix design of new concrete compositions shall be carried out by a base (competent) organization with the following presentation of the results on all the types of tests (for strength, water-tightness, frost resistance, etc.) to the Register for verification and approval;

.3 in preparation of concrete mixture and placing it in structures, the requirements of the Rules for the Construction of Hulls of Sea-Going Ships and Floating Facilities with Use of Reinforced Concrete and RS-approved standards shall be followed. In so doing:

.3.1 the concrete prepared for grouting shall comply with the composition approved by RS for a given structure;

.3.2 permissible deviations from the dosage set for cement and water are ± 1 %, for aggregates ± 2 %;

.3.3 placing of concrete in a structure shall be completed within 60 min since the time of mixing with water; the total time since concrete preparation till its placing is not to exceed the time when the concrete starts to lose its mobility;

.3.4 addition of water to concrete mixture is forbidden;

.3.5 breaks in concrete placing in one structure are not to exceed 1 h at an ambient air temperature above 25 °C, in other cases, 2 h. With more prolonged breaks, concrete placement shall be stopped and may be resumed after concrete hardening; to remove the cement film therewith, the indentation shall be surfaced by one of the RS-approved ways;

.3.6 prior to the final set, horizontal surfaces shall be wiped off by the RS-approved way and covered with sackcloth, tarpaulin, etc. for protection from sun rays, draughts and precipitation;

.3.7 after the final set until the attainment of grade strength, all concrete surfaces (including panels and concrete structures closed with wooden forms) shall be poured with water suitable for concrete preparation; the watering is conducted three times at an air temperature above 25 °C and at least two times per shift at the other temperature;

.3.8 loading, turning-over and transportation of panels, their testing for tightness, movement on the building berth, etc., as well as concrete freezing until it attains the strength specified in 5.2.4 are forbidden;

.3.9 samples are taken from every batch of at least 9 m³ in volume. By a batch is meant a concrete mixture of the same composition and identical by a production process which is used for the manufacture of one section or butts and monolithic elements per one shift, but not more than 50 m³. The cubes shall be stored under the same conditions as the concrete of a structure;

.3.10 a slump is measured with a slump cone at places of concrete preparation and placement at least once per shift for each composition of concrete;

.3.11 to prevent segregation, only one-fold manual relaying of concrete is allowed;

.3.12 free drop of heavyweight concretes (2,5 t/m³) from a height of over 2 m and over 1,5 m for the lightweight ones is not allowed;

.3.13 permissible deviations of the protective coat shall be within 1 — 3 mm;

.3.14 installation of holders of the protective coat shall prevent the penetration of water to the reinforcement;

.4 the following methods of concrete inspection shall be used at the shipyard:

.4.1 check of the grade strength by testing standard cubes of concrete at 28 days; in questionable cases, the Register may demand strength tests of cubes chipped out from the hull structure;

.4.2 with hidden reinforcement, the protective coat thickness is checked with reinforcement baring or the ultrasonic method; the protective coat at panel ends may be measured with a scale rule;

.5 the assembly and welding of reinforcing fabrics, cages and connecting rods shall be in line with the requirements of the Rules for the Construction of Hulls of Sea-Going Ships and Floating Facilities with Use of Reinforced Concrete and standards. In this case:

.5.1 no pores in welding are allowed;

.5.2 in beading, two to three pores not exceeding 0,5 mm in diameter per the weld length, as well as undercuts not more than 0,5 mm deep per 30 % of the weld length are allowed;

.5.3 in overlapping welding of the reinforcement, the weld discontinuity is allowed in way of transverse bars passage retaining the total length of a weld;

.5.4 any welding-on to connecting rods within 50 mm off the concrete surface is not allowed;

.5.5 in spliced fabrics, two outer rows of reinforcement overlaps along the fabric perimeter shall be stiffened.

.5.2 At patrol the RS surveyor keeps under control:

.1 concrete:

regular checking of physical and mechanical properties of cement for conformity with the requirements of a standard and cement certificate;

concrete plant operation;

particular emphasis is placed on the accuracy of components dosage;

manufacture and storage of concrete samples;

concrete components (absence of foreign inclusions, dirt, clay, dust, chips, etc.). If shortcomings are revealed, the shipyard shall check concrete components in samples taken in the presence of the RS surveyor;

correspondence of cement grades for butt joints and sections;

.2 reinforcement:

conformity with design documentation;

conformity of reinforcing fabrics, cages, connecting rods, embedded parts and other metallic elements with the requirements of approved drawings (including bar diameters and spacing, their welding and anchoring, mounting, reinforcement cleaning of rust, dirt, oil, concrete, coordinates of connecting rods and embedded parts);

observance of tolerances for manufacturing fabrics, cages and connecting rods (refer to Appendix 4-1 to this Section);

.3 concreting process:

condition of molds for manufacturing sections, their tight closing, lubrication, boundary forms, etc. The forms shall be sufficiently strong and tight to prevent the laitance leak from concrete;

proper mounting and attachment of embedded parts and outfitting components;

mounting and attachment of holders of the protective coat which assure its set value; the holders shall be consistent with the grade of concrete in use;

conformity of the composition of the concrete prepared with the RS-approved one, its homogeneity and mobility;

concrete transportation and placement;

.4 thermal treatment:

observance of a treatment cycle;

inspection of concrete strength after the cycle completion. Sections may be broken away from molds when the concrete strength reaches the value, which is not less than the one assumed in the strength calculation of sections and other prefabricated elements of the hull during construction according to 2.1.9, Part I "General Requirements for Construction" of the Rules for the Construction of Hulls of Sea-Going Ships and Floating Facilities with Use of Reinforced Concrete, but at least 20 MPa in axial compression. If the concrete has not gained the strength required, the section shall be additionally treated or cured under natural conditions at a positive temperature until gaining the required strength;

chambers and stands for thermal treatment shall ensure uniform heating, temperature control in various points and be tight. To reduce the works time on the building berth, the thermal treatment of concrete placed in joints and monolithic areas may be allowed subject to uniform heating, tight construction shelters, draught-free and other compulsory conditions;

regulation and control of steam curing conditions, as a rule, shall be carried out with an automation system covering all the thermal treatment operations;

checked are the results of automatic recording the process of steam curing, the maintenance and contents of a log or other document of the shipyard's technical control body or testing laboratory wherein the operation of thermal treatment shall be recorded;

.5 winter concreting:

at an air temperature below 0 °C, the concrete mixture shall be conveyed to the place of concrete deposit being heated up to 40 °C;

a temperature of cages shall be at least 15 °C;
 immediately after concreting, the concrete shall be encased for warmth-keeping using construction shelters with steam supply or by another approved way until the concrete gains 70 % of the grade strength; the concreting area after being frozen is rejected;
 steam shall be wet and uniformly distributed over all the surfaces of the structure concreted;
 steam jets shall not hit the freshly laid concrete;
 abundant concentrated fall-out of drops on the concrete shall be prevented;
 concrete heating by other ways (electric heating, chargrills, etc.) shall be agreed with the RS Branch Office;
 in winter, concreting is allowed with the additive of sodium nitrite in percentage of the cement mass:

$t, ^\circ\text{C}$	- 5...0	- 10... - 5	- 15... - 10
%	3	5	7

.6 storage and transportation of sections:
 after manufacturing, sections shall be stored at specially equipped warehouses and areas under conditions preventing their deformations and damages;
 sections of ship's vertical structures (of bulkheads, sides, etc.) shall be stored vertically in cassettes or pyramids, all the others, stacked horizontally;
 section stacks shall rest on wooden spacers placed on the levelled horizontal foundation. Every section shall be separated with spacers arranged in the vertical with their axes deviations within 10 mm. The spacers thickness shall be at least 25 mm and not less than a height of projecting parts. The spacers of one row shall be of the same material;
 number of sections in a stack is established depending on the quality of spacers material, their strength and that of structures;
 transportation shall be carried out with use of special traverses assuring uniform loading on every lifting eye of the section;
 turning-over shall be performed in special tilters preventing damages to panels or their connecting rods;
.7 works on the building berth including:
 preparation of the building berth for hull laying including the availability of the shipyard's report containing the levelling data;
 sequence of sections installation;
 reinforcing and welding of reinforcement;
 in single cases, it is allowed to clear the reinforcement lengthwise to ensure its fair displacement or to use intermediate bars;
 preparation of sections or the indentation for concreting, scratching, removal of concrete in way of the reinforcement, of the cement skin along edges, washing. Working of edges of concrete elements being joined to remove the cement skin shall be performed across the entire area of contact with the grouting concrete for all the elements of the structure bearing design forces;
 verification of used materials correspondence with the method of reinforcement and metallic elements welding;
 installation of forms (their strength, tightness, surface quality). Gaps between form section boards shall not be more than 1 mm. The leak of cement grout is not allowed;
 preparation for concreting, at a negative ambient air temperature inclusive;
.8 for concreting of interpanel joints and monolithic parts of the hull, the concrete used shall have the same main characteristics as the one for section manufacture. In so doing, it shall be taken into account that the maximum size of an aggregate grain in the concrete mixture is not to exceed 10 mm and the mobility of the latter for horizontal butts shall be with a slump not more than 8cm, for vertical butts, not more than 15 cm. The necessary and sufficient strength of concrete of butt joints before dismantling their shuttering is specified by the designer by calculation on the basis of the ship's (floating dock's) construction process in use, and in any case it shall not be less than:
 10 MPa for vertical butts;
 15 MPa for horizontal butts.

6 TIGHTNESS TESTS

6.1 Tightness tests for reinforced concrete hulls is carried out after the elimination of defects, revealed by external examination, and the completion of mounting embedded parts and welded-on outfitting components.

Standards and types of tests are given in Appendix 4-2 to this Section. Tightness tests are conducted according to the procedure approved by the Register wherein may be initially specified the performance of preliminary and then final tests. To ensure the hull launch, tightness tests may be performed by taking water up to the launching waterline in ship's spaces or in the pit. In the latter case, provision shall be made to prevent a premature hull shif; or rise. Prior to taking water, the interior of spaces up to the launching waterline shall be submitted for surveying. Final tests may be performed afloat as the spaces are available and submitted to the RS surveyor.

Floating docks are additionally tested for tightness by submersion up to the maximum draught. In submersion, watertightness of dry compartments, passage tunnels, the safely deck above ballast compartments, the unit of the reinforced concrete pontoon joint with metallic wing walls (composite docks) is tested.

Defect places revealed in tests shall be rectified according to the procedure approved by the RS Branch Office.

7 READINESS FOR LAUNCHING

7.1 In inspection of the availability for launching, the RS surveyor checks the elimination of defects identified in tests and surveys. The permit for ship's launching or floating out is executed with the shipyard's document signed by the surveyor.

PERMISSIBLE DEVIATIONS IN FABRICATION AND CONSTRUCTION OF REINFORCED CONCRETE HULLS OF SHIPS

Table

Nos.	Normable quantity	Tolerance, in mm
1	Overall dimensions of finished fabrics:	
	without face strips	± 25
	with face strips	± 10
2	Difference of lengths of finished fabric diagonals	± 10
3	Displacement of bars from a straight line in the fabric plane	± 5
4	Dimensions of single meshes	± 5
5	Dimensions of finished cages and connecting rods:	
	lengthwise	± 25
	across a width and through a thickness	± 3
6	Spacing of longitudinal bars of the cage	± 5
7	Clamps spacing	± 10
8	Nonperpendicularity of cage clamps to principal reinforcement	5°
9	Spacing of fabrics in plates	± 3
10	Deviation lengthwise of and across the section:	
	before scratching	$+10; -15$
	after scratching	-100
11	Thickness and height of framing ribs	$+5; -3$
12	Nonperpendicularity of ribs to the plate	1 per height of 100 mm, but not more than 5
13	Ribs displacement from the marking-out line	± 3
14	Plate thickness:	
	up to 100 mm	± 3
	over 100 mm	± 4
15	Curvilinearity of the section plane	0,001 panel length, but not more than 8
16	Local unevenness of the section surface in measurements with a meter rule:	
	for outer surfaces	5
	for others	8
17	Roughness of the section surface	2
18	Deflection of embedded part axes from the marking-out line in plan if the relevant instructions in a drawing are lacking	± 5
19	Deflection of embedded parts from the set position relative to the verticals	± 2 mm per 100 mm of the part height
20	Displacement of face strip axes from the marking-out line	3
21	Deviation of the height of the embedded part position from the theoretical surface of the section	± 3
22	Deflections construction of sections of horizontal structures:	
	from the theoretical plane (displacement, misalignment)	± 10
	lengthwise and across a width, respectively, from transverse and longitudinal check lines on the building berth	± 10
23	Deflections in erection of sections of ship's sides and outer walls of superstructures:	
	of the outer surface of the panel from the theoretical line of the ship's overall dimension lengthwise and through the height, respectively, from horizontal and vertical check lines on the building berth	± 10
	trim per the panel length	± 10
24	Deflections in construction of sections of transverse and longitudinal bulkheads:	
	of the bottom edge lengthwise of the ship for transverse bulkheads and across the ship's breadth for longitudinal bulkheads from theoretical positions	± 15
	through the height from check lines on the building berth	± 10
25	through the vertical	2 per 1 m of a linear length or height, but not more than ± 15
26	Mutual displacement of sections for outer surfaces	± 5
27	Mutual displacement of adjacent sections of inner structures	10
	Misalignment of reinforcing bars in the reinforcement of intersection joints:	
	in overlapping welding or in welding with use of straps through the thickness of plates for all panels (excepting secondary recesses); for the reinforcement of different diameters, the lesser is assumed through the height and thickness of a rib at the butt width:	0,5 reinforcement diameter, but not more than
	up to 300 mm	diameter, but not more than 10
	over 300 mm	diameter, but not more than 15

Table — continued

Nos.	Normable quantity	Tolerance, in mm
28	in welding with use of a weldpool in the area of a welded joint (200 mm) at the reinforcement diameter:	
	10 mm and less	1
	10 – 30 mm	2
	over 30 mm	3
	displacement of straps from the axis of fabric and cage bars	± 3
	Misalignment of reinforcing bars of hull blocks being joined in overlapping welding or in welding with use of straps:	
	at the butt width ≤ 350 mm:	
	through the plate thickness	0,5 reinforcement diameter
	through the vertical butt and lengthwise of the horizontal butt	not more than the reinforcement diameter
	at the butt width > 350 mm:	
	through the plate thickness	not more than 15 mm
	through the vertical butt and lengthwise of the horizontal butt	1,5 reinforcement diameter, but not more than 30 mm
<p>Notes: 1. Depending on the purpose and requirements for structures, tolerances may be toughened according to the instructions of technical documentation.</p> <p>2. Tolerances for deflections of the same sign shall not be accumulated.</p> <p>3. In all the cases of bending misaligned connecting rods for welding, the thickness of the protective coat and the whole element at large shall within the tolerances set.</p>		

STANDARDS OF TIGHTNESS TESTS OF REINFORCED CONCRETE SHIPS AND FLOATING FACILITIES

Table

Nos.	Spaces	Type of test	Hull parts to be examined
1	Forepeak and afterpeak used as ballast compartments	By filling with water to the top of an air pipe, but at least 1 m above the bulkhead deck	Shell plating, watertight bulkheads, deck, chain locker, sealing glands
2	Forepeak and afterpeak not intended for filling with water	By filling with water to a head of 0,3 m above the deck and hose testing above that level	Ditto
3	Double-bottom compartments	By filling with water to the top of an air pipe	Shell plating, inner bottom, watertight floors and stringers
4	Dry cargo compartments, engine room, air compartments of double-bottomed ships	By filling with water up to the launching draught and hose testing above that level	Shell plating, watertight bulkheads, deck, hatch covers and coamings
5	Ditto for ships with no double bottom	By filling with water up to the launching draught and hose testing above that level	Ditto
6	Compartments and tanks being filled with water and oil products, as well as ballast compartments (excepting docks)	By filling with water to a head up to the top of an air pipe, but at least 2,5m above the deck or plating bounding the compartment from above	Shell plating, deck (platform, plating), watertight bulkheads, hatch covers and coamings
7	Ballast compartments of docks	Prior to launching: by filling the docking basin with water up to the level of the launching draught and hose testing above that level. After launching: by taking water in turns up to the maximum possible head, considering the strength, but at least 1 m above the pontoon deck (refer to Note 12)	Shell plating Shell plating, watertight bulkheads, deck, covers
8	Dry compartments of docks, passage tunnel	By filling with water up to the launching draught and hose testing above that level (refer to Note 12)	Shell plating, watertight bulkheads, covers and coamings
9	Compartment in tweendecks	Hose testing over the entire surface	Ditto
10	Chain locker	By filling with water to a head of 1 m above the bulkhead deck	Locker contour
11	Superstructures, deckhouses including companions and open parts of trunks of the engine room and similar spaces	Hose testing for all outer surfaces	Sides, decks, outer walls
12	Coamings of hatches and vent pipes located in open parts of decks	Ditto	Outer walls
13	Closing appliances for openings in tight parts of the hull (doors in hold and tweendeck bulkheads, covers of skylights and companion hatches, upper deck scuttles and side scuttles of the main hull, scuttles in decks and outer bulkheads of superstructures, deckhouses, as well as covers of manholes in tight decks, platforms and bulkheads ignored in compartment testing)	Hose testing	Doors, covers, scuttles
14	Cofferdams	By filling with water to a head of 1 m above the bounding deck, but at least up to the bulkhead deck (refer to Note 12)	Entire contour

Table — continued

Nos.	Spaces	Type of test	Hull parts to be examined
15	Watertight trunks	By filling with water up to the bulkhead deck; hose testing if the trunks are located above the bulkhead deck	Ditto
16	Joint of dock's reinforced concrete pontoon	Hose testing (refer to Note 12)	Entire joint perimeter
<p>Notes: 1. The level of watertightness shall be assessed by the following indications: wetting = darkening of the surface without forming single drops; watering = appearance of single fixed drops; drip leakage = movement of single drops without forming a continuous jet; jet leakage = continuous flow of water with no single drops visible.</p> <p>2. Contours, compartments and structures being adjacent to seawater in service are considered watertight if wetting occurs. Watering is admissible on external sides of ballast compartments and on watertight bulkheads.</p> <p>3. Fuel oil tanks are considered tight if no wetting is visible at a head of 1 m above the tank crown. Wetting is admissible at a head up to the top of an air pipe.</p> <p>4. Water tanks are considered watertight if no drops appear at a head of 1 m above the tank crown, and no drop runs, at a head up to the top of an air pipe.</p> <p>5. The watertightness test may be performed at the above-zero ambient air temperature only.</p> <p>6. By the hose testing shall be understood the watering with a hose having the nozzle diameter of at least 12 mm and the minimum pressure of at least 200 kPa. A distance from the nozzle to the surface under test shall not exceed 1,5 m and shall be reduced to 1 m in special cases (presence of pores on the surface, etc.). The test duration is at least 10 min per each 10 m² of the surface under test. Vertical surfaces shall be watered from the bottom upwards.</p> <p>7. Cable boxes and sealing glands are subject to the tightness test by the compressed air jet.</p> <p>8. The level of structure watertightness shall be determined by the time of defect occurrence since the test beginning: 20 min and over — for the hose testing, 3 h and over since the time of filling (submersion) completion — for the filling of compartments with water and in testing the compartments for a dock submersion.</p> <p>9. Test standards for hull structures missing in this Table shall be set by agreement with the Register considering the operational conditions and purpose.</p> <p>10. When justified, the spaces not bordering on the outer contour may be tested afloat.</p> <p>11. With the precast construction of reinforced concrete hulls, if approved by the Register, the hose testing of all surfaces may be replaced by that of grouting joints only.</p> <p>12. The tests of compartments and structures as per items 7, 8 and 16 are preliminary. The final watertightness tests are carried out in dock submersion for a limiting draught.</p> <p>13. In questionable cases, the Register reserves the right to demand the performance of other types of tests at its discretion.</p>			

INSTRUCTIONS ON INCLINING TEST OF SHIPS

1 APPLICATION

1.1 The Instructions on the Inclining Test of Ships shall be used in determination of the weight and position of the centre of gravity of the light ship in accordance with the requirements of 1.5, Part IV "Stability" of the Rules for the Classification and Construction.

2 DEFINITIONS AND EXPLANATIONS

2.1 For the purpose of the Instructions, the following terms are used.

Inclining test is a series of sequential transverse movements of the test weight on board the ship to cause some inclinations and to measure the relevant angles of heel, as well as to survey the light ship and read draughts needed for determination of the light ship weight and coordinates of its centre of gravity using calculating methods of the ship theory.

Draught is a vertical distance measured from the base line to the waterline.

Survey of a light ship is the inspection of the ship's condition related to missing, redundant or movable objects. The weight and position of each object centre of gravity shall be precisely determined and recorded as on the basis of these data and also of the inclining measurements and results will be obtained the values of the light ship weight and coordinates of its centre of gravity.

Survey of the test weights is the verification of the mass marked on test weight. The survey shall be carried out close enough in time the inclining test.

Light ship is a ship of which construction (updating, repair) is completed, but without cargo, stores, crew and their effects, and other components of deadweight.

Fully pressed-up tank is a fully filled tank without voids due to heel, trim or inadequate ventilation. Any level of filling below 100 %, e.g. 98 %, when the tank is considered full for operational purposes, is not allowed. After tanks pressing-up, the ship should be subjected to inclinations to remove air therefrom. The above procedure shall be completed prior to the final measurements of a liquid level. To prevent pollution, special precautions shall be taken in pressing-up oil tanks.

Empty tanks are tanks wherein water is absent. Generally it is inadequate to empty tanks using pumps until they stop to pump out water. After liquid pumping-out, the tank shall be examined from the inside to decide whether is the final stripping with portable pumps or manually needed. The exception is very narrow tanks or the ones in way of the drastic rise of the bottom as the free surface will be insignificant. All empty tanks, to which all access holes shall be opened, shall be examined, and the very tanks, properly vented and recognized safe for entry. A safe device for checking a sufficient level of oxygen and minimal level of toxic gases shall be ready for use. A document issued by a competent body and confirming the safe access to all tanks and enclosed spaces shall be onboard the ship.

3 PREPARING SHIP TO INCLINING TEST

3.1 In good time prior to the inclining test, the ship's instruction on inclining performance as applied to the particular ship shall be developed and submitted to the Register for examination and approval. The instruction shall contain the following particulars:

- .1** name and hull number of the ship, if applicable;
- .2** date, time and location of the test;
- .3** inclining weight data:
 - .3.1** type;
 - .3.2** total mass and composition (number of units and mass of each);
 - .3.3** way of transfer from side to side;

- .3.4 procedure for test weights transfer;
- .3.5 anticipated maximum angle of heel to each side;
- .4 measuring devices:
 - .4.1 pendulums — approximate location and length;
 - .4.2 U-tubes — approximate location and length;
 - .4.3 inclinographs — location and calibration details;
- .5 estimated parameters of trim and initial stability of the ship for the time of the inclining test;
- .6 condition of tanks;
- .7 estimated mass and coordinates of the centre of gravity of missing, redundant or movable objects;
- .8 scheme of ship's positioning;
- .9 specific instructions on measurements performance;
- .10 detailed description of any computer software to be used to aid in calculations during the inclining test; and
- .11 name and telephone number of the person responsible for conducting the inclining test.

3.2 General condition of ship.

3.2.1 The ship's construction shall be close to its end by the time of the inclining test.

3.2.2 Considering that the scope and type of works to be completed (the expected missing mass) impact an accuracy of determining a light ship displacement, such works shall be well known. If it is impractical to precisely determine the mass and position of a centre of gravity for the missing object, the inclining test shall be carried out after the installation of such an object in the ship.

3.2.3 Prior to the inclining test, all the materials like packing, scaffolding, sand, garbage, etc. being temporarily on board the ship shall be reduced to a minimum. Crew members or the personnel directly not involved in the inclining test shall leave the ship before the test.

3.2.4 Any rainwater, snow or ice accumulated on board shall be removed prior to the test.

3.2.5 The anticipated liquid loading for the test shall be included in the Instructions on the Inclining Test. The number of slack tanks shall be kept to an absolute minimum. The viscosity of the fluid, the depth of the fluid and the shape of the tank shall be such that the mass, coordinates of centre of gravity and free surface effect can be accurately determined.

The Report of Liquid Cargoes Condition shall be drawn up which shall include liquid cargoes available on board at the time of the inclining test.

3.2.6 The ship shall be moored in the protected part of a water area which is free of disturbing forces caused by, for example, waves of passing ships, swell or sudden discharges from land utility systems. The wind velocity shall not exceed 3,5 m/s. In inclining, the current and ship's trim shall be taken into account. To prevent ship's touching the bed, the water depth shall be measured and recorded in appropriate locations prior to the test. The water density shall be precisely measured. The ship shall be moored so that nothing prevents its inclination. Gangboards for access to the ship shall be removed. The number of cables, hoses, etc. from the shore shall be minimal and an opportunity of their loosening shall always be provided.

3.2.7 The ship shall be in the upright position and have the sufficient draught to avoid drastic changes of the waterline area in inclinations. The ship's trim shall not exceed 1 % of the ship's length if hydrostatic data are used in calculations; otherwise, direct calculations with due regard for the actual trim shall be performed. In all cases, drastic changes of the waterline area in ship's inclinations shall be avoided. The ship's heel shall be within 0,5° with the test weight in its initial position.

3.2.8 The total mass of the test weight shall be adequate to ensure the ship's heel within 1° — 4° to each side. The test weight shall be compact and ensure the precise determination of coordinates of its centre of gravity. Each test weight unit shall be marked with its number and mass specified. Each test weight unit shall be surveyed before each inclining test. Provisions shall be made for cargo cranes of the adequate lifting capacity and outreach, or for other arrangements for the quick and safe transfer of the test weight.

Where the use of solid weights to produce the inclining moment is demonstrated to be impracticable, the movement of water ballast may be permitted, provided the requirements in 2.3.4, Annex 1 to Part B of the International Code on Intact Stability, 2008 (2008 IS Code) are met.

3.2.9 The use of 3 pendulums is recommended but a minimum of 2 shall be used to allow identification of bad readings at any one pendulum station. Pendulums shall be located in an area protected from the wind. Their length shall provide a deflection of at least 15 cm across the measuring scale with the test weight at one side.

One or more pendulums may be substituted by other Register-approved measuring devices (U-tubes or inclinographs). The inclinographs or other measuring devices may only be used in conjunction with at least one pendulum.

4 DOCUMENTATION

Number of groups	Side	Movements												
		0	1	2	3	4	5	6	7	8	9	10	11	12
2	P S	2 1	 1, 2	 2	1, 2 	2 1	 1, 2	1 2	1, 2 	2 1	 	 	 	
4	P S	2, 4 1, 3	4 1, 2, 3	 1, 2, 3, 4	1 2, 3, 4	1, 3 2, 4	1, 2, 3 4	1, 2, 3, 4 	2, 3, 4 1	2, 4 1, 3	 	 	 	
6	P S	2, 4, 6 1, 3, 5	4, 6 1, 2, 3, 5	6 1, 2, 3, 4, 5	 1, 2, 3, 4, 5, 6	1 2, 3, 4, 5, 6	1, 3 2, 4, 5, 6	1, 3, 5 2, 4, 6	1, 2, 3, 5 4, 6	1, 2, 3, 4, 5 6	1, 2, 3, 4, 5, 6 	2, 3, 4, 5, 6 1	2, 4, 5, 6 1, 3	2, 4, 6 1, 3, 5

Note. Heeling ballast groups are designated with figures.

5.5 The following accuracy of measurements shall be ensured in the process of preparation and during the inclining test:

pendulum length	5 mm;
draught and freeboard.	10 mm;
arms of test weight transfer and coordinates of cargoes centre of gravity	10 mm;
pendulum deflections	1 mm;
measurements in heeling tables,	0,2 mm
mass of test weight (persons)	1 %
density.	0,1%

5.6 The results of the inclining test shall be executed as the report and submitted to the Register for review. Based on the positive results of the review, the Register representative signs and stamps the front page of the record with the surveyor's seal.

5.7 The model form recommended for the inclining test record is given in Appendices 5-1 — 5-13.

5.8 The record shall contain the assessment of the inclining test performance in accordance with 1.5.11, Part IV "Stability" of the Rules for the Classification and Construction.

5.9 All calculations performed during the inclining test and in preparation of an inclining test report may be carried out by a suitable computer program. Output generated by such a program may be used for presentation of all or partial data and calculations included in the test report if it is clear, concise, well documented, and generally consistent in form and content with the form given in 5.7.

5.10 The record shall be translated into English for ships engaged in international voyages.

6 PROCESSING OF INCLINING TEST RESULTS

6.1 The measurements made in the inclining test and ship's service documentation are assumed as the initial data in the processing of inclining test results.

6.2 The ship's sag is taken into account by any reasonably precise way in calculating the displacement and z-coordinate of the centre of gravity.

6.3 The displacement and coordinates of the centre of gravity are determined depending on a value of trim.

6.4 The displacement and coordinates of the centre of gravity are determined from the following formulae:

.1 at a trim $\psi < 0,005L$ and the ship's hull sag below $0,0025L$:

$$\Delta = \gamma V; \quad (6.4.1-1)$$

$$z_g = r + z_c - h_k; \quad (6.4.1-2)$$

$$x_g = x_c + R \operatorname{tg} \psi; \quad (6.4.1-3)$$

$$y_g = h_k \operatorname{tg} \theta_0; \quad (6.4.1-4)$$

where Δ = weight displacement of the ship, in t;
 γ = плотность воды, т/м³;
 V = water density, m³;
 r = transverse metacentric radius, in m;
 h_k = transverse metacentric height in conditions of the inclining test, in m;
 x_c, z_c = coordintes of the ship's centre of buoyancy, in m;
 x_g, y_g, z_g = coordintes of the ship's centre of gravity, in m;
 R = longitudinal metacentric radius, in m;
 θ_0 = initial angle of heel, in deg.

Theoretical elements are determined by use of hydrostatic curves;

.2 at a trim $\psi \geq 0,005L$, or the ship's hull sag $\geq 0,0025L$:

$$\Delta_\psi = \theta V_\psi; \quad (6.4.2-1)$$

$$z_{g\psi} = z_{c\psi} + (r_\psi - h_k) \cos \psi; \quad (6.4.2-2)$$

$$x_{g\psi} = x_{c\psi} - (r_\psi - h_k) \sin \psi; \quad (6.4.1-3)$$

$$y_{g\psi} = h_k \operatorname{tg} \theta_0. \quad (6.4.1-4)$$

The values of V_ψ , $z_{c\psi}$, $x_{c\psi}$ and r_ψ are determined with due regard to the trim and ship's hull bending by a computerized or manual calculation on the basis of the lines drawing and Bonjean curves.

6.5 The metacentric height according to the results of separate measurements of h_i , is determined in Table 6.5.

In the inclining test of the floating crane using its own crane, the metacentric height, in m, is determined according to the results of separate measurements by the formula

$$h_i = \frac{(R-r)\psi_i}{\theta_i - \psi_i}. \quad (6.5)$$

Table 6.5

Measurement number	Increment		$h_i = \frac{II}{III\Delta}$, in m	$h_i - h_k$, in m	$(h_i - h_k)^2$, in m ²
	of heeling moment, in tm	of angle of heel, in rad.			
I	II	III	IV	V	VI
1					
2					
·					
·					
·					
n					
			Σh_i		$\Sigma (h_i - h_k)^2, m^2$

6.6 The metacentric height, in m, in the inclining test is determined by the formula

$$h_k = \Sigma h_i / n. \quad (6.6)$$

6.7 The displacement and coordinates of the light ship's centre of gravity are determined in Table 6.7. Permanent liquid cargoes, including liquid cargoes remaining in the hull, which are taken into account in the mass loading of a light ship during design, but are lacking on board the ship in the inclining test, shall be considered in processing of the inclining test results as missing cargoes.

Table 6.7

Loading	Mass, in t	Arms, in m			Moment, in t-m		
		X	Y	Z	M_x	M_y	M_z
Ship in inclining test							
Missing cargoes							
Redundant cargoes							
Light ship							

7 CALCULATION RESULTS

The light ship elements from the inclining data are presented in comparison with the effective ones.

Table 7

Ship's elements	Design values	
	by data of inclining test	By design (or from the effective Stability Booklet)
Δ , in t x_g , in m y_g , in m z_g , in m h , in m d_w , in m d_K , in m M_{ψ} , in t•m		

INCLINING TEST RECORD

" ____ " ____ 20 ____

(Place of inclining test)

1. Ship

Name, hull number _____

Type and purpose _____

Shipyard, year of built _____

Shipowner, port of registry _____

Length L _____

Breadth B _____

Depth D _____

2. Organization of inclining test

Purpose of inclining test _____

(after construction, repair, conversion, etc.)

Performers of inclining test:

Leader _____ (position, full name)

Participants _____ (positions, full names)

The Register representative witnessing the inclining test _____

(full name)

Time period of inclining test:

Started _____ h _____ min

Ended _____ h _____ min

The inclining test has been performed in accordance with _____

(guidance document)

3. Inclining test conditions

Wind speed _____ m/s

Current speed _____ m/s

Water surface state _____

Air temperature _____ °C

Water density _____ t/m³

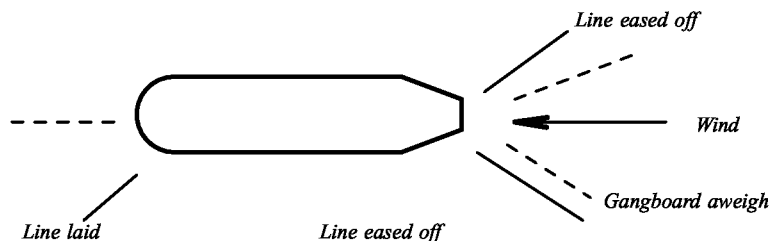
Under-keel clearance _____ m

Ice conditions _____

4. Preparation

4.1 The ship is prepared for the inclining test (refer to Appendices 10.2 — 10.6).

4.2 Scheme of ship positioning. Specified are ship's position and securing, wind and current direction, etc.



Initial heel _____ deg.

4.3 Foreign objects, cargo remains, building waste, snow are removed from the ship. Icing of outside and internal surfaces, the underwater hull inclusive, is absent. Redundant and missing cargoes are taken into account (refer to Appendices 10-2 — 10-3).

Cargoes including liquid ones	Percentage of light displacement	Mass, in t	Arms, in m			Moments, in tm		
			X from middle	Y from central plane	Z above base line	M_x	M_y	M_z
Redundant								
Missing								

4.4 The effect of free surfaces of liquid cargoes and running machinery on inclining

(to be listed)

test performance has been practically prevented.

4.5 Service documentation used in the inclining test

Nos.	Name	Document No.	Performer

4.6 The solid ballast _____ is placed in the ship.
(to be specified)

Nos.	Location	Mass, in t	Coordinates, in m		
			X from middle	Y from central plane	Z above base line
1					
2					
In all					

4.7 The metacentric height assured is about _____ m.

Liquid ballast taken therewith is _____ t (refer to Appendix 10-4).

4.8 The following requirement concessions are admitted in the inclining test

(guidance document)

Nos.	Concession nature	Concession reasoning

5. Inclining test

5.1 The draughts and freeboard taken into account (refer to Appendix 10-7).

Place of measurement	Draught, in cm	Freeboard, in cm
Frame No.		

The ship's hull sag in the inclining test is _____ mm (refer to Appendix 10-7).

5.2 In measurements of angles of heel, mooring lines were slackened and the ship was free to list.

5.3 Heeling moments and angles of heel taken into account (refer to Appendices 10-5 and 10-8).

Notes: 1. Signatures in copies of the inclining test record shall be confirmed by the tracing holder if signing the materials tracings on the spot is impractical.

2. Appendices 10-2 and 10-13 are the integral part of the inclining test record.

Measurement Nos.	test weight mass, in t	Movement arms, in m	Increment of heeling moment II×III, in tm	Increment of angle of heel, in deg./rad.			
				Pendulum bob (device) No.1	Pendulum bob (device) No.2	Pendulum bob No.3	Design value $\frac{V + VI + VII}{3}$
I	II	III	IV	V	VI	VII	VIII
1							
2							
·							
·							
·							
<i>n</i>							

5.4 To measure the rolling period, the ship was swung with a _____ of _____ t in mass. (load)

The rolling period of the ship in the inclining test $\tau =$ _____ s (refer to Appendices 10-8 and 10-11).

6. Remarks

(at the discretion of the inclining test leader)

7. Processing of inclining test results

The inclining test results are processed by _____

(name of the enterprise being the tracing holder of inclining test materials)

8. Conclusions

The inclining test performance is satisfactory.

The following actual data of the light ship are considered to be ascertained resulting the inclining test:

displacement $\Delta_0 =$ _____ t;

z-coordinate of the centre of gravity $z_g =$ _____ m;

abscissa of the centre of gravity $x_g =$ _____ m.

Leader of the inclining test _____
(full name)

Participants of the inclining test _____
(full name)

Surveyor witnessing the inclining test _____
(full name)

Ship _____

" _____ " _____ 20 _____

LIST OF REDUNDANT CARGOES

Nos.	Cargo	Mass, in t	Arms, in m			Moments, in tm		
			<i>X</i> from middle	<i>Y</i> from central plane	<i>Z</i> above base line	M_x	M_y	M_z
In total:								

List executed by _____
(full name)

Ship _____

" _____ " _____ 20 _____

LIST OF MISSING CARGOES

Nos.	Cargo	Mass, in t	Arms, in m			Moments, in tm		
			<i>X</i> from middle	<i>Y</i> from central plane	<i>Z</i> above base line	M_x	M_y	M_z
In total:								

List executed by _____
(full name)

Ship _____

" _____ " _____ 20 _____

LIQUID CARGOES STATE REPORT

Nos.	Name	Liquid type	Mass, in t	Arms, in m			Moments, in tm			Weight group
				X from middle	Y from central plane	Z above base line	M_x	M_y	M_z	
1	Tank No.	Drinking water								Redundant cargo
2	Tank No.	Lube oil								Ditto
3	Liquid cargo remains in the hull ¹	—								Light ship
4	Liquid cargoes in machinery, installations, systems, piping ensuring their operational condition ¹	—								Ditto
5	Water in the swimming pool	Sea water								Missing cargo
6	Liquid ballast	Ditto								Redundant cargo
In total: redundant cargoes missing cargoes										
¹ To be specified design data.										

The metacentric height of about _____ m is assured by ballast as per item 6 of Table.
Продолжение табл.

Tanks Nos. _____ are fully pressed up to a top of air pipes. Valves of service lines are closed and sealed.

Report is executed by _____
(full name)

APPENDIX 5-5

Ship _____

" _____ " _____ 20 _____

REPORT ON AVAILABILITY AND TEST WEIGHT TRANSFER

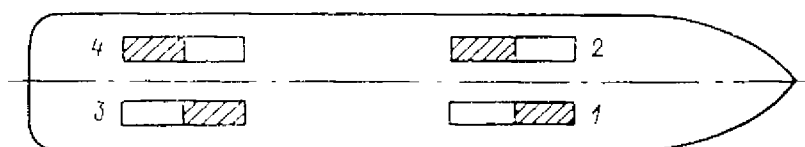
1. Test weight _____ is weighed on a balance rated at _____ kg with precision
(to be specified)

measurements of _____ kg.

The balance and balance weights have passed the calibration test on " _____ " _____ 20 _____.

Group	Mass, in kg	Centre of gravity coordinates, in m			Number of test weight units	Marking
		X from middle	Y from central plane	Z above base line		

2. Test weight is arranged in the _____ according to the scheme
(ship's name)



The design and shape of test weight ensure its proper securing and determining the coordinates of its centre of gravity.

3. Sequence of test weight transfer.

Indices	Movements									
	0	1	2	3	4	5	6	7	8	<i>n</i>
P	24	4	—	1	13	123	1234	234	24	.
S	13	123	1234	234	24	4	—	1	13	.
Arms, in m	0	a_2	a_4	$-a_1$	$-a_3$	$-a_2$	$-a_4$	$+a_1$	$+a_3$.

Report is executed by _____
(full name)

APPENDIX 5-6

Ship _____

" _____ " _____ 20 _____

DEVICES AVAILABILITY REPORT

For inclining test performance, the devices approved by _____

(organization and document)

_____ are prepared and their type is _____

The devices are in good repair, fitted in the ship and ready for operation according to the instruction.

The calibration of devices is carried out immediately before the inclining test, which results are given in Table.

Nos.	Manufacturer of device	Hull No.	Interim specification for supply	Scale of records			
				by certificate		by calibration	
				angles, in mm/deg.	time, in mm/s	angles, in mm/deg.	time, in mm/s
1							
2							
3							

Report is executed by _____
(full name)

Surveyor witnessing calibration _____
(full name)

Ship _____

" _____ " _____ 20 _____

DRAUGHTS AND FREEBOARD MEASUREMENTS REPORT

1. Measurements are made with use of _____
(gadget)

Place of measurement	Time of measurement	Reading level	Draught by mark, in cm	Measurement from mark (deck), in cm		Measurement value, in cm		Correc- tion (thickness of keel or deck stringer)	Theoretical value, in cm		Theoretical mean value, in cm	Design value
				P	S	P 4-5	S 4-6		P	S		
Draught												
Fore frame No.	<u>Prior to inclining</u> After inclining	Mark 30	300	<u>20</u> 22	<u>22</u> 22	<u>280</u> 278	<u>278</u> 276	2	<u>278</u> 276	<u>276</u> 274	<u>277</u> 275	276
Middle frame No.	<u>Prior to inclining</u> After inclining	Loadline mark	400									
Stern frame No.	<u>Prior to inclining</u> After inclining	Mark 34	340									
Freeboard												
Frame No.	<u>Prior to inclining</u> After inclining	Upper deck	<u>229</u> 228	<u>227</u> 224				2	<u>227</u> 226	<u>225</u> 222	<u>226</u> 224	225
Frame No.	<u>Prior to inclining</u> After inclining	Upper deck										
Frame No.	<u>Prior to inclining</u> After inclining	Upper deck										

2. Design values of draughts and freeboard are plotted on _____

(drawing)

3. Resulting measurements, the ship's sag in the inclining test was _____mm.

4. Water density sampled at a depth of _____m was _____t/m³.

Report is executed by _____
(full name)

Ship _____

" _____ " _____ 20 _____

REPORT ON PENDULUM DEFLECTION MEASUREMENTS

Pendulum No. 1 (2,3). Their locations _____

Length of the pendulum λ = _____ mm.

Measurement No.	Pendulum deflections, in mm								Sum \sum_1^i	Pendulum reading, $b = \Sigma_i$	Angle of heel, $\theta = b/\lambda$, in rad.
	S	P	S	P	S	P	S	P			
	1	2	3	4	5	6	$i-1$				
2											
.											
.											
.											
n											

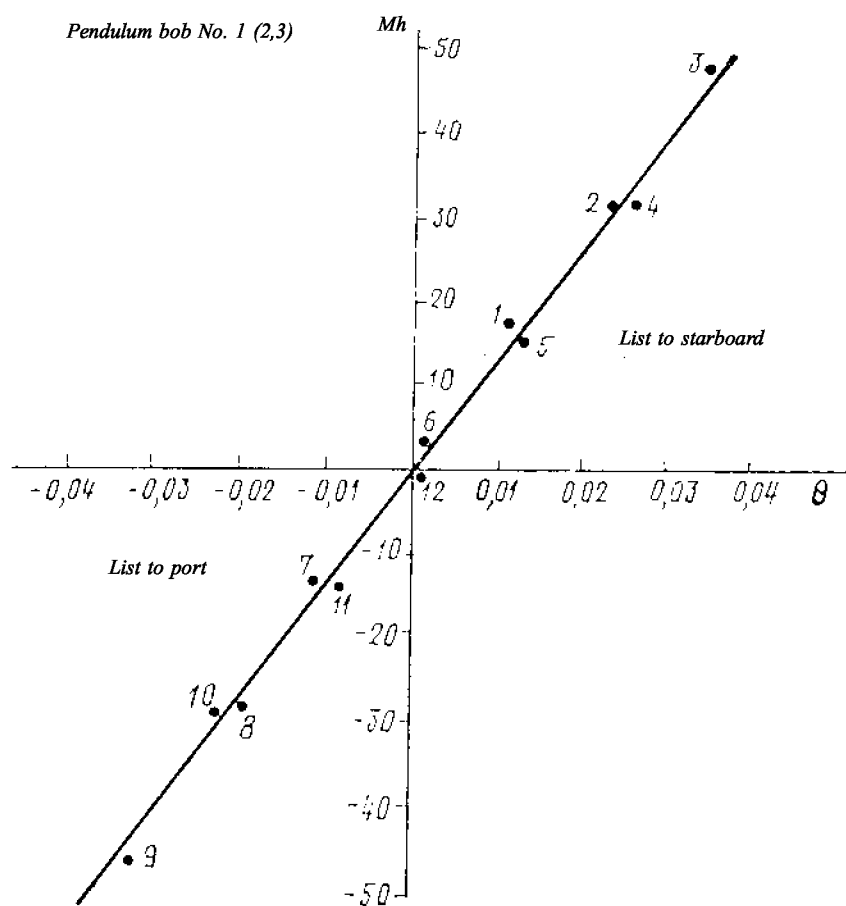
Measurements are executed by _____
(full name)

Measurements			1	2	3	4	5	
Number of full oscillations	k		5	6				
Period by inclinograph	b	mm						
	$t_1 = b/m_2$	s						
	$\tau'_i = t_i/k$	s						$\Sigma \tau'_i$ $\tau' = \Sigma t_i/n$
Period by stopwatch	t_2	s						<div><div></div><div></div></div>
	$\tau'' = t_2/k$	s						<div><div></div><div></div></div> $\tau = \frac{\tau' + \tau''}{2}$

Ship _____

" " _____ 20 _____

PLOT OF ON-LINE CONTROL OVER INCLINING TEST



Leader of inclining test _____
(full name)

Ship _____

" _____ " _____ 20 _____

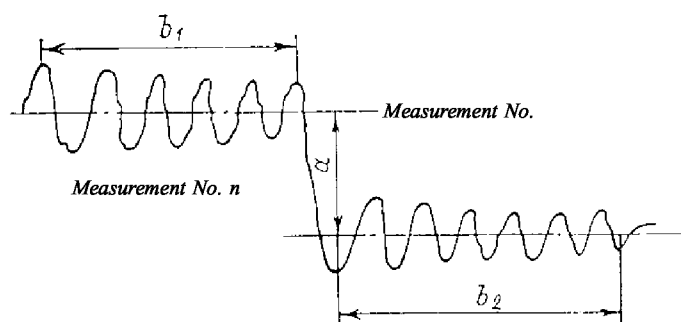
HEELING TABLE 1 (2,3)

Inclinograph ser. No. _____

Scale:

angles () _____ mm/deg

time () _____ mm/s



Measurements		1	2	3	4	5	
Heel	a , in mm						
	$\theta^\circ = a/m_i$						

Member of commission _____
(full name)

Register representative _____
(full name)

Ship _____

" _____ " _____ 20 _____

REPORT ON ROLLING PERIOD MEASUREMENTS

Swinging	1st observer			2nd observer		
	Number of full oscillations k	Total time t , in s	Period $\tau = t/k$, in s	Number of full oscillations k	Total time t , in s	Period $\tau = t/k$, in s
1						
2						
.						
.						
.						
Sum			$\Sigma \tau$			$\Sigma \tau$
$\tau_{an} = \Sigma \tau / n$			τ_1			τ_2
			$\tau_{design} = \frac{\tau_1 + \tau_2}{2}$			

Report is executed by:

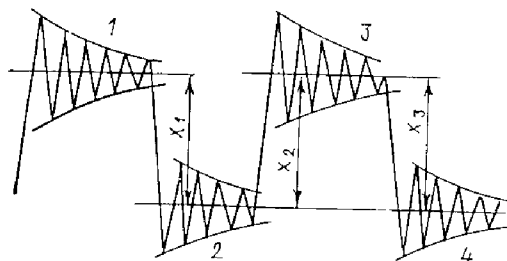
1st observer _____
(full name)

2nd observer _____
(full name)

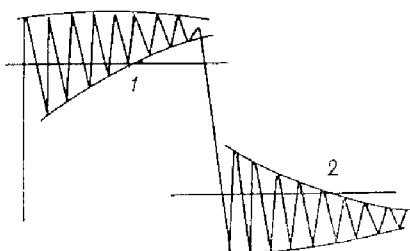
Ship _____

CALCULATION OF SHIP'S ELEMENTS FROM INCLINING TEST DATA

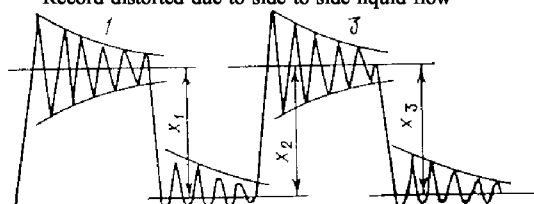
EXAMPLES OF RECORDS MADE WITH INCLINOGRAPH



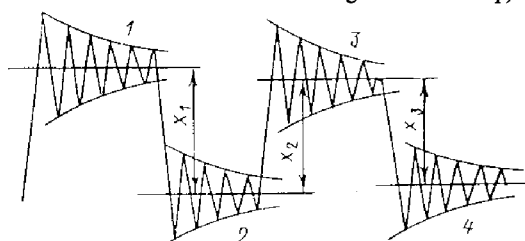
Good record and its correct processing



Record distorted due to side-to-side liquid flow



Record displays the presence of an obstacle for free oscillations of the ship or device pendulum
(see the record of the 2nd and 3rd runnings across the ship)



Record displays the reduced number of people running across the ship
(distance between the axes of the 1st and 3rd runnings across the ship is drastically reduced)

INSTRUCTIONS ON LIGHT-WEIGHT CHECK

1 GENERAL

1.1 A light-weight check of a ship means determining the light-ship weight and its longitudinal centre of gravity on the basis of ship survey and draught measurements.

1.2 Preparations for light-weight check and its performance shall be carried out in compliance with instructions on light-weight check developed in advance and reviewed by the Register. The instructions shall contain the particulars given in 3.1.1 — 3.1.4, 3.1.7 — 3.1.9, Appendix 4 to this Section.

1.3 The light-weight check shall be witnessed by the Register representative.

1.4 The waters in the area where the light-weight check is conducted shall be free from floating objects and ice which might restrict draught measurements. The depth of water under the keel shall not be less than 0,5 m.

1.5 The light-weight check shall be carried out in calm weather, in a sheltered area. Conduct of a light-weight check under icing is not permitted.

2 PREPARATIONS FOR LIGHT-WEIGHT CHECK

2.1 The ship shall drift freely or be held by lines. Mooring lines, hoses and power lines connected to the ship shall be slack. The access ramps shall be removed.

2.2 The angle of heel shall not exceed 1°.

2.3 The ship's metacentric height at the time of the light-weight check shall be positive.

2.4 Cargo in the holds is not permitted. The number of missing items and surplus items, which weight and coordinates of the centre of gravity can be accurately determined, is unrestricted at the time of the light-weight check. Where this is impracticable, the surplus items shall be removed from the ship, and the missing items, loaded on board the ship.

2.5 The equipment, outfit, spares, etc., shall be in their regular positions.

2.6 The chance of the liquid cargoes carried on board the ship flowing (transferring) from tank to tank shall be excluded. Pipeline valves shall be closed and sealed.

2.7 Technical documentation to establish the weight and location of the surplus and missing items shall be in place prior to the light-weight check.

2.8 Any unwanted objects, debris, snow, ice, etc., shall be removed from the ship.

2.9 A light-weight check can be conducted with auxiliary machinery running, provided this does not impair the check results.

2.10 The persons involved in the light-weight check shall be briefed and efficient communications between those involved in the check provided.

2.11 Prior to the light-weight check, lists of surplus and missing items shall be drawn up, with indication of their name, location, weight and coordinates of the centre of gravity. The lists shall be approved by the person in charge of the check and submitted to the Register representative. The inspection of the ship shall be carried out by the board and the Register representative prior to the check shall verify that the lists mentioned above are complete, and the ship properly prepared

2.12 Instructions of the person in charge shall be followed for commencing and completing the light-weight check.

3 LIGHT-WEIGHT CHECK

3.1 Measurements of the ship's draughts shall be performed by draught marks and by freeboard readings to be taken in at least 5 locations over the length of the ship. A report on draught measurement results shall be drawn up.

3.2 In case of discrepancy between the ship's draughts obtained from draught marks and those obtained from freeboard readings, the freeboard readings shall be authoritative.

3.3 The specific gravity of the water shall be determined on the basis of a sample taken from a depth equal to half the mean draught of the ship at the time of the light-weight check.

3.4 The deflection of the ship may be taken into account when calculating the displacement using any method of adequate accuracy.

3.5 The ship's displacement at the time of the test and the abscissa of its centre of gravity are determined depending on the ship's hull trim and bending in accordance with the requirements in 7.4 of Appendix 10 to this Section.

In this case, $x_{g\psi}$ shall be determined by the formula

$$x_{g\psi} = x_{c\psi} - (z_g - z_{c\psi})\sin\psi$$

where z_g = z-coordinate of the ship's centre of gravity in test conditions computed on the basis of the data of the effective Stability Booklet.

3.6 The displacement and the longitudinal centre of gravity of a light ship at light-weight check shall be determined according to Table 3.6.

Table 3.6

Load	Weight, in t	Longitudinal centre of gravity, in m	Moment, in t•m
		X	M_x
Ship during check			
Missing items			
Surplus items			
Light ship			

3.7 In preparation and during the light-weight check readings shall be accurate to the following:

draught 10 mm;
freeboard. 10 mm.

3.8 The recommended form of the Report is given in the Annex to these Instructions.

3.9 The results of the light-weight check shall be executed as the report and submitted to the Register for review. Based on the positive results of the review, the Register representative signs and stamps the front page of the record with the surveyor's seal.

3.10 If the ships are engaged on international voyages, the report shall be translated into English.

3 EQUIPMENT, ARRANGEMENTS AND OUTFIT

3.1 GENERAL

3.1.1 This Section specifies the scope and procedure of technical supervision during installation and testing of the ship equipment, arrangements and outfit.

3.1.2 General provisions for the organization of the technical supervision are given in Section 1.

3.1.3 Technical documentation.

3.1.3.1 Installation and testing of the equipment, arrangements and outfit shall be performed under the Register technical supervision according to the RS-approved technical documentation.

3.1.4 Technical supervision of the Register.

3.1.4.1 Surveys during installation and testing of the equipment, arrangements and outfit shall be performed according to the examination and testing plan developed by the shipyard according to 3.2.1 based on Table 3.1.4.1, taking into account 3.3.

3.1.3 Tests and checks specified in this Section are based on an assumption that the arrangements, equipment and outfit have been tested at the firm (manufacturer) in compliance with the requirements of Section 3, Part IV "Technical Supervision during Manufacture of Products" of the Rules for Technical Supervision.

In case some tests were not conducted at the firm (manufacturer) and it is confirmed by an entry in the RS certificate, then these tests shall be conducted.

Additional checks and tests may be assigned by the surveyor upon results of examination of the arrangements, equipment and outfit in substantiated cases.

3.2 SURVEY PLANNING

3.2.1 Prior to commencement of survey of the arrangements, equipment and outfit of the ship under construction, the RS Branch Office shall agree the examination and testing plan developed by the shipbuilder taking into account Table 3.1.4.1. The shipbuilder shall be informed about that at a kick off meeting prior to commencement of construction according to 1.7.1 and with due regard to 3.3.

The builder shall agree to undertake ad hoc investigations during construction as may be requested by RS where areas of concern arise and the builder to agree to keep RS advised of the progress of any investigation. Whenever an investigation is undertaken, the builder shall be requested, in principle, to agree to suspend relevant construction activities if warranted by the severity of the problem.

3.2.2 During approval and agreement of the examination and testing lists a note shall be taken of specific published Administration requirements and interpretations of statutory requirements.

3.2.3 Quality standards for installation and testing of the arrangements, equipment and outfit shall be reviewed and agreed during the kick-off meeting. The work shall be carried out in compliance with the RS rules and under the RS technical supervision.

3.2.4 Any changes to the kick-off meeting records shall be agreed and documented.

3.3 CHECKS AND TESTS

3.3.1 Steering gear.

3.3.1.1 Survey of the steering gear shall be performed according to Table 3.1.4.1.

3.3.1.2 During the mooring trials, the following shall be checked:

.1 operation of the rudder and steering gear by means of continuous putting the rudder from hard over to hard over with alternate actuation of the starboard and port units during a period stated in the approved program of trials taking into account the salient feature of the power unit of the steering gear;

.2 control of the rudder or steering nozzle from the wheel house and other locations by means of changing over the control system, as well as from the steering gear compartment in case of manual control;

Table 3.1.4.1

Nos.	Item of technical supervision	Installation on board ship						Mooring trials	Sea trials
		Verification of			Control				
		technical docu- mentation	docu- ments on products	marking, branding	of installa- tion and arrange- ment onboard	of fixing dimen- sions	in opera- tion		
1	Rudder and steering gear:	+	+	+	+	+	—	+	+ ¹
1.1	rudder stocks, including their flanges	+	+	+	+	+	—		
1.2	rudder axles including their flanges		+	+	+	+	—		
1.3	rudder blade and steering nozzle in assembly		+	+	+	+	—		
1.4	rudder and steering nozzle pintles		+	+	+	+	—		
1.5	pintle bushes		+	+	+	+	—		
1.6	rudder stock bearings		+	+	+	+	—		
1.7	parts of connections:		+	+	+	+	—		
	rudder stocks, rudder stock with rudder blade, with steering nozzle; rudder axle with sternframe; tiller or quadrant with rudder stock								
1.8	tillers, rudder quadrants		+	+	+	+	—		
1.9	rudder, steering nozzle stops and their parts		+	+	+	+	—		
1.10	parts of spindle drive of steering gears		+	+	+	+	—		
1.11	steering chains		+	+	+	+	—		
1.12	active means of ship's steering ²	+	+	+	+	+	—	+	+
2	Anchor arrangements:		+	—	—	+	+	+	+
2.1	anchors		+	+	+	+	—		
2.2	chain cables and parts of their securing of 13 mm and over in diameter		+	+	+	—	—		
2.3	anchor stoppers		+	+	+	+	+		
2.4	device for releasing the inboard end of the chain cable or rope		+	+	+	+	+		
2.5	anchor hawses ³		+	+	+	+	+		
3	Mooring arrangements:	+	—	+	+	—	—	+	—
3.1	bollards, cleats, fairleaders, rollers and stoppers		+	+	+	+	—		
4	Towing arrangements:	+	—	+	+	—	—	+	—
4.1	bitts, bollards, fairleaders, rolls and stoppers		+	+	+	+	—		
4.2	tow hooks and towing rails with fastenings for securing these parts to ship's hull, tow line releasing device		+	+	+	+	—		
4.3	snatch-blocks		+	+	+	+	—		
4.4	towing rails		+	+	+	+	—		
4.5	emergency towing arrangement	+	+	+	+	+	+		
5	Signal masts:	+	—	+	+	+	—	—	—
5.1	metal, wooden and glass reinforced plastic masting, fixed gear of masts and their standing rigging		+	+	+	+	—		
5.2	loose gear of standing rigging		+	+	+	+	—		
6	Openings in hull, 1st and 2nd tiers of superstructures and deckhouses and their closing appliances:								
6.1	side and flush deck scuttles (deckhouse windows), round and square	+	+	+	+	+	+		
6.2	doors in outside plating	+	+	+	+	+	+	+ ⁴	
6.3	outside doors in superstructures and deckhouses	+	+	+	+	+	+		
6.4	covers of companionways and ventilation trunks	+	+	+	+	+	+		
6.5	ventilators	+	+	+	+	+	+		

Table 3.1.4.1 — continued

Nos.	Item of technical supervision	Installation on board ship						in operation	Mooring trials
		Verification of			Control				
		technical docu-mentation	docu-ments on products	marking, branding	of installation and arran-gement	onboard	of fixing dimen-sions		
6.6	covers of tank manholes	+	+	+	+	+	+	+ ⁴	
6.7	doors in main watertight bulkheads	+	+	+	+	+	+		
6.8	hatch covers of dry cargo holds, holds fitted for alternate carriage of liquid in bulk and dry cargoes, tweendecks, covers of cargo tanks	+	+	+	+	+	+		
7	Equipment of spaces:								
7.1	ceiling, battens, lining of cargo holds	+	+	+	+	—	—	—	
7.2	doors in ship's spaces on escape routes	+	+	+	+	+	—	—	
7.3	stairways and vertical ladders	+	+	+	+	—	—	—	
7.4	guard rails, bulwark and gangways	+	+	+	+	+	—	—	—
7.5	guiding fittings in holds of container carriers	+	+	+	+	+	—	—	—
7.6	devices for securing movable decks, platforms, ramps and similar structures in non-working position	+	+	+	+	+	—	+ ¹	—
7.7	low-location lighting systems (photoluminiscent, electrically powered)	+	+	+	+	+	+	—	—
8	Arrangements for securing of timber deck cargo (strengthened bulkwark or guard railing, sockets or other fittings for uprights, joint rings, lashings)	+	+	+	+	+	—	—	—
9	Items made of ropes for all applications	+	+	+	+	—	—	+	—
10	Emergency outfit:	+ ⁵							
10.1	soft collision mats, rigid collision mats with outfit	+	+	+	+	—	—	—	—
10.2	tools of emergency outfit	+	+	+	+	—	—	—	—
10.3	materials of emergency outfit	+	+	+	+	—	—	—	—
11	Hoisting gear for shipborne barges	+	+	+	+	+			
¹ According to the approved program. ² Refer to 3.4.4. ³ Supervision is performed according to Section 2. ⁴ The RS supervision of the drives is performed according to Sections 5 and 10, if uncovering and covering of openings is carried out both in ports and at sea. ⁵ Ship's List of Supplies.									

.3 capability of the main steering gear to put the rudder over from 35° on one side to 35° on the other side, and that of the auxiliary steering gear to put the rudder over from 15° on one side to 15° on the other side;

.4 operation of the steering gear with two cylinders (in line, adjacent, etc.) functioning, instead of four;

.5 operation of the rudder or steering nozzle stops;

.6 operation of safety valves when the slide block is against the stops fitted on the steering gear. The lift pressure of the safety valves shall meet the requirements of 6.2.4.1, Part IX "Machinery" of the Rules for the Classification and Construction with due account of the operating instruction for the steering gear;

.7 correctness of the rudder or steering nozzle angle indicator readings as compared to their actual position determined from the dial of the mechanical indicator on the steering gear (refer to 2.9.15, Part III "Arrangements, Equipment and Outfit" of the Rules for the Classification and Construction);

.8 operation of the auxiliary steering gear;

.9 direction of the steering wheel rotation and direction of the rudder or steering nozzle deflection;

.10 power supply systems of the electrical units of the steering gear from the main and emergency sources of electrical power, remote and local control systems, alarm system and the technical condition of the whole electrical equipment in accordance with the requirements of Section 10;

.11 operation of the hydraulic drive in accordance with the requirements of 5.15.7 and 8.3.2.7;

.12 operation of the main and/or auxiliary manually operated steering gear — of spindle, steering rope and other type, including check of their assemblies and components in operation;

.13 possibility of using a rudder tackle and hand tiller on board ships where they may be employed as an auxiliary steering gear;

.14 operation of the braking device;

.15 operation of the torque-limiting clutch when the tiller quadrant is against the stops in case of electric steering gear, check of the clutch adjustment;

.16 intact position of the rudder blade angled to either side with one hydraulic pump in operation, as well as with two hydraulic pumps in parallel operation.

3.3.1.3 During the sea trials, the following shall be checked:

.1 operation of the main steering gear to put continuously the rudder or nozzle rudder over from 35° on one side to 35° on the other side within the time specified in the program of trials approved by the Register, at the deepest seagoing draught and ahead speed, with alternate operation of the starboard and port units, and being controlled alternately from all control stations. Where it is impractical to demonstrate compliance with this requirement during sea trials with the ship at its deepest sea-going draught and running ahead at the speed corresponding to the number of maximum continuous revolutions of the main engine and maximum design pitch, ships regardless of date of construction may demonstrate compliance with this requirement by one of the following methods:

during sea trials the ship is at even keel and the rudder fully submerged whilst running ahead at the speed corresponding to the number of maximum continuous revolutions of the main engine and maximum design pitch; or

where full rudder immersion during sea trials cannot be achieved, an appropriate ahead speed shall be calculated using the submerged rudder blade area in the proposed sea trial loading condition. The calculated ahead speed shall result in a force and torque applied to the main steering gear which is at least as great as if it was being tested with the ship at its deepest sea-going draught and running ahead at the speed corresponding to the number of maximum continuous revolutions of the main engine and maximum design pitch; or

the rudder force and torque at the sea trial loading condition have been reliably predicted and extrapolated to the full load condition. The speed of the ship shall correspond to the number of maximum continuous revolutions of the main engine and maximum design pitch of the propeller.

On all occasions when trials are conducted with the ship not at the deepest sea-going draught, the loading condition can be accepted on the conditions that either:

the rudder is fully submerged (at zero speed waterline) and the ship is in an acceptable trim condition;

the rudder torque at the trial loading condition have been reliably predicted (based on the system pressure measurement) and extrapolated to the maximum sea-going draught condition using the following method to predict the equivalent torque and actuator pressure at the deepest sea-going draught:

$$Q_F = Q_T \alpha; \quad (3.3.1.3.1-1)$$

$$\alpha = 1,25 \left(\frac{A_F}{A_T} \right) \left(\frac{V_F}{V_T} \right)^2 \quad (3.3.1.3.1-2)$$

where α = extrapolation factor;

Q_F = rudder stock moment for the deepest service draught and maximum service speed condition;

Q_T = rudder stock moment for the trial condition;

A_F = total immersed projected area of the movable part of the rudder in the deepest sea-going condition;

A_T = total immersed projected area of the movable part of the rudder in the trial condition;

V_F = contractual design speed of the ship corresponding to the maximum continuous revolutions of the main engine at the deepest sea-going draught;

V_T = measured speed of the ship (considering current) in the trial condition.

Where the rudder actuator system pressure is shown to have a linear relationship to the rudder stock torque, the above equation can be taken as:

$$P_F = P_T \alpha \quad (3.3.1.3.1-3)$$

where P_F = estimated steering actuator hydraulic pressure in the deepest sea-going draught condition;

P_T = maximum measured actuator hydraulic pressure in the trial condition.

Where constant volume fixed displacement pumps are utilized, then the regulations can be deemed satisfied if the estimated steering actuator hydraulic pressure at the deepest draught is less than the specified maximum working pressure of the rudder actuator. Where a variable delivery pump is utilized, pump data shall be supplied and interpreted to estimate the delivered flow rate corresponds to the deepest sea-going draught in order to calculate the steering time and allow it to be compared to the required time.

Where $A_T > 0,95A_R$, there is no need for extrapolation methods to be applied.

Alternatively, the designer or shipbuilder may use computational fluid dynamic (GFD) studies or experimental investigations to predict the rudder stock moment at the full sea-going draught condition and service speed. These calculations or experimental investigations shall be approved by RS;

.2 operation of the steering gear with the cylinders of the power unit disconnected in possible variants;

.3 correctness of the rudder or steering nozzle angle indicator readings as compared to their actual position determined from the dial of the mechanical indicator on the steering gear (refer to 2.9.15, Part III "Arrangements, Equipment and Outfit" of the Rules for the Classification and Construction);

.4 operation of the rudder or steering nozzle stops;

.5 operation of the sealing arrangements (gland) on the rudder stock;

.6 tightness of the hydraulic part of the steering gear power unit;

.7 intact position of the rudder blade angled to either side;

.8 absence of excess of the nominal parameters of the steering gear when the rudder or nozzle rudder is put over from one side to the other side (refer to 6.2.1.5, Part IX "Machinery" of the Rules for the Classification and Construction);

.9 time required to put the rudder or steering nozzle over from 35° on one side to 30° on the other side under conditions specified in 3.3.1.3.1, which shall not exceed 28 s; in oil tankers and combination carriers, gas carriers, chemical carriers and other ships intended for the carriage of dangerous goods (refer to 1.2, Part VI "Fire Protection" of the Rules for the Classification and Construction of Sea-Going Ships) of 10000 gross tonnage and upwards, in passenger ships of 7000 gross tonnage and upwards and in all nuclear ships the main steering gear shall ensure the above time with each one of the available identical power units being inoperative;

.10 time required for the auxiliary steering gear to put the rudder or steering nozzle over from 15° on one side to 15° on the other side at the deepest seagoing draught (refer to 3.3.1.3.1) and the ahead speed of the ship equal to one half of its maximum ahead service speed or 7 knots, whichever is greater; the time required to put the rudder or steering nozzle over shall not exceed 60 s;

.11 operation of the steering gear when putting the rudder or steering nozzle over at astern speed contemplated by the design;

.12 parameters of the electrical and hydraulic equipment in accordance with the requirements of Sections 5 and 10;

.13 operation of the main and/or auxiliary steering gear by putting the rudder from hard over to hard over as outlined in 3.3.1.3.1, 3.3.1.3.9 and 3.3.1.3.10.

The force applied to the steering wheel handles of the main steering gear when handled by one man shall not exceed 120 N with the number of rotations, when shifting the rudder from hard over to hard over, not more than $9/R$ where R is arm (radius) of the steering wheel up to the middle of its handle length. The force applied to the steering wheel handles of the auxiliary manually operated steering gear when handled by not more than four men shall not exceed 160 N per helmsman.

In the series-built, non-self-propelled ships, the said tests, on agreement with the RS surveyor, may be carried out during the mooring trials. In this case, the required forces applied to the steering wheel handles shall be determined by comparing their values obtained during mooring and sea trials.

3.3.1.4 Technical supervision of the active means of ship's steering shall be performed in case where the installation thereof is accepted to ensure the specified steerability of the ship at the low speed by simultaneous operation of the steering gear. The RS Branch Office shall establish the scope and procedure of the surveys and approve the test program.

In other cases, the RS surveyor shall only make sure that the design and construction of the active means of ship's steering do not affect adversely the overall safety of the ship.

3.3.2 Anchor arrangements.

3.3.2.1 Survey of the anchor arrangement installation on board the ship shall be performed according to Table 3.1.4.1.

3.3.2.2 During the mooring trials of the anchor arrangement the following shall be checked:

.1 test in operation of the anchor machinery at no-load condition during a period of time specified by the program of ship trials approved by RS;

.2 reliability of engagement and disengagement of the chain sprockets;

.3 operation of the band brakes;

.4 operation of the drive;

.5 dropping of the anchors from the hawses with disconnected clutches of the windlass (capstan) chain sprockets and released chain cable stoppers;

.6 passing of the chain cable through the sprocket, chain stopper, guide rollers and anchor hawse and chain pipes;

.7 absence of chain kinks, impacts against hawses, twisting and skipping over the sprocket;

- .8 operation of the stoppers and guide rollers;
- .9 entering of the anchor into hawse, absence of overturning when approaching the hawse and fit of the anchor to the ship hull at three points;
- .10 adjustment of the torque-limiting clutches;
- .11 correctness of the anchor cable counter's indications; the length of the chain cable paid out shall be determined by the number of shackles which have passed through the chain sprocket of the machinery (visually, by marks on the chain) and by comparing with the readings of the receivers-indicators;
- .12 absence of the releasing of the brake in the event of de-energization of the remote control system or driving gear of the main anchor machinery;
- .13 operation of the device for securing and releasing of the inboard end of the chain cable by means of turning the flywheel until the hooks are completely open and the first shot of the chain cable in the chain locker releases;
- .14 operation of the interlock system ensuring safe functioning of the anchor arrangement and set sequence of operations;
- .15 operation of the alarm on fulfilling the set anchor operations at the remote control station;
- .16 functioning of the anchor arrangement being manually operated (with the aid of capstan bars, levers, etc.) or with the use of other deck machinery.

3.3.2.3 During mooring trials of the anchor arrangement, the following shall be additionally checked in prototype ships:

- .1 passing of the joining links and inboard end chain length through the chain sprocket and stopper;
- .2 anchor heaving-on speed, including the maximum possible speed when the anchor approaches the hawse;
- .3 free passing of the anchor relative to the hull, especially in ships with bulbous bow, having regard to service heel and trim;
- .4 self-stowing of the entire heaved-in chain without dragging apart in the chain locker, whereupon the chain shall be veered away overboard; in so doing, the chain shall not be jammed in the chain locker and deck pipe.

3.3.2.4 During the sea trials of the anchor arrangement the following shall be checked:

- .1 alternate dropping of the chain cable for its whole length and hoisting thereof with breaking the chain cable out from a depth not less than 82,5 m (with three shackles in suspended condition). The average heaving-in speed measured on the length of two shackles shall be not less than 9 m/min. On agreement with the RS Branch Office, in series-built ships, exclusive of the prototype ship, the anchor arrangement which machinery has been exhaustively tested on bench during manufacture, including the test for nominal null may be tested at lesser depth but not less than at 45 m;
- .2 the heaving-in speed as the anchor approaches the hawse shall be not less than 10 m/min; it is recommended that the speed during pulling the anchor into the hawse shall not exceed 7 m/min;
- .3 operation of the band brake of the anchor machinery by dropping and abrupt braking from one to two times on each chain cable length;
- .4 proper run of the chain cable, normal engagement of the chain cable with the chain sprocket. No twisting, slip, impacts of the chain cable are allowed; the chain shall leave the sprocket and pass through the stoppers and hawses without sharp kinks and rotations;
- .5 dropping of anchor to a depth specified in 3.5.4.1 with the use of the anchor machinery drive;
- .6 checking of the hand drive; the heaving-in speed shall be not less than 2,5 m/min, and the force applied to the handles shall be not more than 160 N per man handling the drive; for series-built ships the check may be performed in the prototype ship and also selectively in some ships of a series;
- .7 electrical equipment of the anchor arrangement in accordance with the requirements of Section 10, operation of the remote control (if any);
- .8 operation of the device to ensure automatic braking by the band brake with the anchor machinery drive disconnected from the sprocket; in this case, the maximum speed of paying-out shall not exceed 3 m/s and the minimum speed shall be not less than 1,4 m/s, ignoring the initial speed-up. Attention shall be given to the absence of skipping of links over the sprocket cams;
- .9 reliability of riding the ship at anchor; it is necessary to check securing the stoppers, their operation, possibility of releasing the stopper when the chain cable is stretched taut (it is recommended that the check is performed with the ship running at slow speed astern); no skipping of links over the sprocket cams shall be allowed when riding at anchor with the sprocket stopped;
- .10 operation of the indicator of the paying out speed of the cable (in ships with Equipment Number of 400 and less).

3.3.2.5 On agreement with the RS Branch Office, use of simulation methods may be permitted for testing the anchor arrangement without proceeding to sea to the depths specified in 3.3.2.4.1 and 3.3.2.4.5. Such testing shall be

preceded by an experimental check of the simulation method in some number of series-built ships according to a program agreed with the RS Branch Office

The program and procedure of the simulation tests shall be approved by the Register Head Office (RHO).

3.3.2.6 Windlass shall be permanently marked with the following information:

nominal size of chain (e.g. "100/3/45" means chain diameter/grade/breaking load, appropriately);

maximum anchorage depth, in m.

3.3.3 Mooring arrangements.

3.3.3.1 Survey of the mooring arrangement installation on board the ship shall be performed according to Table 3.1.4.1.

3.3.3.2 During the mooring trials of the mooring arrangement the following shall be checked:

.1 each mooring machinery in operation in idle run and at rated pull during a period of time specified in the program of trials approved by RS;

.2 heaving-in speed of the mooring line;

.3 each machinery loaded to develop 1,25 times the rated pull; along with that, it is necessary to check operation of the brakes under abrupt braking condition;

.4 operation of the automatic mooring winches;

.5 manual control of the automatic winches from local positions;

.6 operation of the manual and remote drives of the band brake from each control station with verification of the operation of the alarm and limit switches;

.7 operation of the drive of the device for limiting the veered out length of the rope and its alarm;

.8 operation of all interlocks;

.9 actuation and operation of the emergency alarms released at the consoles and remote alarm for the emergency mode;

.10 proper operation of the hydraulic system component when the mode switch is set to "automatic", "drum", "warping head", "stop" position;

.11 maximum speed of heaving-in of an unloaded mooring line and reeling-up of the line on the winch drum;

.12 range of the winch operation forces in "pay out" and "haul in" modes;

.13 operation of the limiter of the mooring line paid out length, automatic drum braking and alarm.

3.3.4 Towing arrangements.

3.3.4.1 When surveying (according to the List) the towing arrangement of a ship assigned the descriptive notation "tug" in the class notation, in addition to the issues specified in 3.1.3, the following shall be checked:

.1 installation and securing of the towing winches on the ship's seating;

.2 number, design, location and securing of towing bollards and chocks, bits, rails, availability of cable stoppers;

.3 type, diameter or circumference, as well as length of the tow line;

.4 adjustment of the mechanical lock of the tow hook which shall be so adjusted that under no towing pull condition the force required to relieve the lever is from 30 to 50 N;

.5 location of the towing winch control position (no operating position shall be located within the zone of tow line run);

.6 location and arrangement of guide rollers, blocks preventing the line from slipping-off and from friction against the hull structures;

.7 arrangement, installation and enclosure class (casings) of the electrical equipment, installation of cable runs, securing, connection and choice of cross-sections of the cables to supply the electrical driving units, towing arrangement control system, alarm system in accordance with the requirements of Section 10, and where hydraulic drive is provided, Section 8.

3.3.4.2 When surveying the towing arrangements of other ships, the requirements in 3.2.3 shall be met, as well as the requirements relevant to the ship concerned which are set out in 3.3.4.1.

3.3.4.3 During the mooring trials the following shall be checked:

.1 towing winches (if any) in operation at the rated pull during the period of time specified in the RS-approved program of ship trials;

.2 operation of the device for governing the tension of the towline and possibility of checking the value of tension at every moment;

.3 operation of the fairlead;

.4 operation of the remote driving machinery;

.5 reliability of the hook lock closing and opening; opening shall be checked three times at a load equal to the rated pull; force applied to the release lever shall not exceed 120 N;

.6 release of the towline from the main hook in three positions — extreme deflections of the towline and in the mid-position. In every position the towline shall be released:

- under no load condition;
- at a load equal to the rated pull;
- .7 release of the towline at the maximum load at hook with the use of the automatic control unit of the limiting heel angles;
- .8 operation of the sound and light warning alarm (if any) activated when the maximum permissible length of towline is veered out;
- .9 manual operation of the automatic winches from a site at the winch;
- .10 proper laying of the towline (the line shall not touch the hull structures);
- .11 side-to-side run of the towline;
- .12 operation of the device for remote release of the tow hook under no load and under load conditions with measurement of the pull;
- .13 passing of the standard towline and towing bridle (semi-bridle) from forward and aft, from the regular shipboard positions, and securing thereof for sea; absence of the line brushing against articles and other structures;
- .14 appropriate power supply of the towing arrangement, operation of the controls and the alarm, proper condition of the electrical equipment and electrical power parameters to suit the requirements of Section 10;
- .15 proper operation of the driving machinery in all control positions;
- .16 operation of the winch in idle run and in "haul in" and "pay out" modes;
- .17 towline hauling-in speed;
- .18 operation of all interlocks;
- .19 towline counter;
- .20 adjustment of the torque-limiting clutch.

3.3.5 Signal masts.

3.3.5.1 General.

3.3.5.1.1 Subject to the Register technical supervision shall be stayed and unstayed signal masts made of steel of a normal and higher strength, light alloys, glass-reinforced plastic or wood including masts of special construction: bipod, tripod and other similar masts.

The Register technical supervision of the masts, which carry derrick booms and other cargo handling gear in addition to the signal means, shall be performed in accordance with the requirements of the Rules for the Cargo Handling Gear of Sea-Going Ships¹.

Technical supervision of the equipment of the signal masts and location thereof shall be performed in accordance with the requirements of Part IV "Technical Supervision during Manufacture of Products" of the Rules for Technical Supervision and Section 14 of the Guidelines.

3.3.5.2 Survey of the signal masts installation on board the ship shall be performed according to Table 3.1.4.1.

3.3.5.3 During the mooring and sea trials of the ship, particular emphasis shall be placed upon the magnitude of the mast vibration under various operating conditions of the main engine.

3.3.6 Openings in hull, superstructures and deckhouses and their closing appliances.

3.3.6.1 Survey (according to the List) of the closing appliances shall be performed in accordance with the requirements of 3.1.3 and Table 3.3.6.1.

3.3.7 Equipment of spaces.

3.3.7.1 When surveying, in addition to the matters specified in 3.1.3, it is necessary to check the following spaces and equipment listed under 3.3.7.1.1 — 3.3.7.1.4.

3.3.7.1.1 As regards dry cargo holds, the following shall be checked:

.1 placing of wooden ceiling on top of the floors in ships with no double bottom. The ceiling shall be solid and extend to the bilge.

In holds intended for the carriage of grain and other bulk cargoes, the wooden ceiling shall be fitted so as to prevent wells, bilges and suction pipes from clogging;

.2 availability of protective wooden screens, grids, chutes, etc. fitted on the manholes, air pipes, sounding pipes, etc. in places subject to impacts of cargo, grabs or other hoisting devices;

.3 fitting of cargo battens made of wood or metal, attached so as to be readily removed or replaced. The fastenings of the cargo battens shall not be welded to the head of the offset bulb plate and to the edges of the face plates of the framing girders;

.4 thickness of the wooden ceiling;

.5 thickness of the wooden cargo battens;

¹Hereinafter referred to as "the Rules for the Cargo Handling Gear".

Table 3.3.6.1

Nos.	Check pattern	Scuttles					doors in shell plating	doors in superstru-cture and deck house	Hatches			ventilation ducts	manholes	Doors in watertight subdivi- sion bulkheads			Doors in ships intended for carriage of vehicles			Cargo hatch covers of:		
		side scuttles			rectangular (deckhouse windows)	flush deck scuttles			companion	skylight	vent. trunks			hinged	sliding	rolling	hinged	sliding	rolling	dry cargo holds and holds for carriage of dry and bulk liquid cargoes ensuring tightness using:		compartments of oil tankers
		heavy	normal	light																tar-pau- lins	gaskets	
1	Absence of defects on the working edges of the collars ¹	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
2	Absence of defects on the gaskets ²	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
3	Fitting of the gaskets to the working edges of collars in the closed, but not in secured position ³	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
4	Even fitting of the gasket in secured position																					
5	Coincidence of the working edges with the middle of gaskets	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
6	Indentation depth of gaskets when in secured position ⁵	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
7	Check of glasses ⁶	+	+	+	+	+				+												
8	Glass seal ⁷	+	+	+	+	+				+												
9	Ease and smoothness of opening, closing and securing with control: from inside	+ ⁸	+	+	+	+	+ ⁹			+ ¹⁰	+ ¹⁰	+ ¹⁰	+ ¹³				+ ¹¹	+ ¹¹	+ ¹¹			
	from outside							+		+ ¹⁰	+ ¹²	+ ¹⁰	+ ¹³			+ ¹⁶	+ ^{16,17}			+ ¹⁴	+ ¹⁵	+
10	Height of coamings							+	+ ¹⁸	+ ¹⁸	+ ¹⁸	+ ¹⁸	+ ¹⁸							+ ¹⁸	+ ¹⁸	+ ¹⁸
11	Quality of welds at the junctions of the closing appliances with the hull, superstructures and deckhouses	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
12	Tightness test: by hose testing ²³ by filling with water or air testing together with the compartment ²³	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+ ²⁰	+ ²¹	+

Table 3.3.6.1 — continued

<p>¹ Dents, tears, non-rounded off corners are unacceptable.</p> <p>² Cracks, cavities, bedding, paint, oil are unacceptable.</p> <p>³ Continuity of fit is checked by a chalk test and shall be ensured at indentation depth not more than 1 mm, except for closures listed in columns 8, 20, 22, having an area of 15 m² and over.</p> <p>⁴ Gaps are verified by feeler gauge or by other agreed methods.</p> <p>⁵ The denting value shall comply with the requirements of the technical documentation.</p> <p>⁶ To be checked are the firm's (manufacturer's) documents, absence of cracks and scratches on the glass, direct contact of the glass with the frame metal, glass thickness.</p> <p>⁷ To be checked are the firm's (manufacturer's) documents, measures to prevent the sealant from being pressed out during installation of the glass.</p> <p>⁸ To be checked also is the performance of special nuts required in particular cases by Rules for the Classification and Construction depending on the position of the scuttle on board ship.</p> <p>⁹ To be checked is the operation of the power gear and hand gear if the latter is contemplated by Sections 5 and 10, as well as the operation of the emergency hand gear used for closing and securing when the power gear is inactivated.</p> <p>¹⁰ If in addition to their intended purpose, hatches are used as emergency escape, the securing device shall be such that it can be operated from both sides.</p> <p>¹¹ To be checked is the control from the local positions only, operation of the devices precluding their opening by incompetent persons, and indicators showing automatically that each door is closed and all dogs are secured.</p> <p>¹² Fastening of portable shields for the glasses, made of the same material as the covers, being at least 3 mm thick.</p> <p>¹³ Fastening in ships of less than 100 m in length of the ventilator covers which shall be permanently attached, while in ships of 100 m in length and over they may be portable, stowed near the ventilators.</p> <p>¹⁴ To be checked is locking of portable beams in their sockets of the coamings, reliability of locking the rolling portable beams when the hatchway is either closed or open, tight pressing of tarpaulins against the hatchway coamings with the aid of battens and wedges, presence of steel bars or other equivalent means to efficiently and independently secure each section of hatchway covers after the tarpaulins are battened down.</p> <p>¹⁵ The following shall be checked:</p> <ul style="list-style-type: none"> for the hatch covers of holds intended for the carriage of flammable and dangerously explosive cargoes – absence of wear between the movable steel parts through the use of materials not creating a spark-like couple; presence of the plating of two adjacent sections in one plane in "secured" position; fit of the bearing end and side vertical plates of the sections to the lower edges or the flanges to the bearing parts of the coaming in "secured" position; lack of load on the running wheels of the sections in "secured" position. <p>¹⁶ To be checked additionally is the operation of the remote drive from a readily accessible position, located above the bulkhead deck, with the use of a flywheel or other similar device, operation of the indicators showing in which position of the flywheel, handle or other similar device the door will be open and at which position it will be closed, to be measured is the force at the flywheel, handle or other similar device during the movement of the door leaf and the time needed to close the door completely, which shall be consistent with the guidelines of the technical documentation.</p> <p>¹⁷ To be checked is the control of the power drive from the position directly at the door as well as the central station, the door closing time is measured, sound alarm is checked.</p> <p>¹⁸ To be measured from the upper edge of the steel plating, and where a wooden or other covering is provided, from the upper edge of this covering.</p> <p>¹⁹ When subjected to hose test, water leaks in the form of isolated drops ("tear drops") are accepted, but the total amount of leaking water when the item is watered by hose over the entire perimeter during 5 min shall not exceed 0,5 l.</p> <p>²⁰ On agreement with the surveyor, they may be relieved of the tests.</p> <p>²¹ The sealing arrangements of the hatch covers of holds intended for the carriage of dry and bulk liquid cargoes (ore-oil carriers, etc.) shall be additionally subjected to air test together with the compartment in accordance with Appendix 1 to Part II "Hull" of the Rules for the Classification and Construction; the pressure value shall be assumed to be equal to the maximum pressure to which the pressure-vacuum valves have been set.</p> <p>²² Prior to installation on board ship, the door shall be tested on bench by the design hydraulic water column pressure; otherwise, the door shall be tested on board ship according to the procedure approved by the RS Branch Office.</p> <p>²³ To be carried out in accordance with Appendix 1 to Part II "Hull" of the Rules for the Classification and Construction.</p>

.6 attachment of the guide uprights for containers to the hull structures, quality of welds;

.7 basic dimensions of the uprights and distance between the uprights, weld throats.

3.3.7.1.2 As regards exits, doors, corridors, stairways and vertical ladders, the following shall be checked:

.1 location and ready access of persons from spaces to the places of embarkation into lifeboats and liferafts;

.2 availability and location of two exits in accordance with the requirements of the Rules for the Classification and Construction and drawings;

.3 consistence between the type and dimensions of doors and the requirements of the drawing;

.4 capability of the exit doors or ladderway covers to be operated from both sides and operation of devices ensuring this;

.5 direction in which the door can open;

.6 availability of detachable panels in the lower portion of the doors of accommodation spaces, as well as the inscription: "Means of escape — knock out in case of emergency" in the passenger ships;

.7 length of the dead-end corridors;

.8 width of exits from the cinema halls and sizes of the ladderways from cargo holds;

.9 sizes of the detachable panels;

.10 width of main corridors in way of passengers' and crew's accommodation spaces;

.11 width of stairways and sizes of landings.

3.3.7.1.3 As regards guard rails, bulwark and gangways, the following shall be checked:

.1 quality of welded joints of the bulwark and gangways;

.2 convenience and safety of passage from the level of the gangway to some crew's accommodation spaces in "A" type ships;

.3 opening below the lowest course of the guard rails and spacing between the other courses of rails, openings in the bulwark;

.4 height of the bulwark and guard rails;

.5 availability, location and arrangement of the life rails and other means ensuring the safety of passage;

.6 location and arrangement of the bulwark freeing ports and their covers.

3.3.7.1.4 As regards movable decks, platforms, ramps and other similar structures, the following shall be checked:

.1 reliability of installation of the movable decks, platforms, ramps and other similar structures in working and non-working positions, consideration shall be given to the surveys of these structures and also their supporting elements at ship's sides, decks and bulkheads, the pillars and suspensions therefor, ensuring their installation in the working position, which have been previously carried out during the survey of the hull;

.2 structural elements for securing of the movable decks, platforms, ramps, etc. in the non-working position and also quality of installation thereof;

.3 movement of the decks, platforms, ramps and other similar structures with the use of regular driving units from the working position to the non-working position and vice versa, in so doing, movement shall be smooth, no jerks, cocking, etc. are accepted;

.4 operation of the arrangements ensuring securing of the movable decks, platforms, ramps and other similar structures in the non-working position, reliability of securing; the hoisting gear and elements thereof shall not generally be kept under load;

.6 operation of electric and hydraulic drive, limiting switches, alarm and interlocking systems in accordance with the requirements of Sections 5 and 10;

.7 strength of the movable decks, platforms, ramps and other similar structures, pillars or suspensions therefor and also their supporting elements at ship's sides, decks at the operating load in accordance with the RS-approved program (in prototype ship);

.8 scope and procedure of test for an arrangement (dockside trials of the ship) including the test thereof under load shall be established by the designer with due account of the salient features of the design and use of the arrangement; the test program shall be agreed upon with the Register.

3.3.8 Arrangements for securing of timber deck cargo.

3.3.8.1 Subject to the supervision of the Register shall be the strengthened bulwark or guard rails, sockets or other fittings for uprights, stanchions, joint rings and lashings.

3.3.8.2 When surveying (according to the List) the arrangements for securing of timber deck cargo, in addition to the matters specified in 3.1.3, the following shall be checked:

.1 installation of uprights and attachment thereof to the hull;

.2 special strengthening of bulwark at places where the stanchions are installed, and quality of welds;

.3 arrangements of joint rings for lashings, quality of welding;

.4 means provided to protect the steering gear and steering ropes from the deck timber;

.5 spacing between uprights;

.6 circumference of ropes, diameter of chains;

.7 distance between joint rings.

3.3.9 Ship's wire, fibre and synthetic ropes of all purposes.

3.3.9.1 During survey the ropes shall be checked in accordance with the provisions of 3.1.3 and also of the relevant chapters of this Section.

3.3.10 Emergency outfit.

3.3.10.1 Subject to the technical supervision of the Register shall be completing, arrangement and securing of the items of the emergency outfit on board ship, taking into account the requirements in 9.1.1, Part III "Technical Supervision during Manufacture of Materials" of the Rules for Technical Supervision.

3.3.10.2 During survey, in addition to the matters specified in 3.1.3, the following shall be checked:

.1 lantern of explosion-proof type;

.2 location of emergency stations and availability of identification inscriptions;

.3 availability of items of the emergency outfit in accordance with the list;

.4 reliability of securing of the items in their regular positions;

- .5 possibility of the outfit items being rapidly used with verification of the release device;
- .6 completeness of collision mats;
- .7 marking of items of the emergency outfit;
- .8 width of free passage to the emergency station;
- .9 sizes of collision mates, bars, planks, wedges, plugs, canvas, rubber, felt;
- .10 diameter of wire, construction shackles, bolts and washers, etc.;
- .11 quantity of cement (brand of the quick-setting cement according to the certificate), concrete setting accelerator, minium, technical fat, oakum and sledge hammers.

3.3.11 Hoisting gear of shipborne barges.

3.3.11.1 During survey (according to the List), the hoisting gear of shipborne barges to be lifted on board the barge carrier shall be checked in accordance with the provisions of 3.1.3 and also proceeding from the additional requirements set forth by the designer on the particular features of the design and manufacture process.

4 FIRE PROTECTION

4.1 GENERAL

4.1.1 This Section specifies the scope and procedure of technical supervision during installation and tests of the fire divisions and systems and during equipping ships with fire-fighting outfit to ensure fire protection of the ship (refer to Table 4.1.1).

Table 4.1.1

Nos.	Item of technical supervision	Installation and assembly			Mooring trials
		Check of documents and brands for materials and products	Check of assembly and arrangement onboard	Test by proof pressure	Check in operation including that in compliance with 4.3
1	Structural protection				
1.1*	Fire-proof bulkheads, ceilings and decks	+	+	—	—
1.2*	Fire doors	+	+	—	+
1.3*	Fire dampers for ventilation dumps	+	+	—	+
1.4	Fuses for self-closing dampers	+	—	—	—
2	Materials (fire protective properties)				
2.1*	Insulation materials	+	+	—	—
2.2*	Materials of internal bulkheads	+	+	—	—
2.3*	Grounds	+	+	—	—
2.4*	Linings	+	+	—	—
2.5*	Finishing materials	+	+	—	—
2.6*	Deck coverings	+	+	—	—
2.7	Textiles	+	+	—	—
2.8	Carpets	+	—	—	—
3	Fire extinguishing systems ¹				
3.1*	Water fire main system	+	+	+	+
3.2*	Sprinkler system	+	+	+	+
3.3*	Pressure water-spraying system	+	+	+	+
3.4	Water screen system	+	+	+	+
3.5	Drenching system	+	+	+	+
3.6*	Foam fire extinguishing system	+	+	+	+
3.7*	Carbon dioxide smothering system	+	+	+	+
3.8*	Fire extinguishing systems for machinery spaces and cargo pump rooms	+	+	+	+
3.9*	Dry powder system	+	+	+	+
3.10	Liquified gas system for domestic use	+	+	+	+
3.11*	Aerosol fire-extinguishing system	+	+	—	+ ²
4	Fire fighting outfit				
4.1*	Fire hoses complete with couplings	+	+	—	+ ¹
4.2*	Fire hose nozzles	+	+	—	+ ¹
4.3*	Air-foam nozzles	+	+	—	+ ¹
4.4*	Portable foam generators	+	+	—	+ ¹
4.5*	Portable foam set	+	+	—	+
4.6	Foam extension pipes	—	+	—	—
4.7	Extension pipes for foam generators	—	+	—	—
4.8*	Water fog applicator	—	+	—	+ ¹
4.9*	Portable fire extinguishers	+	+	—	—
4.10*	45 l and 135 l foam fire extinguishers	+	+	—	+
4.11*	16 kg and 45 kg CO ₂ or powder fire extinguishers	+	+	—	+
4.12*	Sand receptacles	—	+	—	—
4.13	Fire smothering blankets	—	+	—	—
4.14*	Fireman's protective clothing and protective clothing for handling dangerous goods	+	+	—	—
4.15*	Portable safe manual lantern	+	+	—	—
4.16*	Breathing apparatus	+	+	—	—
4.17*	Lifeline	+	+	—	—
4.18	Portable fire motor-pumps	+	+	—	—
4.19*	International shore connection	—	+	—	—

Table 4.1.1 — continued

Nos.	Item of technical supervision	Installation and assembly			Mooring trials
		Check of documents and brands for materials and products	Check of assembly and arrangement onboard	Test by proof pressure	Check in operation including that in compliance with 4.3
4.20*	Foam concentrate	+	—	—	—
4.21*	Extinguishing medium	+	—	—	—
4.22	Spares and tools	+	+	—	—
4.23*	Gas analyser for vapours of oil products and for oxygen content	+	—	—	—
<p>¹ Operability of the system items shall be checked at random in association with the system. ² To be checked for operability on all ships.</p> <p>Note. * means equipment and products regulated by the International Convention for the Safety of Life at Sea, 1974. Symbols: "—" — to be carried out; "—" — not to be carried out.</p>					

4.1.2 General provisions for the organization of the technical supervision are given in Section 1.

4.1.3 Technical documentation.

4.1.3.1 Installation and testing of the fire-fighting equipment shall be performed under the Register technical supervision according to the RS-approved technical documentation.

4.1.4 Technical supervision of the Register.

3.1.4.1 Surveys during installation and testing of the fire-fighting equipment shall be performed according to the examination and testing plan developed by the shipyard according to 4.2.1 based on Table 4.1.1, taking into account 4.3.

4.1.5 Tests and checks specified in this Section are based on an assumption that the structures, systems and fire-fighting outfit have been tested at the firm (manufacturer) in compliance with the requirements of Section 4, Part IV "Technical Supervision during Manufacture of Products" of the Rules for Technical Supervision.

In case some tests were not conducted at the firm (manufacturer) and it is confirmed by an entry in the RS certificate, then these tests shall be conducted.

Additional checks and tests may be assigned by the surveyor upon results of examination of the fire-fighting means in substantiated cases.

4.2 SURVEY PLANNING

4.2.1 Prior to commencement of survey of the fire-fighting means of the ship under construction, the RS Branch Office shall agree the examination and testing plan developed by the shipbuilder taking into account Table 4.1.1. The shipbuilder shall be informed about that at a kick off meeting prior to commencement of construction according to 1.7.1 and with due regard to 4.3.

The builder shall agree to undertake ad hoc investigations during construction as may be requested by RS where areas of concern arise and the builder to agree to keep RS advised of the progress of any investigation. Whenever an investigation is undertaken, the builder shall be requested, in principle, to agree to suspend relevant construction activities if warranted by the severity of the problem.

4.2.2 During approval and agreement of the examination and testing lists a note shall be taken of specific published Administration requirements and interpretations of statutory requirements.

4.2.3 The shipyard shall be requested to advise of any changes to the activities agreed at the kick off meeting and these shall be documented in the examination and testing plan. E.g. if the shipbuilder chooses to use or change sub-contractors, or to incorporate any modifications necessitated by changes in production or inspection methods, rules and regulations, structural modifications, or in the event where increased inspection requirements are deemed necessary as a result of a substantial non-conformance or otherwise.

4.2.4 Quality standards for installation and testing of the fire-fighting means shall be reviewed and agreed during the kick-off meeting. The work shall be carried out in compliance with the RS rules and under the RS technical supervision.

4.2.5 Any changes to the kick-off meeting records shall be agreed and documented.

4.3 STRUCTURAL FIRE PROTECTION

4.3.1 The structural fire protection shall be checked against the RS-approved design documentation, in which the types of the applied fire-proof divisions, products and materials shall be indicated.

4.3.2 When surveying the fire-proof divisions and materials used for insulation, finishing and deck coverings of spaces, their compliance with the RS-approved drawings, as well as with the Type Approval Certificate/Type Approval Certificate for Fire-Proof Division shall be checked.

The RS surveyor is entitled to require submission of the relevant documents, confirming equivalence of substitutes accepted. In doubtful cases, the surveyor may require additional information, including test performance.

4.3.3 When surveying the fire doors (refer also to 4.2.2) and other closures of openings, the following shall be checked in fire-proof divisions:

- correct installation, operability and tightness of closing according to the instruction of the manufacturer;
- possibility of opening and closing doors by a single man's effort;
- operation of closing facility of the self-closing doors when activated from the door position and when remotely activated (if provided);
- operation of controls for opening and closing of skylights;
- operation of the fire ventilation dampers.

4.3.4 Availability and location of the fire control plans drawn up with the use of colour symbols in agreement with IMO resolution A.952(23), as well as the construction and marking of the enclosure for stowage of the duplicate set of the plans shall be checked.

4.4 FIRE EXTINGUISHING SYSTEMS

4.4.1 The systems shall be verified for compliance with the RS-approved documentation and for the presence of certificates or Type Approval Certificate for the equipment forming part of the systems.

Verification on board ship shall be carried out in accordance with Table 4.1.1.

In the process of verification of the system components for compliance with the requirements of the technical documentation, the requirements of 8.3.1.2 shall be met.

4.4.2 When checking the system components for correctness and reliability of arrangement, the requirements of 8.3.1.3 shall be met.

4.4.3 General.

4.4.3.1 These provisions cover the ship's systems referred to in Table 4.1.1.

The purpose of the operational tests of the systems is to verify their availability for immediate action, operability, compliance of their parameters with the RS-approved technical documentation.

4.4.3.2 Prior to operational test, all the fire extinguishing systems shall be completely assembled, supplied with organic equipment, instruments, spares and furnished with necessary technical documentation (instructions, data sheets, records and certificates), as well as with seals and brands.

4.4.3.3 Prior to operational test, the fire extinguishing systems shall be tested by test pressure according to Table 3.13.1, Part VI "Fire Protection" of the Rules for the Classification and Construction (refer to also the requirements of 8.3.1.8).

4.4.3.4 The operational testing of the systems shall be conducted in conformity with the RS-approved programs with the observance of the relevant instructions and guidelines on operation and maintenance of fire extinguishing systems.

4.4.3.5 If the systems are arranged for remote starting, the remote starting system shall be tested simultaneously with the fire extinguishing system.

4.4.3.6 Upon testing, the fire smothering systems shall be made operable (the supplies of extinguishing medium in bottles including the remote starting bottles shall be replenished).

4.4.3.7 Duration of testing the systems shall be sufficient for comprehensive check of their operability.

4.4.3.8 If a prototype ship is provided with a system which has not undergone major modifications against some earlier system arranged by the shipyard involved on a ship of a different type and already subjected to tests in accordance with the program for the prototype ship, testing of the system in accordance with the program for series-built ships may be accepted.

If a system, before being installed on board ships, underwent tests according to an agreed program, the amount of testing on board the prototype ship may be reduced.

4.4.3.9 In systems fitted with alarm to warn of the fire extinguishing medium release, operation of the alarm shall be checked and actual time of alarm operation until the system starting determined. At the same time, check shall be made on the possibility to evacuate a person in this interval of time from the remotest area of the protected space, as well as on the visibility and audibility of alarms from any area of the protected space with the machinery running.

4.4.3.10 In the water fire main and foam extinguishing systems, reliability of the remote and local starting of pumps shall be checked.

4.4.4 Water fire main system.

4.4.4.1 During the testing of the water fire main system, all the main fire pumps shall be put into operation; along with that, water delivered to the fire main shall be discharged through regular fire hoses and nozzles. Delivery of water to each consumer specified by the system shall be also checked.

4.4.4.2 Part of the fire hoses shall be connected to the remotest and highest hydrants.

4.4.4.3 On the prototype ship, two hydrants most distant in longitudinal extent and one hydrant most distant in vertical extent shall be fitted with pressure gauges to determine water pressure, which shall not be lower than that given in Table 3.2.1.1, Part VI "Fire Protection" of the Rules for the Classification and Construction.

4.4.4.4 On the prototype ship, the capability of ensuring the delivery of two water jets to any area of each space, deck and empty hold shall be checked visually.

4.4.4.5 Where the fire pumps are intended also for other fire extinguishing systems, simultaneous testing of these systems shall be conducted in conformity with the requirements of 3.2.1.11, Part VI "Fire Protection" of the Rules for the Classification and Construction and the sufficiency of water quantity and pressure for parallel operation of all systems shall be checked.

4.4.4.6 Where an emergency fire pump is provided on board, its operation for the intended purpose to supply the common fire main with the closed stop valves in accordance with the requirements of 3.2.4.6 and 3.2.4.7, Part VI "Fire Protection" of the Rules for the Classification and Construction shall be checked.

4.4.4.7 Tests of the permanently installed fire monitors shall be conducted to determine compliance with their specifications.

4.4.4.8 On ships with the water fire main systems kept permanently under pressure, subject to check are existence of pressure in the fire main and automatic actuation of the fire pump when the pressure in the system drops. On ships with remote starting of the pumps, delivery of water to the main without any additional openings of valves in the pump room shall be checked.

4.4.5 Sprinkler system.

4.4.5.1 The following shall be checked prior to the system testing:

existence of pressure in the system and pressure tank;

pressure at the remotest sprinklers in accordance with 3.3.2.2, Part VI "Fire Protection" of the Rules for the Classification and Construction.

4.4.5.2 On board ships, operability of the system shall be checked by delivering water through a special test valve on one of the control arrangements. In doing so, the following shall be checked:

.1 constancy of pressure in the system with the sprinkler pump running;

.2 operation of the pressure maintaining device and the tank water level control device, as well as the timeliness of automatic actuation of the sea water pump;

.3 operation of an alarm signal at the control arrangements, at the main fire control station and machinery space. At the main fire control station and machinery space the signal shall indicate section containing the test valve which has opened;

.4 operation of the non-return stop valve preventing the water from penetrating from the sprinkler system into the fire main.

After the testing, the system shall be filled with fresh water.

4.4.5.3 On the prototype ship, a test opening-up of at least three sprinkler heads shall be made, whereby the following shall be checked:

.1 constancy of pressure in the system with the sprinklers opened up and sprinkler pump running;

.2 operation of the pressure maintaining device and the tank water level control device as well as the timeliness of automatic actuation of the sea water pump;

.3 operation of an alarm signal at the control arrangements, at the main fire control station and machinery space. At the main fire control station and machinery space the signal shall indicate section containing the sprinkler which has opened.

4.4.5.4 Operability of equivalent sprinkler systems developed on the basis of the Guidelines adopted by IMO resolution A.800(19), as amended, is checked in compliance with the manufacturer recommendations according to the Register-approved program.

4.4.6 Pressure water-spraying system.

4.4.6.1 On prototype ships, the pressure water-spraying system shall be tested in operation; in doing so, the following shall be determined, where possible:

.1 uniform distribution of the sprayed water along the vertical extent and over the area of the protected space, as well as over the surfaces;

.2 agreement between the actual discharge of water provided by one spray nozzle and the design or rated one (a spray nozzle shall be chosen close to the water supply source).

4.4.6.2 On series-built ships, test shall be conducted by actuation of the system sections, and water from the spray nozzles may be carried off through a special water carrying-off arrangement.

4.4.7 Water-screen and drenching system.

4.4.7.1 The water-screen or drenching system on board the prototype ships shall be tested in operation to verify its capability of providing a solid water obstruction or of drenching the protected surfaces; in doing so, the following shall be checked:

.1 consistency between the obtained data of supply rate provided for in the RS-approved design for such systems;

.2 consistency of the actual water discharge and pressure of individual spray nozzles with the rated or design data (at random);

.3 operation of the automatic actuation of the pressure water-screen system (if provided).

On series-built ships, the test shall be conducted by actuation of a single system section, and water from the spray nozzles may be carried off through a special water carrying-off arrangement.

4.4.8 Foam fire extinguishing system.

4.4.8.1 On prototype ships, the foam fire extinguishing system shall be tested in operation; in doing so, the following shall be checked:

.1 availability of the Register Type Approval Certificate;

.2 content of the foam concentrate in water solution, %;

.3 solution pressure before the foam generating equipment;

.4 ensuring normal operability of a design number of the foam applicators or foam generators with at least two water nozzles operating simultaneously;

.5 foam or solution supply rate, in l/min•m²;

.6 foam expansion ratio and drainage time, if prototype tests of the foam-making equipment (monitors, foam applicators and/or foam generators) for type approval in accordance with 4.3.9 and 4.3.14, Part IV "Technical Supervision during Manufacture of Products" of the Rules for Technical Supervision have not been done or have been done using other type (make) of foam concentrate. Instead of testing onboard, these tests may be performed at the laboratory or by the manufacturer. The foam expansion and drainage time of the foam produced shall not differ more than ± 10 % of that determined in item 8 of Table 4.3.6 of the above mentioned Part;

.7 technical data of the fixed monitors and consistency of their technical documentation for manufacture with the specifications, as well as operation of the changing-over devices;

.8 arrangement of the monitors basing on the condition of supplying foam to any tank deck area.

4.4.8.2 On series-built ships, the percentage of foam concentrate in the solution in accordance with 4.4.8.1.2 shall be determined, and the entire system shall be checked for operability.

4.4.8.3 On series-built ships where foam of 1000:1 expansion ratio is used, it is necessary to check additionally the functioning of the foam generator discharge orifice closing device (refer to 3.4.3.2.6, Part VI "Fire Protection" of the Rules for the Classification and Construction).

Verification of the requirements in 4.4.8.1.5 and 4.4.8.1.6 shall be made by means of delivering foam by the changing-over device to a measuring tank during at least 30 s.

4.4.9 Carbon dioxide smothering system.

4.4.9.1 To be checked prior to the tests are the presence of brands and documents on the cylinders and tanks, correctness of laying the pipes to the protected spaces, absence of detachable joints if the pipes pass through the accommodation spaces.

4.4.9.2 During the test, the release valves shall be opened for each protected space, and through a test release of the compressed air at a pressure not lower than 0,5 MPa to each protected space in turn air outflow from all nozzles of the space concerned shall be checked.

The tests by releasing carbon dioxide, as specified in 4.4.9.5 and 4.4.9.6, may be dispensed with if there are system calculations confirming proper choice of the manifold, pipe and nozzle outlet diameters, as well as the absence of drastic pressure drops in the system when carbon dioxide flows through it.

4.4.9.3 On ships provided with the low-pressure system, it is necessary to check the pressure in tank and the liquid carbon dioxide level, as well as the actuation of alarm signals:

- at the relief valve operation pressure;
- when carbon dioxide penetrates into the protected space;
- when the level in the tank is lowered;
- in case of one refrigerating plant failure.

4.4.9.4 On prototype ships provided with the low-pressure system, it is necessary to check during the filling of the tanks with carbon dioxide:

- alarm to indicate lowering of the liquid carbon dioxide level;
- alarm to indicate failure of the refrigerating plant;
- agreement between the indications of the device for direct monitoring of the liquid carbon dioxide level and the indications of the remote-reading instrument;
- automatic change-over of the refrigerating plant from the main to emergency source of power as well as automatic starting of one plant when the other plant is rendered inoperative.

4.4.9.5 On prototype ships, the high-pressure system shall be tested by test supply of the rated amount of carbon dioxide into one of the protected spaces (machinery space or hold) with the duration of supply measured in accordance with 3.8.1.5, Part VI "Fire Protection" of the Rules for the Classification and Construction. In so doing, simultaneous opening of the valves of cylinders used in groups shall be ensured.

4.4.9.6 Operation of the breathing valves or their substitutes (refer to 3.1.2.6, Part VI "Fire Protection" of the Rules for the Classification and Construction) shall be checked.

4.4.9.7 Operation of the refrigerating plants of low-pressure system shall be checked (in the same manner as the operation of marine refrigerating installations).

4.4.9.8 Upon finalization of all the tests, at the surveyor's discretion, the cylinders may be subjected to random control weighing, or the amount of carbon dioxide shall be determined in a different approved way.

In the tanks of low-pressure systems, the amount of carbon dioxide shall be determined by special devices or instruments. It shall be not less than the rated one. Admissible deviation is 5 %.

4.4.10 Fire-extinguishing systems in machinery spaces and cargo pump rooms.

4.4.10.1 Test in operation for gas fire-extinguishing systems equivalent to carbon dioxide fire-extinguishing systems approved by RS in compliance with IMO circular MSC/Circ.848, as amended; water-based and water mist fire-extinguishing systems approved by RS in compliance with IMO circular MSC/Circ.1165, as amended, as well as fixed water-based local application fire-fighting systems approved by RS in compliance with IMO circular MSC.1/Circ.1387 shall be performed in compliance with the manufacturer's recommendations according to the Register-approved program.

4.4.11 Dry powder system.

4.4.11.1 On prototype ship, tests shall be carried out by putting one powder installation of the fully filled system into action.

In doing so, it is necessary to check: system for remote release from a local hose station; all the filings which may be remotely opened; time from the beginning of release until the moment when the powder emanates from the spraying gun (not exceeding 30 s); consistency between the spraying gun performance and the specified data.

Where monitors are available, their specified parameters shall also be checked.

4.4.11.2 On series-built ship, the system shall be checked by test release from one of the local hose stations with empty container. In such a case, the cylinders may contain compressed air.

4.4.12 Aerosol fire extinguishing system.

4.4.12.1 On prototype and series-built ships, it is necessary to check the arrangement of the generators of fire extinguishing aerosol (refer to 3.11.1.7 and 3.11.1.8, Part VI "Fire Protection" of the Rules for the Classification and Construction).

4.4.12.2 On prototype and series-built ships, tests shall be conducted by simulating start-up of the generators disconnected from the starting circuits.

During the tests, special simulators shall be connected instead of the generators. Along with that, it is necessary to monitor:

- visual and audible indication of the fire extinguishing remote control device;
- time delay and simulation of the generator start-up;
- disconnection of ventilation in the protected space; activation of the emergency alarm system in the protected space.

4.4.12.3 On prototype and series-built ship, it is necessary to check resistance of the system to false operation through connecting a special simulator of the starting unit to each starting circuit with the generators disconnected from the starting circuits.

The tests shall be conducted under operating conditions when all the consumers of electrical power are loaded to the practical maximum.

4.5 FIRE-FIGHTING OUTFIT, SPARE PARTS AND TOOLS

4.5.1 Subject to the Register technical supervision are completion, marking, location and attachment of the items of fire-fighting outfit, spare parts and tools referred to in Table 4.1.1.

During survey of fire-fighting outfit items, their compliance with Type Approval Certificate or certificates issued by the Register shall be checked.

4.5.2 During survey (according to sheet or List), it is necessary to check location of fire-fighting outfit, spare parts and tools in accordance with the RS-approved fire plans.

4.5.3 Portable fire motor-pumps shall be checked for reliable operation (refer to 5.1.17, Part VI "Fire Protection" of the Rules for the Classification and Construction) at the lightest seagoing draught.

5 MACHINERY

5.1 GENERAL

5.1.1 The provisions of this Section apply in technical supervision of the machinery listed in the RS Nomenclature.

The Section establishes the procedure of the technical supervision to be performed by the Register during installation and testing of machinery on board the ship.

5.1.2 General provisions for the organization of the technical supervision are given in Section 1.

5.1.3 For the purpose of this Section, the following abbreviations have been adopted:

ICE — internal combustion engine;

MGTI — main geared turbine installation;

GTI — gas turbine installation;

GT — gas turbine;

TDC — top dead centre;

BDC — bottom dead centre;

MODU — mobile offshore drilling unit;

AT — astern turbine;

LPC — low-pressure compressor;

HPC — high-pressure compressor;

CCP — controllable pitch propeller.

5.1.4 Based on the tables and requirements of this Section, the shipyard shall elaborate and agree with the RS Branch Office the examination and testing plan accounting for the construction process of a particular ship at the shipyard concerned (refer to 13.3, Part I "General Regulations for Technical Supervision" of the Rules for Technical Supervision). The shipyard shall be informed about that at the kick-off meeting prior to commencement of construction (refer to 5.2.1 with regard to 5.3).

5.1.5 Prior to installation, the RS surveyor shall check the presence of the RS-approved documentation as required by Parts I "Classification", VII "Machinery Installations" and IX "Machinery" of the Rules for the Classification and Construction.

5.1.5.1 Quality standards of the shipyard (or machinery manufacturer) for installation and testing of the ship machinery shall be reviewed and agreed prior to commencement of technical supervision (refer also to 4.3).

5.1.6 When surveying the installation, it is necessary to check compliance with the requirements of the RS-approved technical documentation, as well as of the Rules for the Classification and Construction imposed on the equipment of machinery spaces, control stations, arrangement of passageways, means of escape and ladders, free access for maintenance and repair of machinery, boilers, piping, fittings, etc.

5.1.7 When installing electrified equipment, the requirements of Section 10 shall be met.

5.1.8 Pipelines of the machinery and machinery installations shall be verified and subjected to hydraulic tests in accordance with the requirements of Section 8.

5.1.9 Surveys of the automatic control, monitoring, alarm and protection systems for the machinery shall be carried out in accordance with Section 12.

5.1.10 The RS surveyor shall ascertain that the machinery has documents confirming manufacture thereof under the technical supervision of the Register (refer also to 5.1.12).

5.1.11 Numerical values for test modes and duration, as well as numerical criteria for installation works given in this Section are provided for reference. Prior to commencement of construction, other quality criteria given in the recognized national or international standards, or manufacturers' documents/instructions may be agreed with the RS Branch Office.

5.1.12 Tests and checks specified in this Section are based on an assumption that the machinery has been tested at the firm (manufacturer) in compliance with the requirements of Section 5, Part IV "Technical Supervision during Manufacture of Products" of the Rules for Technical Supervision and have the documents confirming their manufacture and testing under the Register technical supervision.

5.1.13 In case some tests were not conducted at the firm (manufacturer) and it is confirmed by an entry in the RS certificate, then these tests shall be conducted.

Additional checks and tests may be assigned by the surveyor upon results of examination of the machinery in substantiated cases.

5.2 SURVEY PLANNING

5.2.1 Prior to commencement of survey of the machinery of the ship under construction, the RS Branch Office shall agree the examination and testing plan developed by the shipbuilder taking into account 3.3. The shipbuilder shall be informed about that at a kick off meeting prior to commencement of construction according to 1.7.1.

The builder shall agree to undertake ad hoc investigations during construction as may be requested by RS where areas of concern arise and the builder to agree to keep RS advised of the progress of any investigation. Whenever an investigation is undertaken, the builder shall be requested, in principle, to agree to suspend relevant construction activities if warranted by the severity of the problem.

5.2.2 During approval and agreement of the examination and testing lists a note shall be taken of specific published Administration requirements and interpretations of statutory requirements.

5.2.3 Quality standards for installation and testing of the machinery shall be reviewed and agreed during the kick-off meeting. The work shall be carried out in compliance with the RS rules and under the RS technical supervision.

5.2.4 Any changes to the kick-off meeting records shall be agreed and documented.

5.3 GENERAL PROVISIONS FOR THE TECHNICAL SUPERVISION DURING INSTALLATION OF MACHINERY

5.3.1 When installing machinery on seatings, the quality of retention of the bench assembly shall be checked; in doing so, use shall be made of the bases, method of attachment and method of control, admissible deviations and initial data specified by the shipyard or manufacturer and which make it possible to carry out installation and control without stripping down the sets.

5.3.2 It shall be confirmed that the installation and mounting of the main machinery on board the ship is performed upon finalization of all assembly and welding operations on the ship's hull in way of the machinery and boiler compartment.

5.3.3 The machinery is attached to the seating by the method agreed with the Register. When the procedure for installation and mounting of the main machinery is agreed, the recommendations given in Appendix 2 to this Section may be taken into account.

5.3.4 No matter what the method of mounting the machinery on seating, the following requirements shall be met:

.1 holes in the seatings used for the fastening bolts shall be so arranged that the distance from their centres to the edge of seatings, stiffeners or vertical plates is not less than 1,5 the bolt diameter;

.2 joints by tightly fitted bolts shall be made to shrinkage fit tolerances with marking of the bolts in their positions;

.3 bolt heads and nuts shall fit tightly to one another, for which purpose the places where the bolt heads and nuts fit against the seatings and feet or frames of machinery shall be undercut, with the perpendicularity to the hole axis being observed, to a depth not exceeding 10 % of the thickness of the machinery foot and machinery frame and seating flange;

.4 fastening bolt tightening forces shall comply with the requirements of drawings;

.5 fastening bolts and nuts shall be reliably protected against working loose;

.6 pipes, cables, etc. shall be connected to the completely attached machinery without any tension, angularity and displacement of the coupling flanges and other joint components.

5.3.5 Irrespective of the mounting and aligning methods of the main machinery, final check of these operations shall be carried out while the ship is afloat.

Any deviations from the RS-agreed procedure of installation and mounting of machinery shall be agreed with the Register in each particular case upon submission of the relevant technical background.

5.3.6 During technical supervision of the mounting of the attached machinery, piping equipment, fittings and instruments removed from the engine during transportation, it is necessary to make sure that they were installed having regard to the requirements of drawings and that, after assembly, their joints were subjected to tightness test.

5.4 MAIN AND AUXILIARY INTERNAL COMBUSTION ENGINES OF POWER OUTPUT 55 kW AND OVER

5.4.1 Surveys during mounting and testing of the engines on board the ship shall be performed according to Table 5.4.1.

Table 5.4.1

Nos.	Item of technical supervision	Types of verification				
		Review of documents and visual examination	Check of mounting	Trials		
				hydraulic and tightness	mooring	sea
1	Installation on seating	+	+	—	—	—
2	Assembly and alignment of engine	+	+	—	—	—
3	Alignment of engine	—	+	—	—	—
4	Mounting of attached machinery	+	+	+	—	—
5	Tests of alarm and protection systems	+	+	—	+	+
6	Tests of machinery and accessories supporting operation of engine	+	+	—	+	+
7	Operational tests of engine	+	+	—	+	+

5.4.2 During survey of the mounting of the main engines installed on board the ship as a unity set, the scope of supervision may be restricted by items 1, 3, 5, 6 and 7 of Table 5.4.1.

5.4.3 When the main engine is installed on board the ship in knock-down form, it is necessary to check the assembly operations in accordance with the procedure of the manufacturer, beginning from the mounting of the bed plate.

The method of check and accepted deviations of the bed plate from rectilinearity and planeness shall be established by the engine manufacturer.

5.4.4 Technical supervision over the correctness of the assembly and alignment of the engine components and units shall consist in verification of the compliance of the mounting clearance with the manufacturer's recommendations or data obtained on the manufacturer's bench.

The check shall be performed by verification of the clearance tables submitted by the manufacturer and by selective measurements.

5.4.5 Alignment of the crankshaft (flange joint) with the thrust shaft or reduction gear shall be checked simultaneously with the alignment of the shaft line or thereafter.

The procedure of checking the alignment shall be specified depending on the design and location of the thrust bearing, flywheel, coupling and the method of checking in the workshop and during mounting.

Alignment of the main engine with the shaft line or reduction gear shall be checked simultaneously with the alignment of the shaft line or thereafter.

Alignment of the engine or reduction gear with the shaft line shall be performed in accordance with the requirements of Section 6.

5.4.6 In case of rigid connection of the aligned shafts, deviations from the rectilinearity of the bed plate, fit of the crankshaft journals to the bearings, deformation of the crank throws (crank web deflection), run-out of the adjacent journals of the crankshaft and shaft mated therewith shall not exceed values specified by the engine manufacturer.

5.5 AUXILIARY INTERNAL COMBUSTION ENGINES OF POWER OUTPUT BELOW 55 kW

5.5.1 Survey during mounting of the auxiliary ICE intended for connection with the driven machinery by means of non-rigid joint as well as engines mated with the driven units at the firm (manufacturer) and installed on board ship shall be carried out in accordance with items 1 and 7 of Table 5.4.1.

During survey of mounting of the auxiliary ICE mated rigidly with the driven units on board ship, it is necessary to check also the alignment of shaft on common bed plate.

5.6 MAIN STEAM TURBINES AND ELECTRIC GENERATOR TURBINES

5.6.1 Survey during mounting and testing of main turbines and geared turbine installations on board the ship shall be carried out in accordance with Table 5.6.1.

Table 5.6.1

Nos.	Item of technical supervision	Types of verification				
		Review of documents and visual examination	Check of mounting	Trials		
				hydraulic and tightness	mooring	sea
1	Installation of turbines, reduction gears on seating	+	+	—	—	—
2	Installation of controls, attached machinery and devices	+	+	—	+	+
3	Alignment of turbines with shaft lines and reduction gears	+	+	—	—	—
4	Systems, machinery and devices supporting the unit	+	—	+	+	+
5	Check in operation	+	—	—	+	+

5.6.2 When checking the mounting of the MGTI and electric generator turbines on seating it is necessary to be guided by the requirements of the RS-approved drawings.

5.6.3 The turbines and geared turbine installations delivered assembled (as unity sets) to ships shall be subjected to check as follows:

.1 installation of the turbine casing and reduction gear on seating on the load gauges shall be checked with the bench loads represented thereon; along with that, it is necessary to check the engagement contact in the gearing and alignment of the turbine and reduction gear with the installed ship's shafting in accordance with the provisions of Section 6.

The installation may be performed also by other method approved by the Register;

.2 fitting of the chocks (shims) to the turbine casing flanges, reduction gear to the seating shall be checked by feeler gauge and by blueing;

.3 alignment of the turbine and reduction gear and installation thereof on seatings shall be checked;

.4 all the checks shall be performed with the pipes connected;

.5 displacement and sag of the turbine rotors shall be checked;

.6 condition of the sliding supports of the turbines and clearances therein shall be checked.

5.6.4 When checking the installation of the controls, attached machinery and devices on the turbine set, it is necessary to make sure that:

.1 the upper part of the stator has been fastened by standard bolts and studs;

.2 the manoeuvring and isolating, shut-off and nozzle, throttle and bleed valves, servomotors, slides and overspeed devices, regulators and their actuators, as well as all other steam distribution, regulation and protection devices have been installed in conformity with drawings and marking;

.3 the condenser has been fastened with the tightness of the detachable joints ensured and the installation of its spring supports and piping allows sufficient mobility during thermal displacements of the turbine and condenser;

.4 fixing of the casing expansion and axial rotor position indicators corresponds to the cold state of the turbine;

.5 mounting of the pipes connected to the turbine set has been carried out with due regard to the possibility of compensating for the thermal elongation of pipes and turbine casings;

.6 fasteners for the mounting of assemblies operating under high temperature conditions have no thread damages, deformations and other defects.

5.6.5 The alignment of the turbine rotors with reduction gear by half-couplings shall be checked with the use of two pairs of pointers or by other RS-approved method which precludes axial displacement of the rotors and reduction gear shafts; in doing so, it is necessary to make sure that:

.1 the turbine set has been completely attached to the seating;

.2 appropriate measures have been taken to preclude misalignment during thermal displacements of the turbine casings on movable supports;

.3 actual angularities and displacements of the shafts to be aligned do not exceed those given in drawings;

.4 the alignment of the reduction gear shaft with the shaft line has been performed in accordance with Section 6.

5.6.6 Where the turbine sets are delivered to ship in knock-down form or when these are repaired on board ship, the verification thereof shall be based on the appropriate requirements of Part IV "Technical Supervision during Manufacture of Products" of the Rules for Technical Supervision.

5.7 AUXILIARY STEAM TURBINES

5.7.1 Surveys during mounting and testing of the auxiliary steam turbines shall be performed according to Table 5.6.1.

5.8 GAS TURBINE ENGINES AND ELECTRIC GENERATOR GAS TURBINES

5.8.1 Survey of GTI and electric generator gas turbines shall be performed according to Table 5.6.1.

5.8.2 The requirements for fastening, mounting, as well as other provisions set out in 5.3 and 5.6 cover the GTI depending on the type and purpose thereof.

5.8.3 The control over the fastening of the GTI casings to seating shall consist in verification that the requirements of the manufacturer stemming from the design features of the units and the requirements of drawings have been met.

5.8.4 The alignment of the GTI sets with one another, with the thrust bearing and with the shaft line shall be checked with the measurements of angularities and displacements of the shaft axes; along with that, it is necessary to make sure that:

.1 the deformation measured with the use of rules, strings, hydrostatic levels, optical devices and other means with an accuracy not less than 30 % of the established tolerance does not exceed values specified by the manufacturer of the set;

.2 the alignment of the shaft line with the GTI sets or the main thrust bearing (unless it is incorporated into the GTI) shall be carried out in accordance with the requirements of Section 6;

.3 the shafts of the GTI sets have been installed in axial direction in positions specified in the service log (if the service log contains no instructions, the shafts shall be shifted to mid-position) with clearances for thermal expansion ensured;

.4 the mutual position of the shafts to be aligned corresponds to the marking;

.5 the GTI frame has been properly fastened to the gas vent housing and the latter has been properly fastened to the seating;

.6 the gas vent housing is clean.

5.9 GEARS AND DISENGAGING COUPLINGS OF MAIN MACHINERY

5.9.1 Survey during mounting and testing of the gears and disengaging couplings of the main machinery on board the ship shall be performed in accordance with Table 5.9.1.

5.9.2 Mounting of the gears and disengaging couplings of the main machinery, alignment with the engine and shaft line on board the ship shall be performed in accordance with the RS-approved drawings depending on their type and design and with due regard to the manufacturer's recommendations (refer also to 5.6.5).

5.9.3 During survey of the gears and couplings, particular attention shall be given to fastening of the assemblies and components to the driving and driven shafts involved in transmitting torque; installation of shafts and couplings shall provide for necessary clearances uniformly distributed around the entire circumference of the driving and driven parts with the couplings in disengaged position.

Table 5.9.1

Nos.	Item of technical supervision	Types of verification				
		Review of documents and visual examination	Check of mounting	Trials		
				hydraulic and tightness	mooring	sea
1	Installation of gears and disengaging couplings on seating	+	+	+	—	—
2	Alignment with shaft line	+	+	—	—	—
3	Check in operation	+	—	—	+	+

Once the shaft line flanges or other power consumer have been connected with the gear, it is necessary to check the gearing teeth-contact pattern which shall not be less than specified in Part IV "Technical Supervision during Manufacture of Products" of the Rules for Technical Supervision.

5.10 GEARS OF AUXILIARY MACHINERY

5.10.1 Survey during mounting and testing of the gears of the auxiliary machinery on board the ship shall be performed in accordance with the requirements of 5.9 and Table 5.9.1, depending on the gear type.

When checking the gear engagement contact, the teeth-contact pattern shall not be less than specified in Part IV "Technical Supervision during Manufacture of Products" of the Rules for Technical Supervision.

5.11 AUXILIARY MACHINERY

5.11.1 Survey during mounting and testing of the auxiliary machinery on board the ship shall be performed in accordance with Table 5.11.1.

5.11.2 Technical supervision during the mounting and testing of the auxiliary machinery driven by the main machinery shall be performed during the survey of the main machinery.

5.11.3 The methods of installing the auxiliary machinery on seating, as well as the methods of checking the quality of the mounting and alignment shall comply with the manufacturer's requirements and the RS-approved drawings.

5.11.4 When checking the alignment of the auxiliary machinery installed on common bed plate and the machinery installed directly on seating, it is necessary to make sure that they have been securely fastened.

Table 5.11.1

Nos.	Item of technical supervision	Types of verification				
		Review of documents and visual examination	Installation on seating	Alignment	Trials	
					mooring	sea
1	Starting air compressors	+	+	+	+	+
2	Turbochargers	+	+	+	+	+
3	Main boiler blowers	+	+	+	+	+
4	Pumps:					
	cooling water pumps of main engines	+	+	—	+	+
	circulating pumps of main condensers	+	+	—	+	+
	lubricating oil pumps of main diesel engines and turbines	+	+	—	+	+
	boiler feed water pumps	+	+	—	+	+
	condensate pumps	+	+	—	+	+
	boiler burner pumps	+	+	—	+	+
	fuel oil transfer pumps	+	+	—	+	—
	bilge pumps	+	+	—	+	—
	fire pumps	+	+	—	+	—
	ballast pumps	+	+	—	+	—
	cargo pumps	+	+	—	+	—
5	Motor-pumps:					
	fire motor-pumps	+	+	—	+	—
6	Steam-jet ejectors of condensers	+	+	—	+	+
7	Circulating pumps of waste-heat boilers	+	+	—	+	+
8	Oil fuel and lubricating oil separators	+	+	—	+	+
9	Bilge ejectors	+	+	—	+	—
10	MODU submerged replenishment pumps	+	+	—	+	+
11	Arrangements for lifting and lowering of:					
	MODU	+	+	—	+	+
	MODU pipes	+	+	—	+	—

5.11.5 Coaxiality of the shafts of machinery delivered to ship aligned on a common bed plate may be checked subject to availability of the machinery manufacturer's requirements or in cases of possible misalignment.

5.11.6 Coaxiality of the shafts of mated machinery with the drive and actuating mechanism enclosed in a single casing shall generally not be checked.

5.11.7 When checking the alignment of the auxiliary machinery, their disalignment, depending on the joint type, shall not exceed the standards specified in the drawings.

5.12 DECK MACHINERY

5.12.1 Survey during mounting and testing of the deck machinery on board the ship shall be performed in accordance with Table 5.12.1.

5.12.2 Technical supervision during the mounting, installation and testing of the electrical equipment, systems, pressure vessels, hydraulic and diesel engine drives used in the deck machinery shall be performed in accordance with the relevant sections of the Guidelines.

Table 5.12.1

Nos.	Item of technical supervision	Types of verification				
		Review of documents and visual examination	Mounting on seating	Alignment	Trials	
					Mooring	sea
1	Steering gears	+	+	+	+	+
2	Windlasses and anchor capstans	+	+	+	+	+
3	Mooring capstans and winches	+	+	—	+	—
4	Winches:					
	towing	+	+	+	+	+
	boat	+	+	—	+	—

5.12.3 Before the deck machinery is installed onboard ship, the following shall be checked:

- .1 availability of brands and documents according to the supervision type established by the RS Nomenclature;
- .2 completeness of delivery.

5.12.4 Upon completion of the mounting work, the deck machinery shall be examined in order to scrutinize quality of the mounting and to verify its compliance with the RS-approved working drawings for installation.

5.13 MECHANICAL TELEGRAPHS

5.13.1 When surveying the mechanical telegraphs, it is necessary to check the correctness in executing orders to go ahead and to go astern, alternately, in all ranges.

5.13.2 It is necessary to check the interlocking device, which ensures correctness in executing the given order.

5.14 FANS OF MACHINERY AND OTHER SPACES

5.14.1 Mounting of the fans shall be performed in accordance with the drawings and the requirements of 5.11.

5.14.2 Surveys during mounting and testing of the fans on board the ship shall be performed in accordance with the RS-approved program.

5.15 MOTORS AND PUMPS OF HYDRAULIC SYSTEMS

5.15.1 Mounting of the motors and pumps of hydraulic systems on board the ship shall be performed in accordance with the requirements of 5.11 and drawings.

5.15.2 Surveys during mounting and testing of the motors and pumps of hydraulic systems on board the ship shall be performed in accordance with the RS-approved program together with the systems, which incorporate them.

5.16 MOORING TRIALS

5.16.1 General.

5.16.1.1 Operational tests of the main and auxiliary machinery on mooring trials are aimed at verifying the quality of their mounting and adjusting, as well as verifying the readiness of this machinery for the sea trials of the ship.

5.16.1.2 The mooring trials of machinery and sets shall be conducted in the presence of the RS surveyor in accordance with a program approved by the Register.

5.16.1.3 Machinery and equipment, which survey does not require putting the ship to sea trials, shall be definitely tested in operation on mooring trials.

5.16.1.4 When verifying machinery in operation on the mooring trials, the checks of machinery area may be combined with checks of electrical and ship's service areas.

5.16.1.5 Mooring trials of electrified auxiliary machinery may be conducted with power supply from the shore-based power sources.

5.16.1.6 In case of forced interruptions in operation of the machinery during their trials, on the agreement with the RS surveyor, a decision shall be taken to continue the operation mode, to increase its duration or to repeat it with due account of the causes of the machinery stopping.

5.16.1.7 It is necessary to take down the values of the propulsion plant parameters and to check compliance thereof with the specified ones.

5.16.1.8 The machinery shall be submitted to mooring trials upon finalization of mounting work, verification of the quality of mounting, assembly and adjustment in association with systems and devices.

5.16.1.9 During the mooring trials, it is necessary to check the manual, remote and automatic control, check the instruments, mechanisms, protection, interlocking and alarm devices in operation for their designated purposes, as well as to check the facilities for communications between the machinery space and navigation bridge and other control stations.

5.16.1.10 When testing the remote and automatic systems, alarm and protection systems, the requirements of Section 12 shall be met.

5.16.2 Main and auxiliary ICE.

5.16.2.1 Tests of the machinery, devices and systems supporting operation of the engine shall precede testing of the engine in order to check their availability for operation; whilst so doing, the following systems shall be checked together with machinery, devices, apparatus and facilities: lubricating oil, water cooling, fuel oil, starting air, exhaust gas.

5.16.2.2 Starting properties of the engine shall be checked on the engine prepared for operation as required by the manufacturer's manual; in so doing, the following parameters shall be checked:

- .1 ambient temperature in machinery space;
- .2 water temperature in cooling system;
- .3 lubricating oil temperature in lubrication system;
- .4 number and sequence of starts and reversals without replenishment of air receivers (in case of reversible engines, starts shall be performed alternately between ahead and astern);
- .5 продолжительность пусков и реверсов;
- .6 duration of starts and reversals;
- .7 minimum pressure in air receivers that provides starting;
- .8 number of starts and voltage of storage battery at the beginning and end of the tests in case of electrically started engines.

5.16.2.3 When the engine operates in the modes stipulated by the program approved by the Register, it is necessary to check the following parameters:

- .1 power output;
- .2 speed;
- .3 gas temperature in exhaust piping;
- .4 water temperature and pressure in cooling system;
- .5 pressure and temperature in lubrication system, delivery of cylinder oil;
- .6 back pressure in exhaust piping;

- .7 temperature of air entering the engine;
- .8 barometric pressure;
- .9 compression pressure in cylinders;
- .10 maximum combustion pressure;
- .11 mean indicated pressure;
- .12 exhaust gas temperature by cylinders;
- .13 scavenging air pressure (in case of two-stroke engines);
- .14 cooling water temperature at cylinder outlet;
- .15 lubricating oil temperature at cooler inlet and outlet;
- .16 fluid pressure and temperature at inlet of piston cooling system;
- .17 fluid temperature at outlet of piston cooling system (by cylinders);
- .18 temperature at cooler inlet and outlet in closed cooling system;
- .19 speed of independently-driven air blowers and turbochargers;
- .20 air pressure in scavenging manifold;
- .21 exhaust gas pressure and temperature at gas turbine inlet;
- .22 air temperature at air cooler inlet and outlet;
- .23 pressure (vacuum) in crankcase;
- .24 fuel oil temperature and viscosity at engine inlet.

5.16.2.4 Parameters shall be measured at the steady thermal state of the engine not less than twice in the operation modes with a duration not over than 2 h and at least once during the subsequent full 2 h or part thereof.

5.16.2.5 Some parameters need not be measured if the design of the engine or set eliminates the possibility of making the measurements.

5.16.2.6 Test modes of ICE on mooring trials shall be determined from Appendix 1 to this Section.

The duration of the mode-to-mode transfer shall depend on the thermal state of the engine and termination of all transients.

5.16.2.7 Engines of diesel-electric ships, as well as engines driving CPP or tested with the use of loading devices may be checked during the mooring trials in the sea trials modes and the findings at the rated power and speed shall be consistent with the engine specifications and bench test data.

5.16.2.8 When testing speed governors and over-speed devices of the main and auxiliary engines, it is necessary to check stability of their operation, as well as consistency of their characteristics with the requirements of the RS-approved documentation in case of manual or remote (non-automatic) control of the speed governors. Subject to checking are the following:

- .1 the value and duration of the dynamic over-speeding when the load changes abruptly. Change of the load shall be determined depending on the purpose of the diesel installation, method of transmitting power to the consumer and availability of special requirements for the installation concerned in the RS-approved documentation;
- .2 the statistical error of the engine speed governing system shall be determined by changing the load on the engine from 0 to 100 % of the rated load at unchanged speed setting of the governor (for the static governors only);
- .3 the stability of maintenance of the set speed (insensitivity of the governing system);
- .4 the possibility of obtaining, with the use of governor, a stable speed over the entire range of speed changing;
- .5 the power distribution among the engines operating in parallel only with the use of the speed governors;
- .6 the operation of devices built in the governor or connected directly therewith and intended to limit the maximum fuel feed depending on various parameters (e.g. during starting of engine, low pressure of scavenging air, depending on the set or true speed, etc.), as well as operation of devices precluding operation of the engine within the critical speed zone and devices limiting the engine load (CPP).

5.16.3 Main and auxiliary steam turbines and turbine installations.

5.16.3.1 During the mooring trials the following shall be checked:

- .1 absence of steam leaks in the turbine joints;
- .2 absence of abnormal noise during starting and operation of the turbines and reduction gears;
- .3 absence of leaks and watering of the lubricating oil;
- .4 performance of the expansion joints on the main steam line, manifolds and other steam pipes;
- .5 performance of the movable supports of turbines and condensers;
- .6 operation of the steam suction and gland-sealing system during manual and automatic regulation;
- .7 operation of the blowing system to ensure complete removal of condensate from all stages and spaces of the turbine;
- .8 steadiness in maintaining the required vacuum in the condenser;
- .9 time of free run-out and sufficiency of lubricating oil for the time of run-out;

- .10 performance of the chokes on the branches of the circulating lubrication line;
 - .11 operation of the overspeed devices and speed governor in conformity with 5.16.2.8.
- 5.16.3.2** When the installation operates in steady thermal modes, it is necessary to note:

- .1 turbine and propeller (generator) speed;
- .2 pressure and temperature of the live steam;
- .3 stem pressure in the intermediate stages and bleed chambers of turbines;
- .4 steam pressure in the gland-sealing system and vacuum in the suction chambers;
- .5 vacuum in the condenser;
- .6 lubricating oil pressure in the lubrication and regulation system;
- .7 lubricating oil temperature at oil cooler inlet and outlet;
- .8 axial position of the rotor and thermal expansion of the turbine casings;
- .9 condensate temperature, level and salinity in the condenser.

5.16.4 Main and auxiliary gas turbines and gas turbine installations.

5.16.4.1 During the mooring trials of GTI, it is necessary to check the following characteristics with due account of the GT design:

- .1 free rotation of the turbine rotors by measuring the run-out time during turbine motoring;
- .2 operation of the starting devices of the GTI and the starting and main fuel oil systems;
- .3 steady maintenance of the set rates throughout the whole range of operating speed;
- .4 reliability of the actuation and shut-down of the necessary units in the "starting", "operation", "stop" and "manoeuvring" modes;
- .5 operation of the unified control of GTI and CPP;
- .6 absence of gas leaks through the joints of the turbines and compressors in all operation modes;
- .7 reliable performance of the end seals of the turbines and compressors the total air leaks through which shall not exceed 1,5 % of the low-pressure compressor capacity;
- .8 automatic reduction of the fuel supply when the gas temperature before the turbine nozzles exceeds the allowable one;
- .9 steady burning of the fuel in all the operating modes of GTI; ease of maintaining the installation and possibility of replacing the burners and inspecting the flame tubes without the installation being out of action;
- .10 effectiveness of cleaning the burners, regenerators, compressors and turbines without the necessity of stopping the GTI by methods recommended by the firm (manufacturer);
- .11 absence of the compressor surge and vibration of the installation components, induced by the GTI operation;
- .12 absence of the critical speed zone within 120 % of the GTI maximum speed;
- .13 possibility of the GTI operation without any limitation in time with the power not less than 20 % of the rated power at full interruption of the water supply to the air cooler;
- .14 steady continuous astern operation of the AST during not less than 15 min with a speed not less than 70 % of the rated speed and with power not less than the rated ahead power;
- .15 time required for transfer to operation of one GT where more than one GT driving a single propeller shaft are available;
- .16 time required for resetting the valves from the "full ahead" to "full astern" position for GTI with AST;
- .17 reliable starting and operation of GTI at the CPP fixed pitch;
- .18 operation of the torsionmeter within the operating speed;
- .19 automatic reduction of fuel supply when the lubricating oil pressure drops and interruption of fuel supply when the speed exceeds the permissible value;
- .20 air pressure in the systems:
 - turbine overspeeding protection;
 - reversing device control;
 - AST friction clutch control;
 - air lead tape control;
 - starting;
 - LPC, HPC space relieving;
- .21 smooth growth of the electric starter current during 4 — 6 s:
 - during motoring,
 - during false starting,
 - during starting;
- .22 time required for GTI to be put on idling mode;
- .23 HPC idling speed;
- .24 LPC idling speed.

5.16.4.2 When testing machinery, devices and systems supporting the GTI, it is necessary at the same time to check correctness of their mounting and adjustment, as well as readiness of the GTI for operational tests; along with that it is necessary to check:

- .1 operation of the fuel oil, lubricating oil, water cooling and air systems with supporting machinery, instruments, apparatus and devices;
- .2 shaft-turning gear and its interlocking with the GTI starting device;
- .3 proper performance of the local and remote control, alarm and protection systems;
- .4 reliability of the local and remote control and operation of the quick-closing devices for emergency shut-down of GTI in any operation mode;
- .5 operation of the device preventing the burners to be removed unless the fuel oil and gas are preliminarily shut off;
- .6 possibility of igniting the fuel oil in other chambers from the chamber with ignition unit where the combustion chambers are of modular construction;
- .7 operation of the reduction gear and shafting brakes;
- .8 presence of the clearance for thermal expansion of the gas vents and other piping connected to GTI, and the tightness thereof;

During the tests it is necessary to note:

parameters defining the operation of the speed governors and overspeed devices of GTI in accordance with 5.16.2.8:

- temperature of the working medium at various cycle points;
- thermal expansion of the GTI casings from the standard indicators;
- pressure and temperature of the lubricating oil, cooling water and fuel oil.

5.16.5 Main gearing.

5.16.5.1 Gearing, reduction gears and disengaging couplings when checked in operation during mooring and sea trials in association with main machinery and sets shall operate without extraneous noise and impermissible heating of the components and bearings; along with that, it is necessary to check:

- .1 pressure and temperature of the medium in the lubrication, control and protection systems;
- .2 operation of the emergency alarm and protection systems;
- .3 operation and interlocking of the shaft-turning gear;
- .4 performance of the emergency connections between the driving and driven parts of the gearing for maintaining the running mode.

Where malfunctions have been detected during the mooring trials, the RS surveyor may require the gearing to be opened up in order to elucidate the causes of malfunctions.

5.16.6 Auxiliary machinery.

5.16.6.1 Each machinery shall be subjected to trials in accordance with Table 5.11.1.

5.16.6.2 Pumps of all types and purposes shall be tested in operation for their intended service, in steady mode, with the characteristics close to the specified ones; along with this, it is necessary to check the following parameters:

- .1 power consumption;
- .2 capacity (if necessary);
- .3 speed;
- .4 pressure, head;
- .5 suction vacuum.

5.16.6.3 During operational tests of the pumps it is necessary to check:

- .1 control from local and remote positions;
- .2 availability of the instrumentation and their working life;
- .3 operation of the lubricating and cooling devices, gland seals and self-priming devices;
- .4 operation of the safely and by-pass devices and reliability of the measures taken to prevent hydraulic impacts;
- .5 tightness of the pipe connections and pump casing joints.

5.16.6.4 Air compressors of all types shall be tested in operation for their intended service, with characteristics close to the specified ones; along with that, it is necessary to check:

- .1 consumed power;
- .2 compressed air pressure after each stage;
- .3 air temperature at the cooler outlet;
- .4 temperature and pressure in the cooling system;
- .5 temperature and pressure in the lubrication system.

5.16.6.5 During the compressor testing it is necessary to check:

- .1 operation of the alarm and protection system;
- .2 operation of the local and remote control devices and ease of handling them;
- .3 safety valves;
- .4 time required to fill the air receiver by air and the capacity.

5.16.6.6 Blowers, fans, chargers of all types and purposes, as well as fuel oil and lubrication oil separators shall be tested in operation for their intended service; along with this the following parameters shall be checked for compliance with the specifications:

- .1 consumed power;
- .2 capacity;
- .3 effectiveness of operation in conformity with the design purpose;
- .4 other characteristics stemming from the specifications depending on the design features of the machinery.

5.16.6.7 It is necessary to check operation of the local and remote auxiliary machinery control systems.

5.16.6.8 Shaft generators, generators and electric motors being part of the unitized machinery, as well as the driving devices and gearing shall be tested together with the machinery in conformity with their purpose.

5.16.7 Steering gear.

5.16.7.1 The steering gear shall be tested as a part of the rudder steering arrangement in accordance with its purpose; the following shall be checked:

- .1 time required to put the rudder by the main, spare, emergency and hand-operated steering gear;
- .2 protection against overload, reverse rotation and operation of the braking devices;
- .3 operation of the limit switches and rudder indicators;
- .4 operation of the automatic alarm and protection devices;
- .5 operation of the control stations;
- .6 forces applied to the handles;
- .7 time required to change over from the main to spare, emergency or hand-operated steering gear;
- .8 continuous shifting the rudder from hard over to hard;
- .9 steady keeping the rudder on the course.

5.16.8 Windlasses and anchor capstans.

5.16.8.1 The windlasses and anchor capstans shall be tested as part of the anchor arrangement; the following shall be checked:

- .1 heaving-in speed of the anchor chain;
- .2 possibility of adjusting the heaving-in speed of the anchor chain;
- .3 operation of the disengaging couplings;
- .4 operation of the torque-limiting clutch;
- .5 operation of the brakes;
- .6 operation of the alarms and protection devices;
- .7 operation of the automatic devices;
- .8 continuous operation for heaving up and dropping the anchors;
- .9 operation of the remote control of the anchor machinery;
- .10 operation of the anchor chain counters.

5.16.9 Mooring capstans and winches.

5.16.9.1 The mooring capstans and winches shall be tested for their design purpose; the following shall be checked:

- .1 speed of heaving-in of a mooring line and the possibility of adjusting it;
- .2 reliable operation of the machinery at a rated pull and overload;
- .3 overload and other protections;
- .4 operation of the brakes;
- .5 operation of the automatic devices and alarms;
- .6 force applied to the handles;
- .7 operation of the manual drive.

5.16.10 Towing and boat winches.

5.16.10.1 When testing the towing and boat winches, the following shall be checked:

- .1 speed of heaving-in of a line;
- .2 reliable operation of the winches at a rated pull and overload;
- .3 operation of the fairlead;
- .4 overload and other protections;

- .5 operation of the brakes;
- .6 operation of the automatic devices and alarms;
- .7 force applied to the handles;
- .8 speed of lowering of the boats;
- .9 interlocking devices of the boat winches.

5.16.11 The mechanical and other telegraphs shall be tested for their design purpose together with the machinery for the correctness of executing orders and interlocking at all settings; the following shall be checked:

- .1 consistency of the order given on the bridge with that in the engine room;
- .2 interlocking, which precludes starting of the machinery in the direction opposite to the one ordered.

5.16.12 Testing of the fans of machinery spaces and spaces containing explosive equipment shall be conducted according to the program with all the specified parameters being checked.

5.16.13 The motors and pumps of the hydraulic systems shall be tested in operation for their design purpose together with the machinery, arrangements or systems they belong to.

5.17 SEA TRIALS

5.17.1 The sea trials shall be carried out in the presence of the RS surveyor according to the program approved by the Register. If specific operational characteristics have been defined by the manufacturer, these shall be included in the test plan.

5.17.2 The sea trials shall be carried out with the aim to check all the main parameters of the machinery installation, operation from all control positions during manoeuvring ahead and astern, reversing capabilities of the installation (including CPP), operation and maintenance of the auxiliary machinery and sets under conditions closely approximating the service conditions.

5.17.3 The program of the sea trials of the propulsion plant, sets and machinery, reduction gears and couplings shall provide for checking of all parameters of the relevant machinery and sets referred to in 5.16, as well as checking of the vibrations at various rates of speed of the ship.

The vibrations of the machinery, equipment and structures on prototype ships, and, if necessary, on series-built ships shall be measured at all the rates of speed of the ship.

5.17.4 The duration of the test modes of the main machinery shall be set in accordance with Appendix 1 to this Section. The frequency of noting the operational parameters of the main machinery shall be established in accordance with 5.16.2.4.

5.17.5 The auxiliary machinery, which check has been finalized on the mooring trials, shall be checked on the sea trials in operation for its design purpose.

5.17.6 The deck machinery shall be tested in modes contemplated for the testing of relevant arrangements in accordance with Section 3.

5.17.7 During the sea trials, the mechanical and other telegraphs shall be checked in operation for their design purpose together with the main machinery for the correct and failure-free execution of the orders at all settings with the interlocking devices to be checked in operation.

5.17.8 During the sea trials of the main hydraulic and electromagnetic couplings, it is necessary to test the emergency connection thereof with the aim to verify maintenance of the running condition of the ship at the speed ensuring manoeuvrability thereof.

5.17.9 The issue concerning replacement of the sea trials of main machinery by the mooring trials with the application of simulation means shall be settled in accordance with the requirements of 18.6.

5.18 REVISION OF MACHINERY AND CHECK TESTS

5.18.1 Upon finalization of the sea trials, the revision of the machinery and sets shall be performed. The extent of the revision shall be determined by the RS surveyor basing on the trial results. The specified extent shall be defined more exactly in the course of the revision of the machinery.

5.18.2 Subject to stripping-down shall be assemblies and components the examination of which is required to confirm the reliable operation of the machinery or set.

5.18.3 Depending on the extent and results of the revision of machinery, check tests shall be carried out within the scope to be established in each particular case.

APPENDIX 1

DURATION OF TESTING OF THE MAIN AND AUXILIARY MACHINERY ON MOORING AND SEA TRIALS

1 Mooring and sea trials of internal combustion engines

1.1 The mooring and sea trials of internal combustion engines (ICE) shall be carried out in compliance with Appendix 7 to Section 5, Part IV "Technical Supervision during Manufacture of Products" of the Rules for Technical Supervision.

1.2 For dual-fuel ICE (DF-engines) when operated on gas fuel, the checks in modes "Astern run at 70 % of the rated speed", "Starts" and "Reversals" shall not be performed.

2 Mooring trials of steam and gas turbines

2.1 Mooring trials of the machinery the load of which changes according to power-propeller revolutions curve shall be carried out in modes given in Table 2.1.

2.2 Mooring trials of the turbogenerators shall carried out in modes given in Table 2.2.

Table 2.1

No. of mode	Torque % of rated value	Duration of trials, h, at main machinery power, in kW	
		up to 750	above 750
1	39	0,25	0,5
2	63	0,25	0,5
3	83	0,25	0,5
4	100	1,00	2,0
5	Run astern	0,50	0,5

Table 2.2

No. of mode	Torque % of rated value	Duration of trials, h, at main machinery power, in kW	
		up to 750	Above 750
1	Idling	0,25	0,5
2	25	0,25	0,5
3	50	0,25	0,5
4	75	0,25	0,5
5	100	1,00	2,0
6	110	0,25	1,0

2.3 Main steam and gas turbines driving CPP or generators the load of which changes according to power-propeller revolutions curve may be tested in modes given in Table 2.1 subject to subsequent tests thereof on the sea trials.

3. Sea trials of steam and gas turbines

3.1 Sea trials of main machinery, which load changes according to power-propeller revolutions curve, shall be carried out in modes given in Table 3.1.

3.2 Sea trials of the main machinery operating according to load curve shall be carried out in modes given in Table 3.2.

Table 3.1

No. of mode	Speed, % of rated value	Duration of trials, in h
1	63	0,5
2	80	0,5
3	91	0,5
4	100	4,0
5	103	1,0
6	Corresponding to rated astern power	0,5
7	Minimum steady	0,25

Table 3.2

No. of mode	Power, % of rated value	Duration of trials, in h
1	25	0,5
2	50	0,5
3	75	0,5
4	100	4,0
5	110	1,0
6	Corresponding to rated astern power	0,5

3.3 Duration of the trials given in Tables 3.1 and 3.2 does not take into account the time required to test the propulsion plant in case of unattended operation as specified in Section 12.

3.4 The main machinery driving CPP, depending on the design of the control and regulation (engine — CPP) system, may be tested according to both the power-propeller revolutions curve and the load curve or according to combined curve.

3.5 Time required to trial the prototype ships in 100 % mode shall be doubled.

3.6 The main machinery made as unity sets, including turbines, gearing, couplings, generators, driving gear, shall be tested according to specially developed programs agreed with the Register and account-ed for various operation variants of the set.

The modes and duration of testing the set shall be established in each particular case, depending on the features thereof.

RECOMMENDATIONS ON INSTALLATION AND MOUNTING OF MAIN MACHINERY

1 General requirements

1.1 The Recommendations set the requirements in the absence of specified and agreed shipbuilding standards or national standards, which application is agreed with the Register.

2 Machinery mounted on metal chocks

2.1 Where the machinery is mounted on metal chocks, generally, the following conditions shall be met:

.1 inclination angle of the chocks, their dimensions, arrangement and surface finish shall comply with the requirements of the mounting drawings;

.2 chocks and their positions shall be marked;

.3 fit of the chock surfaces to be mated with the machinery and seating shall be checked before the seating bolts are tightened.

3 Machinery mounted on spherical spacers

3.1 Where the machinery is mounted on spherical spacers, generally, the following conditions shall be met:

.1 diameter of the spherical spacer shall be such that the specific pressure on the spacer, induced by the mass forces and bolt tightening forces does not exceed the one shown on the drawings;

.2 diameter of the spacer shall not exceed the width of machinery foot or frame, however, if the specific pressure exceeds the standards shown on drawings, the spacer diameter shall be increased in comparison with the width of the machinery foot or frame flange;

.3 no spherical spacer protruding from the seating shall be generally permitted;

.4 displacement of the upper half of the spacer in relation to the lower one, as well as the displacement of the spacer in relation to the machinery foot or frame flange shall not be permitted;

.5 to prevent displacement of the spacers during drilling, the spacers may be tacked together and to the seating by electrical welding.

4 Machinery mounted on adjustable chokes

4.1 Where the machinery is mounted on adjustable chokes, generally, the following conditions shall be met:

.1 diameters of the adjustable chocks shall be taken depending on the specific pressure thereon, and the greatest diameter shall not exceed the width of the seating flange and machinery foot;

.2 shift of the upper chock part to one side in relation to the lower part shall not exceed the one shown on drawings;

.3 diameter of the hole for normal bolt shall exceed the bolt diameter by the value of shift of the both chock parts;

.4 to prevent displacement of chocks when the holes are machined for tight-fitting bolts, the both chock halves may be tacked together and to the seating by electrical welding.

5 Machinery mounted on steel levelling spacers

5.1 Where the machinery is mounted on the steel levelling spacers, generally, the following conditions shall be met:

.1 the levelling spacer shall consist of at most two plates whose contact surfaces shall have the required quality;

.2 fitting the spacers in place is not needed, they may be tacked by electrical welding;

.3 fit of the spacer surfaces to be mated with the bearing surface of machinery and the seating shall be checked before the fastening bolts are tightened.

6 Machinery mounted on shock absorbers

6.1 Where the machinery is mounted on the shock absorbers, design of the used shock absorbers shall comply with the requirements of the technical documentation approved by the Register at that, generally, the following conditions shall be met:

.1 machinery aligned together may be mounted on shock absorbers only when there is a common bed plate;

.2 shafts of the aligned machinery mounted on the shock absorbers shall allow free relative movement of the machinery in operation;

.3 all connections to the machinery mounted on the shock absorbers shall allow free relative movement of the machinery in operation;

.4 places where the shock absorbers are installed on the bearing surface of the seating shall be so machined that the freely installed shock absorbers fit snugly to the seating and frame or to the machinery foot;

.5 tight fit of the levelling washers to the bearing surfaces of the machinery feet or frames installed on vertical and ceiling foundations shall be checked with two bolts tightened and the remaining bolts slightly loosened; in so doing,

indications of deformation of all the shock absorbers shall be detectable and misalignment of the machinery attachment plane in relation to the foundation plane shall not exceed the requirements of drawing.

7 Machinery mounted on wooden chocks

7.1 Where the machinery is mounted on the wooden chocks, generally, the following conditions shall be met:

- .1** places for installation of the wooden chocks shall be conditioned and painted;
- .2** the wooden chocks shall be manufactured of Grade 1 hardwood (oak, yew, ash, beech); the chocks shall be free of cracks and the moisture content of the wood shall not exceed the prescribed one;
- .3** in specific cases, the wooden chocks may be made of several parts, each part being fastened by at least two anchor bolts;
- .4** the minimum and maximum thickness of the wooden chock shall be indicated in the technical documentation;
- .5** the quality of fit of the wooden chocks shall enable the machinery foot or frame to be snug against the chock and also the chock against the bearing surface of the foundation;
- .6** prior to installation, the wooden chocks shall be boiled thoroughly in drying oil or treated otherwise in order to protect against decay;
- .7** no wooden chocks shall be used in oil storages, cofferdams, machinery and pump spaces of oil tankers.

8 Machinery mounted on plastic pads

8.1 General requirements.

8.1.1 The present requirements may be applied in technical supervision of the plastic pads for installation of machinery on seatings, unless otherwise specified in the technical documentation approved by the Register.

8.1.2 Machinery shall be mounted on plastic pads in compliance with the instructions and recommendations of plastics manufacturers and machinery or arrangements manufacturers.

8.1.3 Plastics used for the pads shall be approved by the Register.

8.1.4 Machinery shall be mounted on the plastic pads using an agreed procedure and under technical supervision of the Register.

8.2 Requirements for the plastics and their testing in the process of the RS approval.

8.2.1 Plastics used for pads shall comply with the requirements of 6.1.2, Part XIII "Materials" of the Rules for the Classification and Construction. Moreover, plastics shall be subjected to water absorption test, ageing test, oil resistance test and seawater resistance test in accordance with the requirements of 2.3.9 — 2.3.12, Part XIII "Materials" of the above Rules.

8.2.2 Plastics used for pads shall be subjected to tests to determine their physical and mechanical properties in accordance with 8.2.2.1 — 8.2.2.6.

Unless otherwise specified in the technical documentation, the test conditions shall meet the requirements of 2.3.1, Part XIII "Materials" of the Rules for the Classification and Construction, namely:

.1 compression strength shall be determined in accordance with 2.3.3, Part XIII "Materials" of the above Rules on the test specimens cut out from the source material and on test specimens subjected to water absorption, ageing, oil resistance and seawater resistance tests in accordance with 8.2.1;

.2 modulus of elasticity in compression shall be determined during the compression test on test specimens at deformation of 0,1; 0,5; 1,0 и 2 % according to 8.2.2.1;

.3 fatigue strength of the plastic in compression shall be determined on four specimens, which dimensions shall be taken the same as in compression test according to 8.2.2.1, subject to the following conditions: number of compression cycles is 107, frequency of cycles is 25 Hz. Diagram of the test loads and alternating load amplitude is shown in Fig. 8.2.2.3. The value of fatigue strength shall be determined from the results of the subsequent compression tests according to 8.2.2.1;

.4 creep shall be determined at the maximum working temperature of plastic but not lower than 70 °C, as well as at the temperature by 20 °C lower than the maximum working one at a load corresponding to specific pressures of 2, 4, 6 and 8 MPa;

.5 linear shrinkage during curing shall be determined on test specimens of 40 mm in thickness at the temperatures of 10, 20 и 50 °C;

.6 linear expansion test during heating and determination of hardness shall be performed in accordance with the national standards.

8.3 Technical documentation.

8.3.1 The following documentation shall be submitted to the RS surveyor (within the design documentation of the ship or in each individual case):

.1 drawings showing installation and attachment of machinery to seating with the use of plastic pads with indication of location and dimensions of pads, stops and anchor bolts including tightly-fitted bolts, as well as positions of the checkpoints for measurements in operation. Moreover, the said drawing shall contain the following information:

mass of the machinery, expected and/or allowable temperature of the pads in operation, mechanical characteristics of the material, tightening torques and design of locking devices for the anchor bolts as well as the value of propeller thrust for the main machinery;

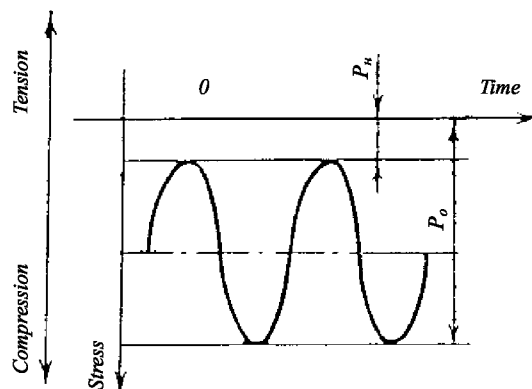


Fig. 8.2.2.3 Diagram of test loads and alternating load amplitude:

P_0 — total stress generated by static and alternating loads, in MPa;

$P_0 = 0,2\sigma_{comp}$ (σ_{comp} — mean value of the static compression strength of source material according to 5.2.12.2.2.1);

P_1 — stress generated by static load, in MPa;

$P_1 \leq 0,1P_0$

.2 calculations of specific loads for the assumed dimensions of the plastic pads, due to machinery mass and anchor bolt tightening, as well as the calculations of the anchor bolt tightening torques and associated stresses in the bolts;

.3 data on the material properties (in accordance with 8.2);

.4 instruction for preparation of the plastic.

8.4 Design requirements

8.4.1 The RS surveyor shall make sure by examinations and review of the QCD documents that:

.1 the allowable specific load on the plastic pads due to machinery mass is determined by the formula

$$P_{allow} \leq \sigma_{comp}/200 \quad (8.4.1.1)$$

where σ_{comp} = compression strength of the plastic, in MPa, but in any case the allowable load shall not be taken more than 0,7 MPa;

.2 the specific load on the plastic pads due to tightening of anchor bolts is not less than 1,75 MPa.

Along with this, the stress in the anchor bolts shall not exceed 0,8 the yield strength of the material;

.3 the maximum allowable total specific load on the plastic pads due to machinery mass and anchor bolt tightening is:

$$P_{max} < 5P_{allow} \quad (8.4.1.3)$$

where for P_{allow} refer to 8.4.1.1.

Maximum allowable total specific load P_{max} may be increased above $5P_{allow}$ upon submission of the relevant technical background.

8.4.2 To ensure that the seatings can take tangential forces including propeller thrust, provision shall be made for special stops or tightly fitted bolts. The bores of these bushes shall be calibrated by simultaneous reaming of holes in the machinery foot and in the seating flange. Tightly fitted bolts shall be installed in way of the plastic pad according to the procedure agreed with the RS Branch Office.

8.4.3 For the machinery to be aligned, provision shall be made for devices to measure position of the machinery in relation to the seating. These devices shall ensure determination of the machinery position on both sides along the length of the machinery. Machinery whose length to width ratio is not over 1,5 shall have devices for measuring at not less than two points and those with length to width ratio over 1,5, at not less than three points on each side.

8.5 Requirements for mounting machinery on the plastic pads.

8.5.1 When moulding the pads, each plastic mixture to be prepared shall be used for producing test specimens being cured under the same conditions as the pads. These specimens shall be subjected to check test for compression and hardness in conformity with 8.2.2.1 and 8.2.2.6 to confirm specified characteristics of the plastic moulded into pads.

8.5.2 Before the plastic is moulded, the anchor bolts, surfaces of machinery and seating which are in contact with the plastic pads shall be coated by anti-adherent compound.

8.5.3 The thickness of the plastic pads shall not exceed 40 mm. Use of the plastic pads of a greater thickness shall be confirmed by the relevant technical background.

8.5.4 For the machinery to be aligned, as well as in other cases where it is deemed necessary, account during installation of the machinery on the plastic pads and during determination of their thickness shall be taken of the plastic shrinkage during curing (refer to 8.2.2.5), as well as the plastic creep (refer to 8.2.2.4) at the appropriate design temperature and specific load.

8.5.5 Before the anchor bolts are tightened, it is necessary to make sure that the plastic pads are fully cured. This shall be effected by checking the hardness unless the plastic manufacturer specifies other methods of checking curing (refer to 8.5.1).

8.5.6 After the anchor bolts are tightened, it is necessary, if need be, to check alignment of machinery, measure crank web deflection, etc. The values of the anchor bolt tightening torques, their equivalent stresses in the bolt bodies or the values of oil pressure in the device for hydraulic tightening of bolts shall be entered in special data cards or measurement tables. Furthermore, after the bolts are tightened, it is necessary to check machinery position using devices referred to in 8.4.5. The results of measurements obtained during such check shall be also entered in the data card or measurement tables.

8.5.7 During moulding and curing of the plastic pads, work which may result in change of the machinery position, that is work causing vibration, shocks, displacement of masses, etc. shall not be performed in way of the machinery.

8.5.8 The main engine and other machinery shall be installed on the plastic pads after completing assembly thereof and alignment of shafts.

6 SHAFTING

6.1 GENERAL

6.1.1 The provisions of this Section apply in technical supervision of the shafting and components thereof listed in the RS Nomenclature.

General provisions for technical supervision are set in Part I "General Regulations for Technical Supervision", general provisions for technical documentation — in Part II "Technical Documentation" of the Rules for Technical Supervision.

6.1.2 The Section lays down the procedure of the Register technical supervision during mounting and testing of the shafting and components thereof on board the ship.

6.1.3 The procedure and scope of the checks, surveys and tests of the shafting on board the ship are determined by the shipyard on the basis of examination and testing plan developed according to 6.2.1 of the Guidelines, as well as to 13.3, Part I "General Regulations for Technical Supervision" of the Rules for Technical Supervision.

6.1.4 The methods of inspection, tools and devices for measuring and testing shall be specified by the shipyard, indicated in the process documentation and, if necessary, agreed with the Register.

6.1.5 Numerical values for test modes and duration, as well as numerical criteria for installation works given in this Section are provided for reference. Prior to commencement of construction, other quality criteria given in the recognized national or international standards, or manufacturers' documents/instructions may be agreed with the RS Branch Office.

6.1.6 Testing and checks stipulated by this Section are performed, provided the materials, completing equipment and products to be subjected to the Register technical supervision according to the RS Nomenclature and incoming for the mounting of the shafting have been manufactured and tested at the manufacturer's and have the documents confirming the Register technical supervision during their manufacture and testing.

Documents confirming the Register technical supervision during manufacture of the materials, related equipment and products to be supervised and incoming for the mounting of propellers on board the ship in accordance with the supervision form stipulated by the RS Nomenclature shall be submitted.

6.1.7 In case some tests were not conducted at the firm (manufacturer) and it is confirmed by an entry in the RS certificate, then these tests shall be conducted.

Additional checks and tests may be assigned by the surveyor upon results of examination of machinery in substantiated cases.

6.2 SURVEY PLANNING

6.2.1 Prior to commencement of survey of the stern tube arrangement and shafting of the ship under construction, the RS Branch Office shall agree the examination and testing plan developed by the shipbuilder taking into account Table 6.2.1 and 6.3 – 6.7. The shipbuilder shall be informed about that at a kick off meeting prior to commencement of construction according to 1.7.1.

The builder shall agree to undertake ad hoc investigations during construction as may be requested by RS where areas of concern arise and the builder to agree to keep RS advised of the progress of any investigation. Whenever an investigation is undertaken, the builder shall be requested, in principle, to agree to suspend relevant construction activities if warranted by the severity of the problem.

6.2.2 During approval and agreement of the examination and testing lists a note shall be taken of specific published Administration requirements and interpretations of statutory requirements.

6.2.3 Quality standards for installation and testing of the stern tube arrangement and shafting shall be reviewed and agreed during the kick-off meeting. The work shall be carried out in compliance with the RS rules and under the RS technical supervision.

6.2.4 Any changes to the kick-off meeting records shall be agreed and documented.

Table 6.2.1

Items of technical supervision	External examination with review of accompanying documents	Tightness test	Checks and measurements associated with shafting alignment	Measurement of clearances	Mooring and sea trials
Shafting:					
thrust shafts	+		+		+
intermediate shafts	+		+		
propeller and stern shafts with liner and water proofing	+		+		
thrust and journal bearings	+		+	+	+
shaft couplings	+		+		
shaft connecting bolts	+				
sealing of propeller shaft cones and flanges for coupling CPP with shaft	+	+			
stern tube arrangements:	+				
stern tubes (bushes)	+				+
stern bearings (including strut bearings)	+			+	
stern tube seals and glands	+	+		+	+

6.3 TECHNICAL DOCUMENTATION

6.3.1 When performing technical supervision, the RS surveyor shall be guided by the technical documentation approved by the Register within the scope required by Part I "Classification" of the Rules for the Classification and Construction and agreed technological processes for mounting and aligning shafting.

6.3.2 Prior to mounting, the RS surveyor shall check the availability of the following technical documentation agreed with the Register:

- the procedure for mounting struts and stern tubes;
- the procedure for attaching the stern tube to the stern boss and for pressing the stern bearing directly in the stern boss;
- the procedure for installing bearings on pads of polymer materials.

6.3.3 Documents on all committed deviations from the RS-approved technical documentation on shafting, as well as on correction of troubles noted at the previous stages of technical supervision shall be submitted to the RS surveyor.

6.4 MOUNTING OF STERN TUBE ARRANGEMENTS

6.4.1 Mounting and installation monitoring of stern tube arrangements shall be performed according to the procedure agreed with the Register. During agreement of the procedure for mounting and installation monitoring of stern tube arrangements the recommendations given in Appendix 2 to this Section may be taken into account.

6.5 MOUNTING AND ALIGNMENT OF SHAFTING

6.5.1 Mounting and alignment of shafting shall be performed according to the procedure agreed with the Register. During agreement of the procedure for mounting and alignment of shafting the recommendations given in Appendix 3 to this Section may be taken into account.

6.5.2 Mounting and check of installation of the detachable couplings including couplings installed using hydropress method, as well as mounting and check of installation of the flexible, disengaging and sound-insulating couplings with shafts shall be performed in accordance with the requirements and guidelines of the technical documentation agreed with the Register.

6.5.3 Mounting, assembly and check of installation of the shaft-turning gear, torsionmeter and tachometer sensor, as well as flange couplings and other devices in the shafting — CPP arrangement shall be performed in accordance with the requirements of the technical documentation.

6.6 MOORING AND SEA TRIALS

6.6.1 Following the mounting on board ship in compliance with Table 6.2.1 the shafting shall be checked in operation simultaneously with the mooring and sea trials of the main machinery. The shafting shall be checked in operation during the mooring and sea trials according to the program being a constituent part of a general ship's program, and using a test procedure approved by the Register.

6.6.2 The readiness of the shafting for trials, on agreement with the Register, shall be determined by positive results of all the specified surveys and verifications performed in the course of the shafting mounting as well as from the measurement tables (records, service log of the shafting).

Based on the results of mooring trials, the possibility of conducting the sea trials shall be determined.

6.6.3 The positive results of the mooring and sea trials shall be determined by the temperature conditions of shafting components specified by the service manual; absence of extraneous noise, shocks, rather high vibrations and other indirect indications of abnormal operation; satisfactory operation of systems, instruments and devices serving the shafting in accordance with the service manual of these systems, instruments and devices, as well as the results of torsional vibration measurement.

6.6.4 The necessity for the revision of assemblies and components of the shafting, stern tube, as well as for the inspection test of the shafting alignment shall be decided basing on the results of sea trials with due account of the design features of the shafting.

6.7 CALCULATIONS AND MEASUREMENTS OF TORSIONAL VIBRATION OF SHAFTING OF THE SHIP'S PROPULSION PLANT AND AUXILIARIES

6.7.1 General.

6.7.1.1 This Chapter contains requirements for calculations and measurements of torsional vibration of shafting of the propulsion plant and auxiliaries (refer to 8.1.1, Part VII "Machinery Installations" of the Rules for the Classification and Construction).

6.7.1.2 The documents on the torsional vibration to be submitted to the Register include:

- .1 shafting torsional vibration calculation;
- .2 program of shafting torsional vibration measurements;
- .3 preliminary conclusion on the results of shafting torsional vibration measurements;
- .4 report on shafting torsional vibration measurements.

6.7.1.3 The program of shafting torsional vibration measurements (refer to 6.7.1.2), in its contents shall comply with the requirements set out in the Instruction on Drawing up Documents on Torsional Vibrations of Shafting of the Ship's Propulsion Plants and Auxiliaries (refer to Appendix 1 to this Section).

6.7.1.4 The program of the torsional vibration measurements (refer to 6.7.1.2.2) is based on the results of the torsional vibration calculation and shall be submitted to RHO or the RS Branch Office before commencement of measurements on the ship under consideration.

6.7.1.5 The preliminary conclusion on the results of shafting torsional vibration measurements (refer to 6.7.1.2.3) shall be made and submitted to the RS Branch Office within the terms, as agreed with the shipyard (in case of ship construction) or with the shipowner (when the ship is in service) upon the completion of measurements in order to make a prompt decision on the permit for operation of the ship's propulsion plant or auxiliaries.

6.7.1.6 The report on measurements (refer to 6.7.1.2.4) shall be submitted to the RS Branch Office not later than 3 months after testing, provided the requirements of 6.7.1.5 are complied with. Otherwise, the decision on the permit for the operation of the ship's propulsion plant or auxiliaries may be taken only after the report on measurements have been submitted to the RS Branch Office.

6.7.1.7 Reports on measurements shall be sent to RHO with the conclusion of the RS Branch Office performing technical supervision during measurements.

6.7.1.8 The results of the torsional vibration measurements made on board the prototype ship shall apply to all ships of this series and shall be reflected in the Register documents issued to series-built ships.

6.7.3 Requirements for torsional vibration measurements.

6.7.3.1 The shafting torsional vibration measurements shall be performed for all variants and conditions possible in operation of the installation for which the torsional vibration calculations are required in compliance with 8.1.2, Part VII "Machinery Installations", taking into account the installation design, provided the operation in these conditions is allowed by the manufacturer.

6.7.3.2 Selection of shafting portions and cross sections for installation of torsional vibration sensors depends on the shafting design and, to verify the reliability of torsional vibration calculation, those system sections where according to the calculation tangible displacement amplitudes or twisting are expected to be recorded with the appropriate natural frequency modes.

6.7.3.3 The shafting torsional vibration measurements shall be made at smooth increasing and decreasing of the shaft speed (from the minimum steady speed up to maximum speed) over the entire working speed range. If necessary (depending on the ship purpose), the measurements may be performed at starts, stops and reverses.

Within the areas of resonance speed and at rated speed, the repeated measurements shall be made at fixed speeds (by points).

Where a barred speed range is required, passages through this barred speed range, both accelerating and decelerating, shall be demonstrated (refer to 4.5.1 of Appendix 1 to Section 18). The times taken shall be recorded and shall be equal to or below those times stipulated in the RS-approved documentation, if any. This also includes when passing through the barred speed range in reverse rotational direction, especially during the stopping test.

6.7.3.4 Where a remote automatic control system (RAC) is available, measurements shall be made with the engine being controlled both by RAC and manually.

6.7.3.5 In sophisticated plants containing several engines, power take-off devices, disengaging couplings, etc. it is necessary to make measurements at various variants of connection of the engines and power consumers for which calculations have been made.

6.7.3.6 On ships equipped with CPP, torsional vibration shall be measured at the nominal and zero pitch but, if necessary, also at the intermediate pitch values.

6.7.3.7 Torsional vibration shall be measured during sea trials of the ship after mounting of all attached standard machinery and adjustment, verification of the main machinery and CPP for compliance with the specified parameters (refer to 6.7.3.3).

The torsional vibration of the shafting may be measured when the ship is in ballast or loaded condition.

6.7.3.8 On ships equipped with CPP, the measurements may be performed during mooring trials, provided the operation of the plant is ensured over the entire speed range (from the minimum steady speed up to maximum speed) by varying the propeller pitch.

6.7.3.9 Torsional vibration of the shafting of auxiliaries or the engine vibrations of "motor" modes shall be measured by the auxiliaries or engine manufacturer and the safe development of their torsional vibration shall be ensured by the manufacturer concerned ("motor" mode of vibration is the mode determined by the elastic-and-inertia parameters of the engine).

If an engine in auxiliaries is mated with a standard generator, compressor, pump, etc. at the shipyard, the measurements shall be made on board ship.

**RECOMMENDATIONS ON DRAWING UP DOCUMENTS
ON TORSIONAL VIBRATION OF SHAFTING
OF THE SHIP'S PROPULSION PLANTS AND AUXILIARIES**

1 General

1.1 The Recommendations establish the procedure for drawing up documents on torsional vibration of shafting of ship's power plants and auxiliaries when submitted to the Register in accordance with the requirements of Section 8, Part VII "Machinery Installations" of the Rules for the Classification and Construction.

The Recommendations set out requirements for the contents and presentation of the calculation and report on shafting and auxiliaries torsional vibration measurements.

2 Recommendations on the contents and drawing up the torsional vibration calculation for shafting of ship's propulsion plants or auxiliaries

2.1 When submitted to the Register, the shafting torsional vibration calculations shall be made out in conformity with the provisions of this Section of the Recommendations. The accepted form of the documents submitted by foreign companies may be different but it shall contain all the required information.

2.2 The torsional vibration calculations, generally, shall contain the information listed below.

2.2.1 The introductory part shall contain grounds for the calculations (development of technical design, modernization of propulsion plant, replacement of propeller, damper diagnostics, etc.). This part shall contain a reference to the calculation procedure and algorithms.

2.2.2 Brief summary specification of the ship and description of its propulsion plant shall be given. The ship's type, project number, as well as the ship's name (if assigned by this time) shall be indicated.

For power plant or auxiliaries, a functional diagram shall be given with indication of each component position and interpretation thereof; as well as the shafting sketch, design torsional diagram including the components of the ship's propulsion plant or auxiliaries.

2.2.3 The basic characteristics and dimensions of the shafting components of the torsional system shall be specified.

2.2.4 Modes specified for operation of the propulsion plant shall be given with indication of speed, and for the installations with CPP — pitch values for various modes. If change in the modes is associated with change in the gear ratio of the reduction gear or with connection of additional auxiliaries, this information shall be given for each mode.

2.2.5 A summary table of data describing the torsional diagram of the system shall be given. The table shall contain description of the masses and portions of the shafting, diameter, length, compliance (stiffness) and minimum section moduli of the shafting portions, mass inertia moments. The torsional diagram of the system shall be also shown here.

For diesel electric propulsion plants, for plants with hydraulic or electromagnetic couplings as well as for plants with variety of connection of the system components, the calculation schemes shall be given separately for each part of the plant (e.g. "main diesel-generator" and "propulsion motor — propeller" or "diesel — driving half-coupling" and "driven half coupling — propeller") or for each variant of connection of the components.

2.2.6 The calculation shall contain the results of determination of natural frequencies for all modes of vibration having a resonance up to the 12th order inclusive within the speed range $(0 — 1,2)n_p$, for each independent part of the plant or each variant of its connection.

2.2.7 The permissible values of stresses (torques and temperature) shall be taken as required in 8.2 — 8.6, Part VII "Machinery Installations" of the Rules for the Classification and Construction, and in case of their absence, according to the data presented by the manufacturers of the relevant equipment or the other normative documents.

2.2.8 Where it is necessary to consider the simultaneous effect of disturbing moments of several orders, the calculation shall contain determination of total stresses (torques). Along with that, the orders being summed up shall be indicated.

2.2.9 Based on the results of calculation, stress (torque) curves shall be presented with indication of permissible values for continuous running and rapid passage and of barred speed ranges.

Along with that, the following shall be taken into consideration:

the width of the barred speed ranges shall be determined according to 8.8, Part VII "Machinery Installations" of the Rules for the Classification and Construction;

the permissible stresses for the portion of the propeller shaft positioned within the stern tube shall be estimated:

for stern tube with non-metal bearings, as in the case of propeller shaft;

for stern tubes with oil-lubricated metal bearings, as in the case of intermediate shaft.

2.2.10 In the conclusion of the calculation, inferences shall be drawn as to the absence of the barred speed ranges within the entire working speed range, as well as during start-stop or as to the necessity of assigning the barred speed range, its position and width. Where necessary, recommendations shall be given on alterations of some plant components (supported by an appropriate calculation) or specified operation conditions of the plant.

2.2.11 The calculation shall contain the requirement for checking the calculation results by measuring the torsional vibration on the ship with indication of measuring equipment and measurement points depending on the purpose of research, with due account of the calculation of the relative amplitudes of the most visible natural frequency modes.

3 Recommendations on the contents and drawing up the program of shafting torsional vibration measurements

3.1 The program of shafting torsional vibration measurements is a basic document being developed by the person who takes the measurements on the basis of results of the torsional vibration calculation and agreed with RHO or relevant RS Branch Office.

3.2 In terms of their content the programs of shafting torsional vibration measurements are divided into integrated and special.

3.2.1 An integrated program is generally developed for the prototype ship of the series in order to verify the results of the torsional vibration calculations for all the system components where critical loads are expected to occur.

3.2.2 A special program is developed for series-built ships aimed at the torsional vibration periodic inspection of some components of the system ensuring its safety (usually dampers). In particular, the guidelines on the contents and drawing up the special program are given in the Procedure for Diagnosing and Determining the Residual Lifetime of Silicone Dampers of Marine Internal Combustion Engines (ICE) (refer to Annexes to the Guidelines on Technical Supervision of Ships in Service).

3.3 In general an integrated program of torsional vibration measurement shall contain the following data corresponding to the given below guidelines on the contents and drawing up the report on shafting torsional vibration measurements (refer to 5.1):

.1 grounds for making measurements (prototype ship, modernization of plant, replacement of propeller, etc.), ship class, project number, name of the ship, as well as the name and number of the documents on torsional vibration calculations with an indication as to who has made the measurements and when these were done and agreed. In case this document has not been submitted previously, it shall be attached to the program;

.2 a sketch of the ship's propulsion plant and its description with the list and basic characteristics of its components;

.3 design torsional diagram of the system and the relevant graphs of natural frequencies for all basic modes of vibration. The recommended positions of the measurement sensors corresponding to the maximum amplitudes of displacement or twisting of the system components shall be shown on a design torsional diagram;

.4 requirements for the conditions under which the sea or mooring trials of the ship and plant (ship's loading and draught, sea state, engine adjustment, shafting condition, etc.) shall be performed;

.5 requirements for variants of the plant components connection and plant operation modes during measurements (speed range and variations, fixed speeds, operation with the cylinder disconnected, manoeuvres, manual or remote automatic control of the engine, etc.);

.6 requirements for measuring systems (range of frequencies and amplitudes measured, types of sensors, the principle of signal transmission and conversion from the sensor to the recording and processing unit), as well as the software intended for processing and spectrum and harmonic analysis on PC, etc.

The measuring systems shall provide the following inaccuracy of measurements:

up to 5 % when measuring vibration amplitudes,

up to 5 % when measuring stress amplitudes,

up to 3 % when measuring vibration frequency;

.7 requirements for installation of sensors and other components of a measuring system including mounting devices and power supply under shipboard conditions.

3.4 The program shall contain requirements for the methods of processing and analysis of torsional vibrations records (including statistical methods) to provide reliability of estimates of the resonance speeds and amplitudes, as well as the total stresses due to forced vibrations.

3.5 The program shall contain the forms of submission of the report on measurements meeting the requirements specified in 5.1.9 — 5.1.12 of the Recommendations.

4 Recommendations on the contents and drawing up the preliminary conclusion on the results of torsional vibration calculations

4.1 The preliminary conclusion shall contain the following details:

name of the ship and project number;
date, place and conditions of taking measurements (ship's loading and draught, sea state, etc.);
person who takes the measurements;
used measuring equipment and points of measurements;
basic measurement modes.

4.2 To be presented are: maximum resonance amplitudes and stresses at sections under consideration with indication of the resonance speeds, vibration orders and modes as well as stresses and loads in the most stressed shafting portions recalculated as a consequence of the measurement results, and measured temperatures of the rubber components of the flexible couplings. For the components listed, the permissible stresses (torques) of these values shall be presented.

4.3 The inferences in the conclusion shall point at the necessity of assigning barred speed range or at the absence of the same. In case where the barred speed range is assigned, it is necessary to indicate position and width thereof, as well as to provide temporary recommendations on the use of the plant with due account of the torsional vibration for the period immediately ahead (until the final report is issued).

5 Recommendations on the contents and drawing up the report on shafting torsional vibration measurements

5.1 The report on shafting torsional vibration measurements shall contain the following data:

.1 grounds for making measurements (prototype ship, modernization of plant, replacement of propeller, etc.), ship's class, project number, name of ship, as well as the number of the previously submitted documents on torsional vibration calculations with an indication as to who has made the measurements and when these have been made;

.2 date, place and conditions of measurements (ship's loading and draught, sea state, etc.), results of the engine adjustment verification.

Brief description and sketch of the ship's propulsion plant and design torsional diagram of the system shall be given here.

If the inertia moment of the propeller when passing through resonance, combined with the mean torque corresponding to the resonance speed, according to the calculation exceeds $2,5M_{nom}$, it is necessary to indicate the propeller interference fit (diametric interference fit δ or axial pull-up δ_{ax} and taper of the propeller) and its corresponding friction torque in the shaft to propeller connection;

.3 brief characteristic of the used measuring systems and sensors therein and recording and processing equipment (type, model, firm (manufacturer), natural frequency, range of frequencies and amplitudes measured, inaccuracy of measurements.

The measuring systems shall provide the inaccuracy of measurements as specified in 3.3.6;

.4 position of the sensors (when measurements are not made at the fore end of the engine — coordinates of sections being torsigraphed or strain measured). Position of the sensors shall be shown on the shafting sketch or calculation scheme of the system;

.5 method of connection of sensors and instruments;

.6 type of time and shaft speed markers;

.7 scales of amplitude or stress records, calibration curves, scale of time marking;

.8 brief description of the plant operation conditions under which measurements have been made (range and rate of the speed measurement, manoeuvres, manual or remote automatic control of the engine, etc.);

.9 graphs of changes (depending on the engine speed) in the vibration amplitudes of the sections being torsigraphed and stress amplitudes at the sections being strain measured with indication of the resonance speeds, orders and modes of the resonance vibrations. The results of the harmonic analysis of torsigraphs (oscillograms) shall be also presented.

Samples or copies of the torsigraphs (oscillograms) at the resonance and nominal speeds shall be presented here. These samples shall indicate the speed, vibration order, record scale, values of the maximum amplitudes and stresses, time marking scale;

.10 comparison of the calculated frequencies, amplitudes of vibrations and stresses with the measured ones.

In case of discrepancy between the frequencies by more than 5 %, recalculation of natural frequencies for the revised torsional diagram of the system shall be presented;

.11 table of measured or recalculated, as a consequence of the measurement results, resonance stresses (torques) due to torsional vibration at various shafting portions (shafts, couplings, reduction gears, etc.), deformations and temperatures of the flexible components of couplings. Where necessary, the values of stresses due to combined resonance and forced vibrations shall be also presented.

A comparison shall be made between the cited values and corresponding permissible values according to the Register rules or other normative documents.

For FPP, the table shall give the inertia moment values when passing through the resonance, combined with the mean torque corresponding to the resonance speed. The total of these shall be compared for the vibration orders under consideration with the friction torque in the shaft to propeller connection;

.12 graphs showing relationship between the stresses, torques and other values and the engine speed, obtained during direct measurements or recalculated proceeding from the results of these for various shafting portions: propeller, intermediate, thrust, crank shafts, couplings, reduction gear. The curves of the relevant, permissible for continuous running and rapid passage values shall be plotted on the graphs. If there are barred speed ranges, they shall be marked on the graphs. If the measured stresses and torques do not exceed 80 % of the permissible values the graphs need not be submitted (enough information in tabular form in accordance with 5.1.11);

.13 inferences on the absence of the barred speed range within the entire operational speed range or on the necessity of assigning the barred speed range, its position and width;

.14 recommendations for making arrangements aimed at reduction of the torsional vibration or detrimental impact thereof under operation conditions (shift of the specified operation modes of the plant in relation to the resonance ones, installation of a unit for rapid passage of the barred speed range in the remote automatic control system and re-adjustment thereof, passage of the barred speed range in case of manual or remote automatic control of the engine, additional adjustment of the engine, more frequent examination of flexible couplings, etc.).

5.2 When it is necessary to make structural alterations in the shafting system, it is recommended to correct the results of relevant calculations (torsional vibration calculation under recommended change in the mass inertia moments of the system or in the compliance of the shafting portions, installation of additional flywheels, damper or antivibrator, change in the firing timing, calculation to be made when the necessary interference fit of the propeller is selected, etc.).

RECOMMENDATIONS ON MOUNTING OF STERN TUBE ARRANGEMENTS

1. The Recommendations set the requirements in the absence of specified and agreed shipbuilding standards or national standards, which application is agreed with the classification society.

2. To mark out the boring of fitness holes in shaft struts and stern tubes, the theoretical axis of the shafting may be laid out using an optical device, steel round line or a light beam. Axis may be laid out by means of the steel round line only for shafting not exceeding 15 m in length. In specific cases, if this follows from the calculation of the technological parameters of alignment, in order to achieve judicious loads on the bearings, the axis position for the shaft stern and stern tube boring shall be shifted relative to the theoretical axis of the shafting by displacing the markers across the end faces of the surfaces bored for the value of the calculated boring ordinates.

The accuracy of installing the markers at calculated positions in relation to the theoretical axis of shafting shall be not less than 0,05 mm. Control circles: one of a diameter equal to boring size and another — larger by 10 mm shall be marked from the centres of the markers on the faces of the struts and stern tube.

With the main machinery secured, it is necessary, when marking out boring, to take into account the mounting clearances.

3. Diameters of the fitment holes, length of the fitment holes, form deviations of the fitment holes, surface roughness shall comply with the guidelines of the technical documentation. The permissible deviation of the axis of the bored fitment holes relative to the control circle centres on the faces of the stnt, stern boss and welded-on pad of the afterpeak bulkhead shall not exceed 0,5 mm. Non-perpendicular position of the machined surface of the end faces of the strut, stern boss and welded-on piece of the afterpeak bulkhead to the axis of the bored holes shall not exceed 0,2 mm/m. To verify the perpendicular position, it is recommended to use a boring bar.

4. The external fitment holes of the stern tube, strut bush mated with the fitment holes of the strut, stern boss and welded-on pad of the afterpeak bulkhead shall be made to the mean actual diameter values of the mated fitment holes of the strut, stern boss with due account of the mean assured interference indicated in the technical documentation (mean interference shall be determined separately for each fitment hole), as well as the permissible clearance in the hole of the welded-on piece of the afterpeak bulkhead. Strut, stern boss and welded-on piece of the afterpeak bulkhead may be bored to actual dimensions taken from the finished fitness holes of the stern tube and strut bush with the requirements for ensuring a predetermined interference in the connection of the bush with strut, stern tube with stern boss and a clearance between the stern tube and welded-on piece of the afterpeak bulkhead met.

5. Prior to installation and during press-fit of the strut bush, stern tube and stern bearings it is necessary to verify that:

all the articles to be installed comply with the accompanying documentation;

actual dimensions of the mated surfaces will afford fit (interference, clearance) required by the drawings. For this purpose, prior to press-fit of the strut bush, stern tube and stern bearings the fitment holes of the strut, stern boss welded-on piece of the afterpeak bulkhead as well as the fitment holes of the articles to be installed shall be subjected to check measurement. The measurement results of the fitment holes shall be entered in measurement tables (record, service log of the shafting) with indication of the ambient temperature during measurements;

technological measures for ensuring press-fit have been put into effect; along with that, the press-fit has been performed by application of forces specified by the technical documentation. Actual press-fit forces read from the indications of pressure gauges of the hydraulic devices shall be entered in the measurement tables (record, service log of the shafting).

6. Once the press-fit has been made, it is necessary to check security of fastening the strut bushes, stern tubes and stern bearings as well as locking the fasteners.

7. The stern bearings, including strut and bossing bearings shall be finished with the mounting clearances, conditions for subsequent alignment of the shafting and tight fit of the stern and propeller shaft to the lower halves of the stern bearings ensured.

The stern tube may be installed in assembly with the stern bearings the internal surfaces of which have been finished on a machine tool.

After completing mounting of the stern tube it is necessary to make check measurements of the internal diameter of the stern bearings at the stern tube fitment holes section, as well as to examine the stern bearings.

RECOMMENDATIONS ON MOUNTING AND ALIGNMENT OF SHAFTING

1. The Recommendations set the requirements in the absence of specified and agreed shipbuilding standards or national standards, which application is agreed with the classification society.

2. After installation and welding, the supporting surfaces of the foundations for bearings shall be machined. The supporting surfaces of the foundations may be machined prior to installation of the foundations on board ship. In this case, after installation it is necessary to check the supporting surfaces of the foundations in accordance with the requirements of this Section.

3. The supporting surfaces of the foundations shall be machined with a slope outwards in the range from 1:150 to 1:50. In accordance with the guidelines of the technical documentation, the bearing foundations may be machined with no slope. The supporting surfaces shall have no slope inwards the foundations.

4. The limiting deviations from non-planeness of the supporting surfaces, as well as thickness of the supporting plates of the foundations, after being machined, shall comply with the requirements of the technical documentation. Individual reductions in thickness shall be accepted for supporting plates with size not more than 10 % of the nominal one. The supporting surfaces of the foundations may have also local unevennesses and cavities up to 0,15 mm in depth which shall be dispersed and have a total length not exceeding 1/3 the nominal length of the supporting surface.

5. The machining quality and flange slope of the foundation shall be checked by rule and feeler gauge. The planeness of the machined foundation surfaces shall be verified by placing the rule over the surface and by measuring the clearances between the rule and supporting foundation surface with the use of the feeler gauge.

6. Prior to installation of the propeller shaft, it is necessary to verify that:

the propeller shaft together with all associated articles to be installed complies with the accompanying documentation;

the propeller and half-coupling have been fitted to the propeller shaft;

the technological measures for drawing in the shafts have been put into effect (lubrication of bearings, liners, etc.);

the results of check measurement of the propeller (stern) shaft working journals and the bearing bores meet the requirements of the technical documentation in respect to the clearance value in the stern bearings and strut bearing.

The results of measurement shall be entered in the measurement tables (record, service log of the shafting).

7. After completing installation of the shaft, it is necessary to check, with the use of feeler gauges, the clearances in strut and stern bearings from the bearing faces in the upper part. The clearances shall meet the requirements of the technical documentation. The difference in side clearances shall not exceed one-half the nominal clearance. The side clearances in the oil-lubricated stern bearings shall be measured at points located at an angle of 30° upward from the horizontal axis. The clearance in the oil-lubricated bearings may be checked by direct measurement of the shaft diameter and internal diameter of the stern bearings. The results of measurement shall be entered in the measurement tables (record, service log of the shafting).

8. The axial position of the propeller (stern) shaft in the stern tube shall be noted. The result shall be entered in the measurement tables (record, service log of the shafting). For the oil-lubricated stern tubes it is also necessary to measure the position of the propeller shaft by the shaft sag gauges (if gauges and standard instrument are available). The results of measurements shall be entered in the measurement tables (record, service log of the shafting).

9. As regards the stern glands, it is necessary to check perpendicular position of the end face of the stern tube or welded-on piece of the afterpeak bulkhead in relation to the shaft surface, the perpendicular position misalignment in this case shall not exceed 0,2 mm/m.

Misalignment between the stern tube gland casing and shaft shall not exceed 25 % of the diametral clearance between the closing sleeve and shaft.

The butts of the gland packing rings shall be cut off to an angle of 90°. Packing shall be placed into the gland box in such a manner that the butts are positioned at an angle not less than 90°. When placing packing, no clearance in the butts shall be accepted. The covering sleeve, with the compressed packing set down, shall enter into the journal box of the gland to a depth not less than 5 mm.

Mounting, testing and control of the fore and after seals of the stern tube with oil-lubricated bearings shall be carried out in accordance with the requirements and guidelines of the technical documentation. As a rule, test shall be conducted with the propeller shaft being turned over. The propeller shaft shall be turned over at the working oil pressure in the lubrication systems of the stern bearings with the spaces between lip seals drained.

A similar method of control shall be applied to the seals of stern tubes with fresh water lubricated bearings.

10. Prior to installation of shafts and alignment of shafting it is necessary to verify that:

- all the installed articles comply with the accompanying documentation;
- foundations for bearings have been checked and their machining finalized according to 6.4.1 — 6.4.4;
- results of check measurements of the shaft journal diameters and bores of the bearing bushes meet the requirements of the technical documentation in respect to the value of the bearing clearances. The measurement results shall be entered in the measurement tables (record, service log of the shafting);
- rolling bearings have been mounted on intermediate shafts. When the optical method of alignment is used, the shafts shall be removed from the rolling bearings for a period when a false shaft with an optical device is installed;
- shafting bearings have been installed on foundation with temporary fixtures for mounting and alignment of shafts and bearings, including installation of adjusting bearings;
- shafts have been laid and turned relative to each other until the check marks scribed on flanges, when the shafts have been mated in the workshop, match each other. Some shaft connections may be mated on board ship in case where it seems impossible to perform this work in a workshop. In such a case, both the radial and axial run-out of the shaft flanges and journals shall not exceed the values given in Part IV "Technical Supervision during Manufacture of Products" of the Rules for Technical Supervision;

propeller (FPP or CPP) has been mounted on the propeller shaft in accordance with the requirements of Section 7.

11. The shafting shall be aligned so that at any ship loading conditions and allowable wears of shaft and bearings under service conditions the loads on bearings and stresses in shafts for a given design of the shafting and its bearings do not exceed allowable values and that the possibility of arising alternating loads or negative reactions is also eliminated. For the shafting connected with reduction gear it is necessary to take into consideration the thermal expansion of the reduction gear (when the shafting is connected with a mechanism of other type, consideration of such expansion is recommended). For heavy-tonnage ships with the intermediate shaft diameter over 500 mm, it is recommended to take into consideration the action of the propeller hydrodynamic moment on the shafting. The said conditions of alignment shall be confirmed by an analysis with necessary calculations made using generally accepted methods. In this case, it is recommended to take the following values as the allowable shaft stresses and bearing loads:

.1 normal bending stresses arising in shafts during mounting and service: not more than 25 MPa — for propeller and tail shafts and not more than 35 MPa — for intermediate shafts;

.2 mean pressure on the lower half of bearings due to the action of load on the bearing in the range:

50 – 500 kPa — for babbitt-lined bearings;

50 – 300 kPa — for non-metal bearings.

12. The method of aligning the shafting shall be dictated by the salient features of its design and established by the shipyard (designer), proceeding from the calculation of the process parameters of alignment with due account of the values of shaft stresses and bearing loads as stated in item 11. The alignment process parameters include: values of loads on the stern, journal and thrust bearings; values of angularities and displacements in the shaft couplings; lack of coaxiality of the bearings in relation to the optical axis of the device, etc.

13. Alignment may be performed by one of the methods listed below:

.1 by loads on the bearings, for which the values of the shafting bearing loads shall be assumed as the design alignment process parameters;

.2 by design angularities and displacements in the shaft couplings, for which the values of the angularities and displacements in the shaft couplings shall be assumed as the design alignment process parameters;

.3 by an optical method in case of shafting with rolling bearings, for which the values of the lack of coaxiality of the bearings in relation to the optical axis of the device shall be assumed as the design process parameters;

.4 by angularities and displacements in the flange connections within the specified tolerances, namely:

by displacement — 0,1 mm;

by angularities — 0,15 mm/m.

Use of one or other method of alignment shall be agreed with the Register.

14. The alignment of the shafting by angularities and displacements in the shaft couplings shall not be permitted if deflection of the shaft ends due to own weight with the shafts lying freely on two journal (or adjusting) bearings exceeds 0,3 mm.

15. No matter what the alignment method is used, the tolerances for the angularities and displacement or other values in the connection of the shafting with the output flange of the main engine (reduction gear) shall comply with the requirements of the main engine (reduction gear) manufacturer.

Along with that, additional loads due to shafting on the bearing of machinery mated with the shafting shall be minimum and lie within the limits permitted by the machinery manufacturer.

16. The shafting may be aligned in a module or assembled hull of the ship while afloat, on building berth or in dock. During the installation of the stern tube and shafting, change in the ship's hull position in way of the shafting and machinery space shall be within ± 3 mm in relation to its position noted at the beginning of the work.

17. The alignment of the shafting shall be checked while the ship is afloat at the displacement not less than 85 % of the light displacement with installed (in the vicinity of the shafting and machinery space) main machinery, boilers, basic heavy auxiliary machinery and special arrangements with a mass more than 1 % of the total mass of machinery and arrangements in this area.

The possibility of checking the alignment and complete mounting of the shafting on the building berth (in dock) shall be agreed with RS upon submission of the relevant technical background.

18. The check measurement of the alignment process parameters shall be made after fitting of shims for bearings.

The check measurement of the loads on the bearings shall be made by alternate weighing of the bearings with the use of dynamometers. In so doing, the bearings shall not separate from the shims by more than 0,1 mm. The measurement of the loads on the bearings may be made by simultaneous weighing them with the use of dynamometers. The allowable deviation of the actual load from the calculated one and the difference in the dynamometer readings shall be determined by calculation.

The check measurement of the angularities and displacements in the shafting couplings shall be made with the use of the following:

- twin pointers with indicators;
- twin pointers or rule and feeler gauge;
- special fixture.

Measurement with the use of a rule and feeler gauge may be used when the flange diameter is over 200 mm. The allowable deviations from the calculated values of angularities and displacements shall be determined by calculation.

When the shafting is aligned by optical method, the rolling bearings shall be installed with the use of a special fixture. The slope of the false shaft axis in relation to the axis of the device or round line shall not exceed 0,6 mm/m.

After alignment, the deviations of the bearing positions from the optical axis of the device shall not exceed the allowable values determined by calculation.

The results of measurement of the shafting alignment process parameters shall be entered in the measurement tables (records, service log of the shafting) which shall contain also the calculated process parameters including the allowable deviations from these values.

19. The connecting bolts of coupling flanges may be manufactured to actual size of holes with the fit specified by the technical documentation ensured. The holes for bolts shall be finished jointly for both flanges of adjacent shafts. Not more than one collar mark up to 1 mm in width and up to 0,3 mm in depth may be permitted on the hole surface over a length of 15 mm, after finish machining.

The completely assembled flange connections shall be tightly squeezed by the bolts. The nuts and heads of the bolts shall fit snugly to the flange planes; a feeler of 0,05 mm in thickness shall not pass between flanges as well as between the bolt head or nut and the flange plane. Fasteners of the flange connections shall be securely locked in compliance with the requirements of the technical documentation.

20. Upon finalization of the alignment, it is necessary to check the position of shafts in the bearings and the fit of the supporting bearing shells to the shaft journals. Such check shall be performed when all the couplings have been completely assembled including coupling with the main machinery as well as with the shafting bearings completely secured. In so doing, a feeler of 0,05 mm in thickness shall not pass to a depth over 10 mm in the lower part of the bearing over an envelope arc of 50 – 70°. Side clearances shall be equal to one-half of the nominal oil clearance. The allowable difference in side clearances shall be equal to 1/6 the oil clearance.

Position of the thrust bearing with non-adjustable thrust pads shall be checked by clearances between the thrust shaft and thrust bearing pads. The difference in fore and aft clearances shall not exceed one-half of the oil clearance.

21. The quality of matching pads to the supporting feet of the bearing housings shall be checked with the bolts loose. A feeler of 0,05 mm in thickness shall not pass between the pads and foundations as well as between the shims and supporting surface of the bearing housing feet.

In some places, the total extent of which does not exceed 1/3 the pad perimeter a clearance up to 0,1 mm may be allowed. The pads shall not hang down from the foundation and protrude from under the bearing housing feet for more than 5 mm. Once the pads have been placed into their positions, they may be tacked by electric welding.

22. Holes in the foundation shall be positioned so that the distances from the hole centres to foundation edges, stiffeners or to vertical plates are at least of 1,5 the bolt diameter.

Holes for the tightly fitted bolts extending through the supporting foot of the bearing housing, pad and foundation shall be machined simultaneously. No more than one collar mark up to 1 mm in width and up to 0,3 mm in depth may

be allowed on the machined surface of the hole over a length of 15 mm along the generatrix. To eliminate intolerable cavities and scores on the hole surface the diameter may be increased to 10 % of its nominal value.

The foundation tightly fitted bolts shall be manufactured to actual sizes of holes with the fit specified by the technical documentation ensured.

23. After securing, the bolt heads and nuts shall fit snugly to the foundation or bearing housing foot. A feeler of 0,05 mm in thickness shall not pass under the nut and bolt head over the length of not less than $\frac{2}{3}$ the perimeter. Fit of the nuts and heads of the tightly fitted bolts need not be checked. To ensure fit, feet and foundations may be undercut. The depth of the undercut shall not exceed 10 % of the bearing housing foot or foundation flange. The bolt shall not be sunk into the nut. Upon finalization of mounting of the bearings, the fasteners shall be securely locked in accordance with the requirements of the technical documentation.

7 PROPELLERS

7.1 GENERAL

7.1.1 The provisions of this Section apply in the technical supervision of the propellers and their components listed in the RS Nomenclature.

General provisions for technical supervision are set in Part I "General Regulations for Technical Supervision", general provisions for technical documentation — in Part II "Technical Documentation" of the Rules for Technical Supervision.

7.1.2 The Section sets forth the procedure of the Register technical supervision during mounting and testing of the propellers and their components on board the ship.

7.1.3 The procedure and scope of the checks, surveys and tests of the shafting during their mounting on board the ship shall be determined by the shipyard based on the examination and testing plan developed in compliance with 7.2.1 of the Guidelines, as well as with 13.3, Part I "General Regulations for Technical Supervision" of the Rules for Technical Supervision.

7.1.4 Numerical values for test modes and duration, as well as numerical criteria for installation works given in this Section are provided for reference. Prior to commencement of construction, other quality criteria given in the recognized national or international standards, or manufacturers' documents/instructions may be agreed with the RS Branch Office.

7.1.5 Tests and checks specified in this Section are based on an assumption that the materials, component parts and products subject to the Register technical supervision according to the RS Nomenclature and supplied for the propeller installation have been manufactured and tested at the firm (manufacturer) and have the documents confirming their manufacture and testing under the Register technical supervision.

7.1.6 In case some tests were not conducted at the firm (manufacturer) and it is confirmed by an entry in the RS certificate, then these tests shall be conducted.

Additional checks and tests may be assigned by the surveyor upon results of examination of the fire-fighting means in substantiated cases.

7.2 SURVEY PLANNING

7.2.1 Prior to commencement of survey of the propellers of the ship under construction, the RS Branch Office shall agree the examination and testing plan developed by the shipbuilder taking into account Table 7.2.1 and 7.4 – 7.7. The shipbuilder shall be informed about that at a kick off meeting prior to commencement of construction according to 1.7.1.

The builder shall agree to undertake ad hoc investigations during construction as may be requested by RS where areas of concern arise and the builder to agree to keep RS advised of the progress of any investigation. Whenever an investigation is undertaken, the builder shall be requested, in principle, to agree to suspend relevant construction activities if warranted by the severity of the problem.

7.2.2 During approval and agreement of the examination and testing lists a note shall be taken of specific published Administration requirements and interpretations of statutory requirements.

7.2.3 The shipyard shall be requested to advise of any changes to the activities agreed at the kick off meeting and these shall be documented in the examination and testing plan. E.g. if the shipbuilder chooses to use or change sub-contractors, or to incorporate any modifications necessitated by changes in production or inspection methods, rules and regulations, structural modifications, or in the event where increased inspection requirements are deemed necessary as a result of a substantial non-conformance or otherwise.

7.2.4 Quality standards for installation and testing of the propellers shall be reviewed and agreed during the kick-off meeting. The work shall be carried out in compliance with the RS rules and under the RS technical supervision.

7.2.5 Any changes to the kick-off meeting records shall be agreed and documented.

Table 7.2.1

Nos.	Item of technical supervision	Review of document for the article	External examination	Check of mounting	Hydraulic tests, check for tightness	Mooring trials	Sea trials	Revision	Test check
1	Fixed pitch propellers (FPP):	+	+	+	+	+	+	—	—
	.1 bosses	+	+	+	—	—	—	—	—
	.2 blades	+	+	+	—	—	—	—	—
	.3 blade securing items	+	+	+	—	—	—	—	—
2	Controllable pitch propellers (CPP) and supporting systems:	+	+	+	+	+	+	+	+
	.1 bosses	+	+	+	+	—	—	—	—
	.2 blades	+	+	+	+	—	—	—	—
	.3 blade and boss securing items	+	+	+	—	—	—	—	—
	.4 pitch control unit hydraulic cylinders and shafts, servomotors in boss	+	+	+	+	—	—	—	—
	.5 CPP components: control heads slider blocks, push-pull rods, washers	+	+	+	—	—	—	—	—
	.6 CPP control systems	+	+	+	+	+	+	—	+
3	Vertical axis propellers	+	+	+	+	+	+	+	+
4	Steerable propellers	+	+	+	+	+	+	+	+

7.3 TECHNICAL DOCUMENTATION

7.3.1 When performing the technical supervision, the RS surveyor shall be guided by the technical documentation approved by the Register within the scope required by Part I "Classification" of the Rules for the Classification and Construction and agreed process procedures for installation and testing of propellers.

7.3.2 Documents confirming the Register technical supervision during manufacture of the materials, related equipment and products to be supervised and incoming for the mounting of propellers on board the ship in accordance with the supervision form stipulated by the RS Nomenclature shall be submitted.

7.3.3 Documents on all committed deviations from the approved technical documentation on propellers, as well as on the rectification of drawbacks detected at the previous stages of technical supervision shall be submitted to the RS surveyor.

7.4 FIXED PITCH PROPELLERS

7.4.1 General provisions concerning technical supervision and mounting of fixed pitch propellers (FPP) on board the ship are set out in 7.1.

7.4.2 Before the FPP is fitted, it is necessary to make sure that:

.1 the propeller cone and shaft cone are free of dents, corrosion and other defects preventing contact of the mated surfaces;

.2 the propeller cone fits to the shaft cone as required by the technical documentation (refer to also Part IV "Technical Supervision during Manufacture of Products" of the Rules for Technical Supervision);

.3 if there are keyed joints, keys are matched as required by the technical documentation;

.4 a control mark has been drawn on the shaft or the fixture for monitoring axial displacement of the propeller being fitted on the cone after the initial position has been determined.

7.4.3 When the FPP is being fitted, it is necessary to monitor axial displacement of the propeller in relation to the shaft, pressure when hydro-press fitting is used, determining axial force and pressure exerted on the mated surfaces.

7.4.4 When mounting the FPP, it is necessary to check installation of the nut and its locking, tests of the propeller (propeller shaft) seal.

7.4.5 When exercising control over the fastening of the detachable parts of FPP, it is necessary to check the tightening force, fastening parts of the detachable blades, nut and fairing.

7.4.6 The securing devices of the bolts (studs), by which the blades are fastened to the detachable-blade propellers of ice class ships, shall be recessed in the blade flange.

7.5 CONTROLLABLE PITCH PROPELLERS AND THEIR SUPPORTING SYSTEMS

7.5.1 General provisions concerning the supervision during the mounting and testing of controllable pitch propellers (CPP) and their supporting systems on board the ship are set out in 7.1.

7.5.2 Prior to mounting of the CPP on board ship, it is necessary to check the mated surfaces of blades, boss with propeller shaft, pitch actuating mechanisms, as well as their fastening parts in order to make sure that they have not been damaged during transportation or storage.

7.5.3 When mounting the CPP on board ship, it is necessary to monitor:

.1 force to make the coupling pressfit on the propeller shaft, tightening torque and quality of locking the securing items in flange joints;

.2 condition of the propeller shaft, boss and blade sealing;

.3 turning-over units and agreement between the blade position and the pitch indicators;

.4 requirement in 7.4.6 shall be met.

7.5.4 Upon finalization of mounting, CPP and oil pipes shall be tested for tightness by a hydraulic pressure in compliance with Part IV "Technical Supervision during Manufacture of Products" of the Rules for Technical Supervision.

7.6 VERTICAL AXIS PROPELLERS

7.6.1 General provisions concerning the technical supervision during mounting and testing of vertical axis propellers (VAP) on board the ship are set out in 7.1.

7.6.2 Prior to the VAP mounting on board the ship, it is necessary to check the flanges of the VAP housing and foundation, foundation bolts and nut for the absence of dents, rust and other defects.

7.6.3 When mounting VAP on board the ship, it is necessary to check:

.1 clearances between the rotor bottom and hull shell plating, between the vanes and guard;

.2 shaft line alignment;

.3 tightening torques of the VAP attachment to the seating;

.4 rotor shaft seals.

7.6.4 Upon finalization of the mounting, VAP shall be tested in compliance with Part IV "Technical Supervision during Manufacture of Products" of the Rules for Technical Supervision.

7.7 STEERABLE PROPELLERS

7.7.1 Prior to mounting of steerable propellers on board the ship, the requirements of 7.1 shall be met. Moreover, it is necessary to check the surfaces of flanges on the foundation and steerable propeller housing, rudder stock, propeller and nozzle in order to make sure that they have no dents, corrosion and other defects.

7.7.2 When mounting steerable propellers on board ship, it is necessary to check:

.1 tightening of the attachment of the steerable propellers to foundation and their locking;

.2 alignment of the driving shaft with driving mechanism.

7.7.3 Upon finalization of the mounting, the steerable propeller shall be tested according to the test program approved by RS.

7.8 MOORING TRIALS OF THE PROPELLERS

7.8.1 Once mounted on board ship, the propellers shall be checked in operation simultaneously with tests of the main machinery in accordance with Section 5.

7.8.2 The mooring trials shall be applied to the standard machinery, equipment, apparatus and control system according to a program approved by the Register.

7.8.3 During mooring trials of CPP, it is necessary to check:

- .1 agreement between the remote pitch indicators and position of the manoeuvring handles and the local mechanical pitch indicator;
- .2 position of the blades and controls of the CPP corresponding to zero-thrust of the propeller;
- .3 operation of CPP when the blades are turned over from "full ahead" to "full astern" from each control console;
- .4 operation of the control, alarm, automatic and protection systems in compliance with Section 12;
- .5 time required to turn over the blades from each console and by each pump set.

7.9 SEA TRIALS OF THE PROPELLERS

7.9.1 The sea trials of the propellers shall be carried out according to a program approved by the Register, simultaneously with the tests of the main machinery in compliance with Section 5.

7.9.2 During the sea trials of CPP, it is necessary to check:

- .1 zero-position of the blades at which the ship has no way with the CPP rotating;
- .2 agreement between the CPP blade position and the power output of the main machinery, the propeller shaft speed and ship speed under various specified operation conditions;
- .3 operability of the CPP under all conditions during the time stipulated for checking the main machinery;
- .4 reversing properties of the CPP when the blades are turned over from "full ahead" to "stop" and back; from "full astern" to "stop" and back; in so doing, it is necessary to measure the turning-over time and oil pressure in the hydraulic system;
- .5 emergency locking of the blades in ahead position, start and operation of the main machinery with the blades locked, as well as reversing of the main engine, if provided;
- .6 operation of the device preventing the engine from overloading;
- .7 turning-on of the stand-by power supply set of the hydraulic system when turning-out of the main set is simulated;
- .8 operation of the control, alarm and protection systems.

7.9.3 During sea trials of VAP, it is necessary to check:

- .1 agreement between the position of the main machinery power control lever and the propeller speed, ship speed or traction force under various operation conditions of the ship;
- .2 operability of VAP under various conditions during the time stipulated for checking the main machinery;
- .3 joint and separate shifting of the handles to control the propulsion and steering servomotors under various operation conditions of the ship;
- .4 time required to shift the control lever from zero position to astern and ahead positions;
- .5 operation of the emergency manual VAP control system;
- .6 operation of the control, alarm and protection systems.

8 SYSTEMS AND PIPING

8.1 GENERAL

8.1.1 This Section specifies the scope and procedure of technical supervision during installation and testing of the ship systems.

8.1.2 General provisions for the organization of the technical supervision are given in Section 1.

8.1.3 Technical documentation.

8.1.3.1 Installation and testing of systems and piping shall be performed under the Register technical supervision according to the RS-approved technical documentation.

8.1.4 Technical supervision of the Register.

8.1.4.1 Verification of the installation and testing of the systems and piping shall be generally carried out in conjunction with the associated machinery, pressure vessels and equipment.

8.1.4.2 The system components shall have documents confirming the Register technical supervision during the manufacture thereof in accordance with the supervision type stipulated by the RS Nomenclature.

8.1.4.3 Surveys during installation and testing of systems and piping shall be performed in compliance with the examination and testing plan developed by the shipyard according to 8.2.1 based on Table 8.1.4.3 taking into account 8.3.

Table 8.1.4.3

Nos.	Items of technical supervision	Installation			Trials				
		Review of technical documentation	External examination with checks of system elements and inspection dismantling	Special checks	Mooring			Sea	
					for tightness under working conditions	in modes specified for supporting mechanisms, vessels and other devices in operation	special checks	in operation	special checks
1	Ship's service systems:								
	.1 bilge	+	+	—	+	—	+	—	—
	.2 ballast, heel and trim	+	+	—	+	+	+	—	—
	.3 sewage	+	+	—	+	+	+	—	—
	.4 scupper pipe	+	+	—	+	+	+	—	—
	.5 heating systems of fuel and luboil tanks, ballast water tanks and cargo tanks of oil tankers	+	+	—	+ ¹	+	+	—	—
	.6 ventilation	+	+	—	+	+	+	—	—
	.7 air, vent, cargo vapour discharge, overflow and sounding pipes	+	+	—	+	+	+	—	—
	.8 hydraulic drives of machinery and equipment	+	+	—	+	+	+	+	—
	.9 voice pipes	+	+	—	+	—	+	+	—
	.10 cargo systems of chemical carriers, gas carriers and oil tankers	+	+	—	—	+	+	—	—
	.11 compressed air for tyfon, clearing of bottom and side fittings, controls of remotely operated fittings, air controlled automatic devices and fittings	+	+	+	+	—	+	—	—
	.12 inert gases								
2	Systems of machinery installations:								
	.1 oil fuel system	+	+	—	+ ¹	—	+	+	—
	.2 luboil system	+	+	—	+	—	+	+	—
	.3 cooling water system	+	+	—	+	—	+	+	—
	.4 compressed air system	+	+	—	+	—	+	+	—
	.5 gas-exhaust system	+	+	—	+	—	+	+	—
	.6 steam and blow-off systems	+	+	—	+	—	+	+	—
	.7 condensate and feed water system	+	+	—	+	—	+	+	—
	.8 thermal oil system	+	+	—	+	—	+	+	—

¹ Tightness tests according to 8.2.2.4.4 and 8.2.3.1.7.

8.1.4.4 When surveying the systems and piping, the RS surveyor, in addition to checking for the fulfilment of the working documentation requirements, shall exercise control over the compliance thereof with the schematic diagrams of the approved design.

8.2 SURVEY PLANNING

8.2.1 Prior to commencement of survey of the systems and piping of the ship under construction, the RS Branch Office shall agree the examination and testing plan developed by the shipbuilder taking into account Table 8.1.4.3. The shipbuilder shall be informed about that at a kick off meeting prior to commencement of construction according to 1.7.1 and with due regard to 8.3 and 8.4.

The builder shall agree to undertake ad hoc investigations during construction as may be requested by RS where areas of concern arise and the builder to agree to keep RS advised of the progress of any investigation. Whenever an investigation is undertaken, the builder shall be requested, in principle, to agree to suspend relevant construction activities if warranted by the severity of the problem.

8.2.2 During approval and agreement of the examination and testing lists a note shall be taken of specific published Administration requirements and interpretations of statutory requirements.

8.2.3 The shipyard shall be requested to advise of any changes to the activities agreed at the kick off meeting and these shall be documented in the examination and testing plan. E.g. if the shipbuilder chooses to use or change sub-contractors, or to incorporate any modifications necessitated by changes in production or inspection methods, rules and regulations, structural modifications, or in the event where increased inspection requirements are deemed necessary as a result of a substantial non-conformance or otherwise.

8.2.4 Quality standards for installation and testing of the ship systems and piping shall be reviewed and agreed during the kick-off meeting. The work shall be carried out in compliance with the RS rules and under the RS technical supervision.

8.2.5 Any changes to the kick-off meeting records shall be agreed and documented.

8.3 TECHNICAL SUPERVISION DURING INSTALLATION OF SYSTEMS AND PIPING

8.3.1 General requirements.

8.3.1.1 Surveying the installation of the systems and piping referred to in the RS Nomenclature shall provide for checking:

- .1 compliance of the system components with the requirements of the technical documentation;
- .2 proper arrangement of the piping, fittings, instrumentation and other components;
- .3 the system as a whole for tightness under the working conditions according to Table 8.1.4.3.

8.3.1.2 In the process of checking the compliance of the system components with the requirements of technical documentation it is necessary to make sure that:

- .1 the completeness of the system complies with the technical documentation;
- .2 articles of the required dimensions and types have been used as the system components;
- .3 the system fittings have the Register documents confirming the Register technical supervision during their manufacture;
- .4 prior to installation on board ship, the system components have been subjected to hydraulic tests by an appropriate pressure.

8.3.1.3 When checking the proper arrangement of the system components, fulfilment of the following requirements shall be monitored:

- .1 assembly, welding and testing of the ship hull, including partition bulkheads, foundations, manholes, etc. shall be finalized;
- .2 fitting-out parts of the hull structures (welded-on pieces, bulkhead/deck pieces, scuppers, etc.) shall be installed;
- .3 installation of machinery, vessels and other equipment being part of the system shall be finalized and adopted by the firm (manufacturer) inspection body;
- .4 bottom, side, shut-off and other fittings and instruments shall be installed;
- .5 standard gaskets, fasteners and hangers shall be installed on the pipes, the latter shall be securely fastened;

- .6 flanges of adjacent pipelines shall be dispersed and not be tangent to the pipes running in parallel;
- .7 presence of devices intended for purging and draining of the medium, absence of visible places of liquid stagnation and air pocket formation; other measures to preclude hydraulic shocks;
- .8 presence of identification plates of the fittings and indicators of the shut-off valve position;
- .9 existence of cathodic protection;
- .10 existence of insulation in the appropriate areas, devices for leak collection, as well as casings which protect the electrical equipment and hot surfaces against contact with the conveyed medium from the detachable joints;
- .11 ease of operation of the local and remote controls of the fittings, reliable access to these controls.

8.3.1.5 Special requirements for the survey of installation of the systems which take account of the salient features of the design and purpose of each system are set out in 8.2.2 and 8.2.3.

8.3.1.6 Allowable misalignment of metal piping during assembly.

Unless otherwise specified by the Register, the tolerances for the misalignment of the pipes to be welded shall be as follows:

- .1 for pipes of all diameters and thicknesses welded with remaining backing ring — 0,5 mm;
- .2 for pipes welded without backing ring:
 - .2.1 with internal diameter less than 150 mm and wall thickness up to 6 mm inclusive — 1 mm or 1/4 the wall thickness, whichever is less;
 - .2.2 with internal diameter less than 300 mm and wall thickness up to 9,5 mm inclusive — 1,5 mm or 1/4 the wall thickness whichever is less;
 - .2.3 with internal diameter of 300 mm and over and wall thickness over 9,5 mm — 2,0 mm or 1/4 the wall thickness whichever is less.

8.3.1.7 Requirements for installation of flexible joints (hoses).

8.3.1.7.1 Installation of hoses shall be carried out in accordance with the requirements of the manufacturer, taking into account the minimum radius of bend, kinking angle and orientation, as well as presence of a support, if necessary. In places where hoses can be subjected to external damages an appropriate protection shall be provided. After installation, the system shall be tested by maximum working pressure and checked for the absence of possible faults and leaks. General provisions concerning installation of the flexible hoses are given in Appendix to this Section.

8.3.1.8 Check of the systems for tightness (except those especially indicated in 8.3.1.8.1) in accordance with 21.2.3, Part VIII "Systems and Piping" of the Rules for the Classification and Construction after their assembly on board the ship shall be generally performed under working conditions during the mooring trials of the systems.

If such conditions make it impossible to judge the tightness of the individual system components (air, sounding and overflow pipes, pipelines which are not easily accessible for examination, etc.) these components shall be subjected to special tightness tests at working pressure prior to testing the systems in operation.

8.3.1.8.1 Butt joints welded on board the ship shall be subjected to hydraulic tests in accordance with 21.2.1, Part VIII "Systems and Piping" of the Rules for the Classification and Construction. In so doing, the fittings of the systems shall be safeguarded against damage by test pressure.

8.3.1.8.2 If the hydraulic tests of the pipeline in assembly are conducted on board the ship, the strength and tightness tests may be combined.

8.3.1.8.3 When carrying out hydraulic tests, attention shall be given to possible formation of air pockets in the upper parts of the piping, and in connection with this, it is necessary to provide appropriate devices for air expulsion.

8.3.1.8.4 Use of compressed air as substitution for the tightness test under working conditions may be accepted only for systems specified in the relevant technical documentation approved by the Register.

8.3.1.8.5 The procedure of testing the piping by compressed air shall make it possible for the RS surveyor to make sure that no leaks from the joints and no impermissible air pressure drop occur in the system.

8.3.1.9 Protective anticorrosive coatings shall be used in accordance with 1.4.2, Part VIII "Systems and Piping" of the Rules for the Classification and Construction and the technical documentation approved by the Register.

During survey the applicable requirements of 2.12.7 of the Guidelines shall be met.

8.3.1.10 Materials containing asbestos shall not be used for installation and assembly of systems and piping on board the ship.

During survey of installation of systems and piping, the documents confirming the absence of asbestos in the materials of connection gaskets shall be submitted.

If the material of a sealing element is a material that has no Type Approval Certificate (except for copper and copper-base alloys, as well as rubber and fluoroplast) the Register reserves the right to require the performance of chemical analysis of the sample of the sealing material. The application of the rubber gaskets is allowed for systems and piping with the working medium temperature not more than 100 °C, fluoroplast — not more than 150 °C.

8.3.2 Special requirements for survey of installation of the ship's service systems.

8.3.2.1 When surveying the installation of the bilge system, the following matters shall be checked in addition to those outlined in 8.3.1:

.1 arrangement of the bilge suctions in all spaces to be drained to determine whether they comply with the design as regards their number and location (depending on the purpose, dimensions and configuration of the bottom part of the space);

.2 installation of non-return and non-return shut-off valves on distributing boxes and bilge suctions in accordance with the design;

.3 ease of access for cleaning mud boxes and strainers without having to disassemble the suctions and absence of superfluous bends between the boxes and bilges;

.4 installation of automatic alarms to give warning in the event of excess of permissible level in the wells;

.5 possibility for free access of water into the bilges or wells where a ceiling or removable covers are fitted;

.6 reliability of the means to disconnect the bilge system from other ship's service systems.

8.3.2.2 When surveying the installation of the ballast system, the following matters shall be checked in addition to those outlined in 8.3.1:

.1 arrangements of suctions in accordance with the design;

.2 arrangement of ballast suctions and discharges in relation to the sea inlet boxes and pipes of other systems;

.3 availability of reliable means to disconnect the ballast system from other systems and from ballast tanks used for storage of fuel oil.

8.3.2.3 When surveying the installation of the sewage system and scupper pipe system, the following matters shall be examined in addition to those outlined in 8.3.1:

.1 proper installation of the side non-return valves, connecting pieces and scupper pipes;

.2 existence of pipe slopes ensuring reliable run-off of liquid;

.3 measures to prevent possible flooding of adjacent watertight compartments through the sewage pipes led to the machinery space bilges and shafting tunnels;

.4 absence of liquid run-off from the non-refrigerated cargo spaces into the bilges of refrigerated cargo spaces;

.5 operation of the hydraulic seals or equivalent devices;

.6 access to self-closing and non-return shut-off valves and their actuators.

8.3.2.4 When surveying the installation of the heating systems of fuel oil, lubricating oil and water ballast tanks, the following matters shall be checked in addition to those outlined in 8.3.1:

.1 mutual arrangement of the suction ends of pipes and heating coils in the fuel oil and lubricating oil tanks having regard to the requirements of 13.3.2 and 13.3.3, Part VIII "Systems and Piping" of the Rules for the Classification and Construction;

.2 availability of arrangements to monitor escape of the heating steam condensate from the fuel oil and lubricating oil tanks;

.3 availability of arrangements to monitor the fuel oil and lubricating oil heating temperature;

.4 tightness of the fuel oil heating coils when tested by hydraulic pressure of $1,5P_{work}$ but not less than 0,4 MPa.

8.3.2.5 When surveying the installation of the ventilation system, the following matters shall be checked in addition to those outlined in 8.3.1:

.1 avoidance of the ventilation duct penetrations through watertight bulkheads;

.2 arrangement of fire dampers, existence of identification painting of the places where these are installed, operation of the automatic and manual drives and ease of access to the damper control, indicators of the damper positions;

.3 gastightness of the ducts for removal of explosion and fire-dangerous vapours and gases, installation of flame-arresting fittings, absence of conditions for spark formation during closing of the ducts;

.4 availability of the closing arrangements for ducts operated from spaces fitted with smothering facilities;

.5 location of the ventilator heads of supply ducts and the air inlets to preclude the risk of drawing in contaminated air and admission of sea water;

.6 height of the ventilator coamings;

.7 independence of the ventilation ducts of stairway enclosures from ducts from other spaces in passenger ships;

.8 fitting of exhaust ducts from galley ranges;

.9 avoidance of the passage of the ventilation ducts intended for ventilation of machinery spaces in passenger ships through the accommodation and service spaces and control stations specified in the RS rules as well as ventilation ducts from the accommodation and service spaces and control stations through these machinery spaces;

.10 presence of devices monitoring operation of fans in enclosed spaces and holds of ships intended for the carriage of motor vehicles and ro-ro machinery;

.11 equipment of the ventilation of battery rooms and boxes to determine compliance with the requirements of the RS rules, namely: supply and removal of air; absence of the flame-arresting fittings; presence of coatings of the ventilation ducts and fan to protect them against the exposure to exhaust gases. In case of natural ventilation, it is necessary to check additionally the angle of duct deflection from the vertical, as well as the duct length. In case of mechanical exhaust ventilation, it is necessary to check additionally the free access for the air to the inlets of exhaust ducts;

.12 possibility of free flow of air to the inlets of exhaust ducts of the cargo pump rooms and location of these inlets;

.13 gastightness of the ducts outside the pump rooms, independence thereof from other ventilation systems and the device for emergency ventilation operating in the event of the inlets located below the floor plates being flooded;

.14 measures to prevent spark formation when the ducts from pump rooms are being closed, location of the outlets relative to other openings, oil vapour ignition sources and the inlets of ventilation ducts;

.15 location of the suction ventilation inlets relative to cargo area, cargo tank openings, open outlets of vent pipes, as well as availability of flame-arresting fittings;

.16 absence of trapped zones in holds intended for the carriage of dangerous cargoes.

8.3.2.6 When surveying the installation of the air, vent, overflow and sounding pipes, the following matters shall be examined in addition to those outlined in 8.3.1:

.1 availability of air pipes for each tank intended for the storage of liquid and each filled cofferdam, as well as the ice and sea inlet boxes;

.2 places where the air pipes are connected to the tanks and their location relative to filling pipes;

.3 fitting of shut-off valves directly on the ice and sea inlet boxes;

.4 places where the air pipes are fitted with due regard to fire safety and their height above the deck;

.5 correspondence of the clear area through the flame-arresting fittings to the cross-sectional area of the air pipe;

.6 fitting of automatic devices to prevent the sea water from getting into tanks through the outlets of air pipes;

.7 arrangement of the air pipes to preclude the formation of hydraulic seals under ship heel and trim conditions;

.8 absence of detachable connections of the air pipes of fuel oil and lubricating oil tanks in way of accommodation and refrigerated cargo spaces, as well as under the lining;

.9 presence of identification plates on the outlets of air pipes;

.10 secure attachment of the air pipes to hull structures and protection thereof against damage by deck cargo;

.11 presence of flame arresters and shut-off devices on vent pipes led from each tank; presence of flame arresters on pipes through which the tanks can communicate, their location which shall preclude the entry of liquid cargo into the flame arresters;

.12 compliance of the flame-arresting fittings of vent pipes (with due account of the ease of disassembly), cross-sectional area, direction of the flow of the gas and air mixture being exhausted, devices for removing liquid installed, where necessary, with the requirements of the RS rules;

.13 height of the vent pipe outlets above the cargo deck and location thereof well away from the sources of ignition;

.14 reliability of special measures to ensure safety of the vent systems in ships carrying boiling petroleum products;

.15 pressure of pressure/vacuum valve operation for opening and closing (at the surveyor's discretion);

.16 location of the common header or pipe to which the overflow pipes are led in relation to the deepest damage and load waterlines;

.17 ease of observation and access to devices to indicate overflow of fuel oil;

.18 location and ease of access to the upper ends of sounding pipes led from tanks, bilges and wells;

.19 ease of passing a sounding rod in the sounding pipes;

.20 reliability of protection of the transparent inserts fitted on level indicators against damages;

.21 location of self-closing arrangements of the sounding pipes fitted in double-bottom fuel oil and lubricating oil tanks relative to the level of floor plates, heated surfaces and electrical equipment and fitting of self-closing control cocks thereon;

.22 protection of the bottom plating from damaging by a sounding rod;

.23 reliability of sealing of the upper ends of sounding pipes and presence of marking (identification plates) thereon;

.24 measures to protect the sounding pipes projecting above the open decks against damaging during the operation of the ship;

.25 reliability of protection against spark formation when taking soundings in fuel oil and lubricating oil tanks;

.26 measures to prevent the formation of air cushions in the upper parts of the sounding pipes.

8.3.2.7 When surveying the installation of the hydraulic drives of machinery and equipment, the following matters shall be examined in addition to those outlined in 8.3.1:

- .1 arrangements for draining off the working fluid upon operation of the safety valves;
- .2 arrangements for air expulsion from machinery and piping;
- .3 arrangements for replenishment of the working fluid leakage and for drainage of the working fluid from the system;
- .4 proper installation of filters upstream of the hydraulic pumps and possibility of maintaining filters in operation;
- .5 measures to prevent the working fluids both from getting on hot surfaces and electrical equipment and from self-ignition when the pressure rises.

8.3.2.8 When surveying the installation of the liquid cargo systems of oil tankers, the following matters shall be examined in addition to those outlined in 8.3.1:

- .1 elevation of the filling pipe terminations above the bottom;
- .2 absence of the by-pass valves and other connecting fittings between the cargo tanks and cofferdams dividing them;
- .3 absence of the cargo pipe passages through tanks not intended for the storage of cargo, and connections with other tanks and pipes, as well as presence of two shut-off devices on the pipe sections connecting different types of cargo;
- .4 fulfilment of the requirements of the Rules for the Classification and Construction concerning pipe laying and the cargo and slop tanks;
- .5 gastightness of the sealing glands of the spindles used to operate the valves placed inside the tanks;
- .6 reliability of the venting system and electric connections according to Section 10;
- .7 absence of detachable connections of pipes in way of the superstructures;
- .8 reliability of the measures to preclude spark formation, including the cases of hose connections from shore installations, installation of earthing system and operation of the rubbing parts of valve drives;
- .9 presence of the spectacle flanges, spool pieces and blank flanges on pipes in way of the superstructure and on the discharging ends of the pipeline;
- .10 fulfilment of the requirements of the RS rules concerning arrangement of driving machinery of cargo pumps, devices used for emergency shut-down of cargo pumps and instruments on delivery piping;
- .11 reliability of measures to prevent oil from getting on heated surfaces;
- .12 possibility of discharging oil residues from cargo and stripping pipelines.

8.3.2.9 When surveying the installation of the compressed air system for tyfon, clearing of side and bottom fittings, air controlled automatic devices and fittings, the following matters shall be checked in addition to those outlined in 8.3.1:

- .1 presence of arrangements to protect the tyfon against penetration of condensate therein;
- .2 use of non-return shut-off valves for clearing the sea inlet boxes;
- .3 protection of the air controlled automatic components against leaks in the hydraulic pipes where arranged jointly in units;
- .4 presence of the duplex reducing valves in the feed lines of air controlled automatic systems.

8.3.2.10 Inert gas system (IGS).

8.3.2.10.1 On prototype and series-built ships, IGS shall be tested in operation thereof to full capacity by delivering gas into the protected spaces.

On series-built ships, IGS may be checked in two steps: by delivering air into the protected space and by venting gas through the deck main to the atmosphere.

8.3.2.10.2 On prototype and series-built ships, it is necessary to check:

stability in delivery of gas with oxygen content and temperature in accordance with 9.16, Part VIII "Systems and Piping" of the Rules for the Classification and Construction and pressure within limits prescribed by design; moreover, operation of the system in ventilation mode shall be checked;

stability in maintaining design water pressure in cooling systems and water level in water seals;
operation of the water seal heating system;
operation of the device maintaining safe pressure in the cargo tanks;
operation of the automatic monitoring and regulating devices and the equipment supporting operation of the system (pumps, blowers).

8.3.2.10.3 On prototype and series-built ships, by changing the mode, working parameters which fall outside the set limits shall be simulated. In doing so, it is necessary to check:

- .1 visual and audible alarms in the following cases:
low water pressure or low water flow rate to the scrubber;

increase of gas temperature in excess of 65 °C for cargo tanks and 50 °C for dry cargo holds;
oxygen content in the inert gas more than 14 % by volume in cargo holds;
oxygen content in the inert gas main more than 8 % by volume;
failure of the power supply to the automatic control system for the gas regulating valve and to the indicating devices referred to in 9.16, Part VIII "Systems and Piping" of the Rules for the Classification and Construction;
low water level in the deck water seal;
gas pressure drop down to 1 kPa;
when gas pressure reaches 10 kPa;
high water level in the scrubber (when using flue gas of boilers);
blower failure (when using flue gas of boilers);
insufficient fuel feed to the generator;
failure of power supply to automatic generator control system;
.2 automatic shutdown of the inert gas blowers (when using flue gas of the boilers) in the following cases:
low water pressure or low water flow rate to the scrubber;
increase of gas temperature in excess of 65 °C for cargo tanks and 50 °C for dry cargo holds;
high water level in the scrubber;
.3 automatic shutdown of the gas regulating valve in the following cases:
low water pressure or low water flow rate to the scrubber;
increase of gas temperature in excess of 65 °C for cargo tanks and 50 °C for dry cargo holds;
high water level in the scrubber (when using flue gas of the boilers);
failure of power supply to the generator;
failure of inert gas blowers (when using flue gas of the boilers);
.4 cut-off of fuel supply to the generator in the following cases:
low water pressure or low water flow rate to the scrubber;
increase of gas temperature in excess of 65 °C for cargo tanks and 50 °C for dry cargo holds;
failure of power supply to the generator;

.5 shut-down of the cargo pumps when the pressure in the main drops to 0,5 kPa or, instead of shutting down the pumps, operation of the alarms may be checked (refer to 9.16, Part VIII "Systems and Piping" of the Rules for the Classification and Construction).

8.3.2.10.4 On ships equipped with the system with inert gas supplied from cylinders (refer to 9.16, Part VIII "Systems and Piping" of the Rules for the Classification and Construction), it is necessary to check the presence of brands and documents on the cylinders as well as the value of pressure therein.

Verification of the cylinders shall be carried out in accordance with 9.7.4, and verification of the whole system, in accordance with 8.3.1 and 8.4.1 of the Guidelines.

8.3.2.10.5 On ships equipped with nitrogen generator system, it is necessary to check:

audible and visual alarms indicating parameters given in 9.16, Part VIII "Systems and Piping" of the Rules for the Classification and Construction;

automatic stop of the compressor (refer to 9.16, Part VIII "Systems and Piping" of the Rules for the Classification and Construction);

automatic locking of arrangements, which maintain permanent pressure of the inert gas in the system (refer to 9.16, Part VIII "Systems and Piping" of the Rules for the Classification and Construction);

operation of the system as required in 4.4.10.1 and 4.4.10.2 of the Guidelines.

8.3.3 Special requirements for surveying installation of machinery installation systems.

8.3.3.1 When surveying the installation of the fuel oil system, the following matters shall be checked in addition to those outlined in 8.3.1:

.1 piping laying and availability of drip trays in necessary places to prevent spillage of fuel on the engines, turbines, gas exhaust piping, boilers, electrical equipment, etc.;

.2 presence of means for emergency shut-down of pumps;

.3 availability of actuators for quick-closing valves and their operation;

.4 availability of drainage arrangements and arrangements for collection leakage fuel;

.5 availability of alarm devices to give warning if the fuel oil reaches the upper predetermined level in the drain and service tanks;

.6 reliability of installation of the non-metal flexible joints and availability of documents on fire-resistance thereof;

.7 tightness of the system when tested by test hydraulic pressure of $1,5P_{work}$ but not less than 0,4 MPa;

.8 presence of thermal compensators on heavy oil pipelines to compensate thermal expansion;

.9 operation of the fuel oil filter interlock so that the filters cannot be opened when under pressure and that fuel oil cannot be supplied therein, when opened;

.10 presence of safely devices to preclude over-pressure in fuel oil heaters and pumps;

.11 operation of arrangements to preclude mixing of different fuel grades.

8.3.3.2 When surveying the installation of the lubricating oil system, the following matters shall be checked in addition to those outlined in 8.3.1:

.1 termination of the lubricating oil drain pipes in the oil drain tank;

.2 reliability of arrangements to prevent mixing of fuel oil and lubricating oil, as well as of lubricating oils of different specifications where common separators are provided;

.3 arrangement of pumps to ensure their suction operation;

.4 measures to prevent the engine room from being flooded through the oil drain tanks in the event when the shell plating is damaged;

.5 arrangements to drain off the lubricating oil upon operation of the safely valve;

.6 arrangement of filters, heaters and other equipment, as well as ease of access thereto;

.7 piping and tanks to make sure that they are free of scale, sand, filings and other foreign objects and matter.

8.3.3.3 When surveying the installation of the cooling water system, the following matters shall be checked in addition to those outlined in 8.3.1:

.1 arrangement of expansion tanks and steam-outlet pipes to exclude formation of trapped zones and ensure cooling of the highest cooled surfaces;

.2 interconnection of sea inlets and location of the isolating valves relative to suctions;

.3 access to filters and means enabling the filters to be cleaned without having to stop the cooling pumps;

.4 arrangements to monitor the tightness of fitting of the sea inlets and gate valves to be closed;

.5 measures to protect the system components against electrochemical corrosion.

8.3.3.4 When surveying the installation of the compressed air system, the following matters shall be checked in addition to those outlined in 8.3.1:

.1 presence of non-return shut-off valves in places specified by the design;

.2 presence of pipe slope and arrangements for draining the accumulations of oil and water and to prevent them from penetration into the main starting valve of the engine;

.3 absence of blind off-takes and blanked nipple unions in the piping, which contribute to the accumulation and self-ignition of oil sediments;

.4 absence of connections between the starting and filling pipes.

8.3.3.5 When surveying the installation of the gas-exhaust system, the following matters shall be checked in addition to those outlined in 8.3.1:

.1 arrangements precluding the possibility of sea water entering the engine;

.2 laying of gas-exhaust pipes and arrangement thereof relative to the oil fuel tanks;

.3 availability and arrangement of manholes, hatches and vertical ladders for cleaning of the uptakes, gas-exhaust pipes, silencers and spark arresters;

.4 availability of cocks to drain tar;

.5 arrangements to prevent the entry of water from the waste heat boilers into the engine and availability of hydraulic seals in these arrangements to preclude the entry of gases into the machinery spaces.

8.3.3.6 When surveying the installation of the steam and blow-off systems, the following matters shall be checked in addition to those outlined in 8.3.1:

.1 presence of slopes along the whole length of the pipes, sufficient to provide run-off of the condensate in the direction of steam movement;

.2 protection of the shell plating of the ship against the action of water during blowing-off;

.3 installation of the steam line well away from the pipelines and equipment of the oil fuel and lubricating oil systems as well as from the electrical equipment, entrances, control stations and other permanently manned places;

.4 availability of arrangements to drain condensate, arrangement of the steam lines in spaces, termination of the open ends of the pipes for steam line blow-off;

.5 measures to reduce the stresses due to thermal expansion, producing of prestressing of the steam lines, possibility of displacement of supports, etc.;

.6 agreement between the clear area through the steam discharge connections and the cross-sectional area of the safely valves;

.7 reliability of the installation of the steam discharging pipes for steam line blow-off and absence of detrimental effect of the discharged steam on equipment.

8.3.3.7 When surveying the installation of the condensate and feed water system, the following matters shall be checked in addition to those outlined in 8.3.1:

- .1 mutual arrangement of the condensate collector, discharge pipe and condensate pump to preclude flooding of the lower row of pipes, and to ensure the required positive pressure and smooth delivery of the condensate to the pump;
- .2 availability of the protective screen on the steam lines of ejectors;
- .3 possibility of free thermal displacement of the piping and equipment.

8.3.4 Requirements for the survey of installation of fittings.

8.3.4.1 Survey of the installation of fittings of all types and purposes, except the bottom and side fittings, shall be performed together with the verification of the installation of systems, to which the said fittings belong.

8.3.4.2 Survey of the bottom and side fittings may be performed immediately before launching of the ship; irrespective of the degree of readiness of the systems and piping connected with these fittings.

8.3.4.3 When surveying the installation of the bottom and side fittings, it is necessary to check:

- .1 compliance of the fittings with the requirements of technical documentation (refer to 8.3.1.2);
- .2 compliance of the arrangement of the fittings relative to hull structures and methods of securing to the shell plating with the requirements of technical documentation;
- .3 material of gaskets and seals of the fittings. Materials, which would readily deteriorate in the event of fire, shall not be used;
- .4 presence of arrangements for clearing, recirculation, heating, as well as gratings;
- .5 operation of the local and remote controls, installation of valve position indicators, ease of access to the driving means;
- .6 proper installation of the non-return valves of scuppers and overboard discharge pipes;
- .7 availability of means for preventing the discharged water from passing inboard, into lifeboats and liferafts;
- .8 installation and attachment of protectors and insulation of the contacts between different metals.

8.3.4.4 The securing parts of the bottom and side fittings shall be strong enough, gaskets shall have no tears, cracks and notches and not protrude beyond the sealed surfaces, the material shall comply with the drawings approved by the Register.

8.3.4.5 The bottom and side fittings installed on sea inlet and ice boxes or distance pieces shall be tested together with them for tightness of closing and tightness of connection in accordance with Appendix 1 to Part II "Hull" of the Rules for the Classification and Construction.

The overboard discharge fittings shall be tested for tightness by the clearing medium pressure which shall not exceed 0,5 MPa.

8.4 SURVEY OF SYSTEMS AND PIPING DURING MOORING AND SEA TRIALS

8.4.1 General requirements for the survey of systems in operation.

8.4.1.1 Survey of the systems in operation shall be performed upon finalization of the installation thereof and upon completion of construction work on board the ship.

8.4.1.2 Prior to the beginning of testing the systems in operation, the program and procedure for testing the systems shall be submitted.

Special requirements for survey of the systems in operation, taking into consideration the peculiar features of their design and purpose, are set out in 8.4.2 and 8.4.3.

8.4.1.3 The final survey of the ship's service systems shall be generally performed during the mooring trials. In this case, in the process of mooring trials of the ship, supervision of the normal functioning of these systems in operation for their designated purpose shall be carried out.

8.4.1.4 In specific cases, considering particular conditions of ship construction (water area pollution, shallow waters, impossibility of creating full loading conditions, etc.), final full or partial verification of the systems: bilge, ballast, ballast water heating, ventilation, air, venting, cargo vapour discharge, overflow pipes, compressed air for air controlled automatic devices and fittings may be performed, on agreement with the Register, during the sea trials of the ship.

8.4.1.5 Survey of the systems of machinery installation during mooring trials shall be performed with the aim to check the readiness of these systems for the sea trials of the ship's machinery installation. Final survey of the systems of machinery installations shall be performed in the course of the sea trials. Checks and tests performed previously during the mooring trials and not associated with operation of the systems for their designated purpose shall not be carried out over again on the sea trials.

8.4.1.6 Mooring trials of the systems of machinery installations, as well as the following ship's service systems: bilge, ballast, fuel tank heating, cargo on oil tankers and ballast water, ventilation, clearing of bottom and side fittings, air-controlled automatic devices and fittings shall be conducted under the conditions stipulated by the trial program. Subject to special agreement with the Register, the driving means of machinery serving the systems may be supplied from shore power sources (steam, air, electricity).

8.4.1.7 Survey of ship's service systems not specified in 8.4.1.6 during the mooring trials, as well as verification of the systems of machinery installations during the sea trials shall be performed in operation, unless this Section and trial program stipulate any particular, especially created conditions for their checking.

8.4.1.8 Prior to testing a system in operation, it is necessary to make sure that the system components have not received damages caused by installation work, that the devices, fittings, machinery and equipment stipulated by the technical documentation are available.

8.4.1.9 The firm (manufacturer) inspection body shall be responsible for the organization of trials, keeping of documentation, making of measurements, suitability of devices, fidelity of entries, etc.

8.4.1.10 As a result of the survey of the system in operation, the RS surveyor shall make sure that:

- .1 all operations stipulated by the technical documentation can be performed;
- .2 fittings and their controls operate reliably;
- .3 there are no working medium leakage and air inleakage;
- .4 standard instruments are suitable and give correct readings;
- .5 there are no impermissible vibrations, heating, noise;
- .6 insulation of piping and system equipment is adequate;
- .7 operational settings of signalling, regulating and preventing facilities and fittings are correct;
- .8 unattended operation and remote control of system equipped by automation devices is possible provided a distinguishing automation mark has been added to class notation of the ship;
- .9 system components are conveniently and safely maintained in operation and stipulated repair work can be performed;
- .10 main and stand-by machinery, vessels and other equipment which are verified in compliance with the requirements of the relevant sections are reliable.

8.4.2 Special requirements for the survey of ship's service systems in operation.

8.4.2.1 When surveying the bilge system during mooring trials, the following matters shall be checked in addition to those outlined in 8.4.1:

- .1 possibility of draining any compartment by each available bilge pump or by their substitutes, as well as possibility of emergency drainage of machinery space except when this is not provided for by the technical documentation;
- .2 operation of the arrangements preventing sea water from passing inboard, as well as from one watertight compartment into another;
- .3 operation of the self-priming pumps or vacuum arrangements;
- .4 possibility of simultaneous drainage of the machinery spaces through direct suctions and of other compartments by other pumps;
- .5 actual capacity of bilge pumping arrangements and effectiveness of draining places where water is likely to accumulate (on prototype ships only);
- .6 drainage of machinery spaces with the use of equipment preventing pollution from ships.

8.4.2.2 When surveying the ballast system during the mooring trials, the following matters shall be examined in addition to those outlined in 8.4.1:

- .1 loading and pumping-out of ballast from each ballast tank by the means intended for this purpose (by pumps, ejectors, gravity, from peaks);
- .2 operation of self-priming pumps when pumping out ballast from double bottom tanks;
- .3 operation of interlocks and local controls of fittings in the event of failure of the remote control system;
- .4 actual capacity of ballast pumps when pumping-out ballast from the remotest tanks and actual highest pressure in ballast compartments when water overflows through the air pipes (on prototype ships only).

8.4.2.3 When surveying the sewage system during the mooring trials, the following matters shall be checked in addition to those outlined in 8.4.1:

- .1 operation of non-return and non-return shut-off protective devices;
- .2 effectiveness of functioning of waste pipes including that in enclosed spaces when water is supplied to simulate fire suppression by shipboard facilities;
- .3 operation of hydraulic seals or their equivalent;
- .4 operation of facilities to prevent pollution from ships.

8.4.2.4 When surveying the heating system of fuel oil, lubricating oil, ballast water tanks and cargo tanks of oil tankers during the mooring trials, the following matters shall be checked in addition to those outlined in 8.4.1:

- .1 maximum temperature of fuel oil and lubricating oil heating which shall be by 15 °C lower than the flash point;
- .2 purity of steam condensate from the heaters of fuel oil and lubricating oil tanks;
- .3 operation of devices reducing steam pressure;
- .4 effectiveness of heating of the ballast tanks and ballast system fittings.

8.4.2.5 When surveying the ventilation system during the mooring trials, the following matters shall be checked in addition to those outlined in 8.4.1:

- .1 gas-tightness of ventilation ducts and operation of distributing devices;
- .2 operation of self-closing fire dampers and gate valves;
- .3 reliability of means of closure of the ventilation ducts and existence of measures to preclude admission of water into the ducts;
- .4 in prototype ships, it will be necessary to measure the actual capacity of ventilation of mechanical type used to monitor the rate of air changes required by the Rules for the Classification and Construction, and to check the effectiveness of ventilation in the following spaces: machinery spaces; enclosed holds intended for the carriage of motor vehicles and ro-ro machinery; refrigeration machinery rooms; refrigerated cargo spaces, battery rooms; foam fire extinguishing stations and smothering stations; control stations; helicopter hangars; holds for the carriage of dangerous cargoes, as well as battery boxes.

8.4.2.6 When surveying the system of air, venting, overflow and sounding pipes during the mooring trials, the following matters shall be checked in addition to those outlined in 8.4.1:

- .1 operation of air pipes when tanks are filled and drained through the relevant pipelines;
- .2 operation of arrangements preventing sea water from admission through the pipes the outlets of which are situated on open deck;
- .3 absence of hydraulic seals in air pipes at the permissible angles of heel and trim of the ship;
- .4 operation of flame-arresting fittings of the vent pipes when tanks are filled and drained and reliability of measures to preclude penetration of cargo oil therein;
- .5 direction of the flow of the discharged gas-air mixtures;
- .6 pressure in compartments at which the pressure/ vacuum valves open and close;
- .7 effectiveness of operation of the overflow pipes precluding egress of fuel oil through air pipe in the event of overflow;
- .8 reliability of measures to preclude the possibility of liquid flowing from one tank into another and liquid vapours entering adjacent tanks through the overflow pipes;
- .9 ease of using sight glasses and operation of alarm devices giving warning of overflow;
- .10 operation of the overflow tank filling alarms;
- .11 operation of self-closing and control cocks of sounding pipes;
- .12 operation of alarms of the cargo vapour discharge system, which produce alarm signal at high and low pressure in cargo tanks.

8.4.2.7 When surveying the hydraulic drives of machinery and equipment during mooring and sea trials, the following matters shall be checked in addition to those outlined in 8.4.1:

- .1 drain of working fluid upon operation of safety valves;
- .2 operation of arrangements for air expulsion from system;
- .3 possibility of filling the system with working fluid and replenishing leakage and complete draining the system;
- .4 operation of filters, regulating fittings and hydraulic accumulators.

8.4.2.8 When surveying the system of voice pipes during sea trials, the following matters shall be checked in addition to those outlined in 8.4.1:

- .1 ease of using the system, reliability of operation of call signals (whistles, bells);
- .2 audibility and clearness of the given orders;
- .3 absence of extraneous background noise in pipes passing through the spaces with high noise level.

8.4.2.9 When surveying the compressed air system for tyfon, clearing of bottom and side fittings, air-controlled automatic devices and fittings during mooring trials, the following matters shall be checked in addition to those outlined in 8.4.1:

- .1 operation of fittings to control the tyfon, which shall give distinct and abrupt audible signals producing the appropriate sound intensity, tone and clear sounding;
- .2 operation of arrangements reducing pressure of air for clearing bottom and side fittings;
- .3 degree of air purification and drying in the air-controlled automatic systems, possibility of changing over the air purifying and drying arrangements, as well as of replacing filtering elements without interruption of air supply to the system.

8.4.3 Special requirements for the survey of the system of machinery installation in operation.

8.4.3.1 When surveying the oil fuel system during mooring and sea trials, the following matters shall be checked in addition to those outlined in 8.4.1:

- .1 effectiveness of arrangements for collection of leakage fuel, filtering and purification of fuel oil;
- .2 operation of arrangements for remote stopping of pumps (refer to Section 10);
- .3 operation of controls of quick-closing valves;
- .4 possibility of cleaning filters without interrupting the supply of fuel to consumers;
- .5 operation of arrangements for regulation and automatic maintenance of the fuel oil temperature and level within the prescribed limits.

8.4.3.2 When surveying the lubricating oil system during mooring and sea trials, the following matters shall be checked in addition to those outlined in 8.4.1:

- .1 uniform and sufficient supply of lubricating oil to consumers;
- .2 effectiveness of arrangements for heating, filtering and purification of lubricating oil;
- .3 alarms to warn of limiting pressure and level of the lubricating oil, automatic start-up of standby pumps;
- .4 operation of sight devices and throttles, as well as protective devices.

8.4.3.3 When surveying the cooling water system during mooring and sea trials, the following matters shall be examined in addition to those outlined in 8.4.1:

- .1 uniform and sufficient water supply by main and standby means;
- .2 reliability of water supply regulation to ensure the most favourable operating conditions for consumers;
- .3 operation of the system to maintain machinery in the hot stand-by mode;
- .4 effectiveness of operation of the sea inlets, their heating, recirculation and clearing;
- .5 means provided to enable the filters to be cleaned without having to interrupt operation of the system;
- .6 operation of expansion tanks, filling with water of the highest cooled spaces, absence of trapped zones;
- .7 transfer to the emergency sea water cooling mode (on prototype ships only);
- .8 operation of arrangements for control and automatic maintenance of the cooling water temperature within the prescribed limits.

8.4.3.4 When surveying the compressed air system during mooring and sea trials, the following matters shall be checked in addition to those outlined in 8.4.1:

- .1 capacity of the main, standby and replenishing compressors with determination of time required to fill air receivers;
- .2 sufficiency of the amount of starting air to provide the specified number of starts and reversals of the main and auxiliary engines, operation of tyfon and for other purposes;
- .3 operation of arrangements enabling starting of main compressors according to 16.2.3, Part VIII "Systems and Piping" of the Rules for the Classification and Construction (on prototype ships only);
- .4 temperature of air entering the receiver and operation of appropriate coolers;
- .5 operation of arrangements for draining the accumulations of oil and water, as well as arrangements for relieving internal pressure of the pipes;
- .6 operation of alarms to warn of the pressure drop and arrangements for automatic control of the compressors.

8.4.3.5 When surveying the exhaust-gas system during mooring and sea trials, the following matters shall be checked in addition to those outlined in 8.4.1:

- .1 gas-tightness of connections and thermal compensators under vibration and high temperature conditions;
- .2 reliable operation of safety devices of the common exhaust lines and by-pass dampers in the composite waste heat/oil fired boilers;
- .3 effectiveness of insulation and reliability of its protection against breaking-down;
- .4 operation of arrangements to prevent the entry of water from the waste heat boilers and wet-type spark arresters into the engines;
- .5 operation of arrangements for extinguishing fire in spark arresters, silencers and waste heat boilers.

8.4.3.6 When surveying the steam and blow-off system during mooring and sea trials, the following matters shall be checked in addition to those outlined in 8.4.1:

- .1 operation of arrangements for compensating thermal expansion of the pipelines;
- .2 operation of arrangements for draining condensate from the housings of fittings and from pipelines;
- .3 absence of vibration;
- .4 operation of steam-driven machinery, pressure vessels and other equipment (refer to the relevant sections);
- .5 sufficiency of cross-sectional area of safety devices.

8.4.3.7 When surveying the condensate-feed water system during mooring and sea trials, the following matters shall be checked in addition to those outlined in 8.4.1:

- .1** operation of arrangements for separating oil and petroleum products;
- .2** operation of heat exchangers, metering devices, water samplers;
- .3** transfer of feed water in all variants stipulated by the technical documentation;
- .4** operation of regulating, protective and safety devices;
- .5** reliability of feeding means when operating separately and in parallel.

9 BOILERS, HEAT EXCHANGERS AND PRESSURE VESSELS

9.1 GENERAL

9.1.1 The provisions of this Section apply in technical supervision during installation and testing of boilers, heat exchangers and pressure vessels on board ship.

9.1.1.1 General provisions for technical supervision are set in Part I "General Regulations for Technical Supervision", general provisions for technical documentation — in Part II "Technical Documentation" of the Rules for Technical Supervision.

9.1.2 Prior to the installation of boilers, heat exchangers and pressure vessels it is necessary to make sure that all seating assembly and welding operations have been completed and the items themselves have the document confirming that they have been manufactured under the Register technical supervision.

9.1.3 Boilers, heat exchangers and pressure vessels shall be installed on and secured to the seatings in accordance with the technical documentation approved by the Register.

9.1.4 Dimensional discrepancies given in this Section may be accepted, unless otherwise specified in the approved technical documentation.

9.2 SURVEY PLANNING

9.2.1 Prior to commencement of survey of the boilers, heat exchangers and pressure vessels of the ship under construction, the RS Branch Office shall agree the examination and testing plan developed by the shipbuilder taking into account Table 9.2.1. The shipbuilder shall be informed about that at a kick off meeting prior to commencement of construction according to 1.7.1 and with due regard to 9.3.

The builder shall agree to undertake ad hoc investigations during construction as may be requested by RS where areas of concern arise and the builder to agree to keep RS advised of the progress of any investigation. Whenever an investigation is undertaken, the builder shall be requested, in principle, to agree to suspend relevant construction activities if warranted by the severity of the problem.

Table 9.2.1

Item of technical supervision	Check of installation on seating and securing	Internal examination	Hydraulic test	Steam test	Check in operation
Steam boilers	+	+	+	+	+
Heat exchangers	+	—	—	—	+
Pressure vessels	+	+	—	—	+

9.2.2 During approval and agreement of the examination and testing lists a note shall be taken of specific published Administration requirements and interpretations of statutory requirements.

9.2.3 The shipyard shall be requested to advise of any changes to the activities agreed at the kick off meeting and these shall be documented in the examination and testing plan. E.g. if the shipbuilder chooses to use or change sub-contractors, or to incorporate any modifications necessitated by changes in production or inspection methods, rules and regulations, structural modifications, or in the event where increased inspection requirements are deemed necessary as a result of a substantial non-conformance or otherwise.

9.2.4 Quality standards for installation and testing of the ship boilers, heat exchangers and pressure vessels shall be reviewed and agreed during the kick-off meeting. The work shall be carried out in compliance with the RS rules and under the RS technical supervision.

9.2.5 Any changes to the kick-off meeting records shall be agreed and documented.

9.3 INSTALLATION

9.3.1 Installation of steam boilers.

9.3.1.1 Boilers shall be installed on seating in accordance with the installation drawing defining the position of the boiler in relation to the centre and base planes, transverse bulkhead or moulded frame.

9.3.1.2 The boiler frame shall be secured to the seating in accordance with the drawing.

9.3.1.3 Mounting and thermal gaps of movable supports with the keeper plates fastened shall comply with the drawing; the value of gap between the base of the main boiler supports and bed plates shall be checked by feeler gauge.

9.3.1.4 Pads fitted between the transition frame and bed plate of the seating shall be at least 3 mm thick.

9.3.1.5 Nut and heads of bolts listening the boiler to the frame or transition plate of the seating shall fit to the surface of the fixed support, keeper plates or transition parts of the seating so that a feeler of 0,05 mm thick cannot pass in between over a length equal to 1/3 the circumference of the nut or bolt head. The fastening bolts and studs shall be prevented from making loose.

9.3.1.6 Local gaps between the pads and flanges of the seating as well as the transition frame with the bolts pressed shall not exceed 0,4 mm; along with that, the zone of contact between the mated surfaces of the pad, flanges of the seating and frame shall be provided over an arc equal to at least 2/3 of the support. On the remaining part, gaps shall be spaced apart..

Note. Place where the feeler leaf of 0,05 mm thick passes to a depth not more than 10 mm shall be considered as the contact point.

9.3.1.7 Overlap of the pads in relation to the seating bed plate shall not exceed 5 mm.

9.3.1.8 Installation and securing of the economizer as well as securing the boiler in its upper part by braces shall be performed in accordance with the requirements of the drawing.

9.3.1.9 Supervision during the installation of alarm and automation systems shall be performed in accordance with Sections 10 and 12.

9.3.2 Installation of heat exchangers and pressure vessels.

9.3.2.1 Installation of heat exchangers and pressure vessels shall be checked in accordance with the requirements of the working documentation for installation.

9.3.2.2 Bearing between heat exchanger or pressure vessel shell and the seating and embracing thereof by the upper band shall correspond to at least 2/3 of semi-circumference.

9.3.2.3 Length of the threaded part of fastening bolts and the gap between the band lug and seating shall be sufficient to tighten up the bands. The fastening bolts and studs shall be prevented from working loose.

9.3.2.4 Pads between the seating, band and the heat exchanger or pressure vessel shall be reliably pressed and not have cracks, tears across the internal and external edges.

9.3.2.5 When installing heat exchangers and pressure vessels, the applicable requirements of 9.3.1 shall be also met.

9.4 INTERNAL EXAMINATION

9.4.1 Internal examination of boilers.

9.4.1.1 The internal examination of a boiler shall be carried out by the RS surveyor upon finalization of installation work thereon, as well as installation of the boiler on seating and securing thereof.

9.4.1.2 The boiler components on the steam and water space side shall be re-activated and cleaned.

9.4.1.3 Ends of the generating, waterwall tubes and downcomers on the steam and water space side of headers shall have no damages, and the welds of drums, headers, end plates, flanges, branches for fittings and other essential components shall have no tears, cracks and other defects.

Using calibrated balls, it is necessary to make sure that the generating, waterwall tubes and downcomers are not deformed and blocked up.

9.4.1.4 During examination, it is also necessary to make sure that:

all hatches and manholes and attachments of the boiler are acceptable for examination, access inside the boiler is provided;

water level indicators have been installed in relation to the water level in accordance with the requirements of the Rules for the Classification and Construction;

internal outfitting of the drums and headers suits the drawing and the outfitting items have been reliably secured;
brickwork of the firing space has not been damaged;
fittings and gauges installed on the boiler are in compliance with the drawing and the impressions of brands and seals of the metrologic organization on the control gauges are not overdue;
drums and headers of the boilers, as well as headers of the steam superheaters are protected against direct effect of radiant heat.

9.4.2 Internal examination of heat exchangers and pressure vessels.

9.4.2.1 Internal examination of heat exchangers and pressure vessels, except air receivers, shall be carried out by the firm (manufacturer) inspection body. Air receivers shall be verified by the RS surveyor.

The internal examination shall be carried out before heat exchangers and pressure vessels are prepared for operational testing on board ship in order to confirm that all their components are in proper condition, re-activated and cleaned, heat exchangers and pressure vessels are fitted with appropriate fittings and devices in accordance with the approved technical documentation.

9.5 HYDRAULIC TESTS

9.5.1 Hydraulic tests of boiler for tightness by permission and in the presence of the RS surveyor.

During the test it is necessary to check the fulfilment of the requirements of Part IV "Technical Supervision during Manufacture of Products" of the Rules for Technical Supervision as far as they are applicable, as well as the completion of all works associated with the installation of valves and gauges. Tightness of the safety valves shall be ensured by inactivating the regular springs.

9.5.2 Boilers with fittings installed thereon shall be tested on board the ship by a pressure in accordance with Table 1.7.1, Part X "Boilers, Heat Exchangers and Pressure Vessels" of the Rules for the Classification and Construction.

9.5.3 The test pressure during the test of the boiler shall be maintained within 5 — 10 min, then it shall be reduced down to the working pressure and maintained constant until the examination is completed.

9.5.4 A boiler shall be considered to have passed the test if no leakage or sweating is detected in welds, water leaks are not detected in expanded joints, as well as in connecting flanges, connections of valves and gauges.

9.6 STEAM TEST OF BOILER

9.6.1 Steam test of boiler shall be carried out after its installation on board ship, prior to mooring trials of the boiler plant, under working pressure.

9.6.2 During the steam test, the boiler and main steam line shall be maintained under the working pressure within 4 — 8 h.

At that the steam from the boiler is not consumed, all main steam line and boiler valves shall be closed, except the shut-off valve and the valve for blowing down the header.

The water level in the boiler shall be within working range, marked on the water-gauge column.

9.6.3 Steam boiler and fittings shall be insulated in such a manner as to provide a possibility of performing checks mentioned in 9.5.4.

9.6.4 During the steam test of the boiler it is necessary to check its welds, boiler and uptake casing, all fittings and connections for tightness, as well as the value of thermal gaps of movable supports.

The results of the steam test shall be considered as satisfactory if no water and steam leaks from the welds, connections and fittings, as well as smoke and hot gas leaks from the boiler and uptake casing have been detected, as well as if the value of thermal gaps of the movable supports is sufficient.

Note. During the steam test, flange joints and fastenings of the fittings on boiler shall not be pressed in order to eliminate the water leaks.

9.7 MOORING AND SEA TRIALS OF BOILER PLANTS

9.7.1 General.

9.7.1.1 General provisions concerning the procedure of supervision during mooring and sea trials of ships, machinery, arrangements, systems and equipment are set out in Section 18.

This Chapter sets forth additional provisions concerning the procedure, scope and methods of supervision during mooring and sea trials of marine boiler plants.

9.7.1.2 The purpose of mooring and sea trials of the main and auxiliary boiler plant for essential services shall check the boilers and their supporting auxiliary machinery, equipment and systems in operation for the designated purpose, to identify their compliance with the approved technical documentation.

9.7.1.3 The non-essential boiler plants and waste heat plants shall be checked in operation for then designated purpose in order to verify safe operation of the boilers and their supporting auxiliary machinery, equipment and systems.

9.7.1.4 Prior to trials, the following documents shall be submitted to the RS surveyor:

- .1** trial program approved by the Register;
- .2** technical documentation on the boiler (specifications, drawings) approved by the Register, diagrams of steam lines, condensate piping, feed water piping, fuel and air supply piping, diagrams of electrical equipment and automatic systems and other diagrams at the RS surveyor's request;
- .3** document of the shipyard inspection body, confirming that the boiler plant is ready for trials;
- .4** data sheets and certificates on the boilers and other supervised items of the boiler plants;
- .5** list of spare parts;
- .6** description and instruction manual for the boilers and equipment of boiler plants;
- .7** documents on fitness of the gauges for use on trials;
- .8** procedure of the trials;
- .9** trials schedule (to be agreed with the RS surveyor).

9.7.1.5 Mooring and sea trials shall be carried out after completing the installation of all boilers, their auxiliary machinery, automation equipment and electrical equipment, supporting systems, piping and equipment, after hydraulic test of the boilers with steam line, air test of the boiler casing for tightness and steam test of the boilers and main steam line.

9.7.1.6 The trials shall be conducted using the fuel specified in the technical documentation on the boiler and adopted for the boilers of the ship concerned. In case the boiler is intended for operation on fuel of several grades, in the prototype ships, the operation of the boiler plant shall be checked using the most and the least viscous fuels of those adopted for the ship concerned. The prototype boiler shall necessarily be tested using the most and the least viscous fuels of those indicated in the technical documentation on the boiler.

9.7.1.7 Steam load of the boiler can be generated by the regular and other ship's consumers. Check of the operation of all regular consumers on board ship shall be compulsory.

9.7.1.8 Each boiler installed on board ship shall be subjected to trials within the scope specified in 9.7.2 and 9.7.3.

9.7.1.9 The automation systems and equipment of the boiler plants during mooring and sea trials shall be checked in operation in accordance with 12.4 and 12.5.6.

9.7.1.10 It is necessary to check the operation of the electrical equipment and to measure the resistance of insulation of the electric circuits before and after the trials (refer to Section 10).

9.7.1.11 Throughout the period of mooring and sea trials it is necessary to monitor operation of all systems and auxiliary machinery being part of the boiler plant, including:

- .1** operation of each fuel pump and fuel filter, attention being given to operation of the valves, fuel heaters, service tank;
- .2** visual monitoring of the combustion quality under all operational conditions of the boiler, the combustion shall be considered satisfactory if the flame-jet does not fluctuate, does not burn at the tuyere edge, unburnt fuel does not get the heating surface and lining;
- .3** operation of each feed pump and feed water filter, each feed valve, feed water intake from the hot well and tank, purity (absence of oil) of the condensate in hot well and in monitoring tank. It is necessary to check operation of the deaerator with regular fittings, gauges and alarms and the feed water intake therefrom;
- .4** operation of each fan, air dampers, tightness of air heaters and air valves;
- .5** tightness of the boiler casing and uptake casing under all operational condition of the boiler. For better determination of the gas-tightness, smoke boxes may be used.

9.7.1.12 Under all operational conditions of boiler plants in prototype ships it is necessary to determine the vibration level of the boiler fronts and uptakes, as well as the level of boiler oscillations in the longitudinal and transversal directions, in way of the steam and water header. The vibrations shall not exceed the standards of the Register or permissible values specified in the RS-approved technical documentation.

9.7.1.13 If during the trials the deviations of the monitored parameters have exceeded the values permitted by the approved technical documentation, it is necessary to re-adjust and re-test the boiler basing on the same parameters and under the same loading.

9.7.1.14 Where during the trials defects or faults are detected, which can cause an emergency situation or affect the safety of the ship or people, the trials shall be interrupted until such defects and faults are corrected. The scope of the repeat trials of the equipment after the defects and faults have been corrected shall be determined by the RS surveyor particularly in each case.

9.7.1.15 Upon finalization of all types of trials of the boiler plant, it is necessary to carry out revision (internal examination) of the boiler and other equipment in order to check the condition of main components and to detect defects and faults which have occurred in the process of operation.

The scope and sequence of the revision shall be decided by the surveyor particularly in each case.

All the detected defects and faults shall be rectified. The need for repeat trials or checks after these have been rectified shall be decided by the RS surveyor in each case.

9.7.1.16 Based on the results of the mooring and sea trials of the boiler plants, the RS surveyor shall evaluate their technical condition which shall be reflected in the appropriate documents of the Register, issued to the ship.

9.7.2 Mooring trials.

9.7.2.1 General.

9.7.2.1.1 Mooring trials of auxiliary boiler plants shall be carried out within the following scope:

- .1 external examination;
- .2 trials of the boiler in starting and shutdown modes;
- .3 trials of the boiler in steady modes;
- .4 manoeuvring trials of the boiler;
- .5 check of the boiler operation under manual control;
- .6 trials of the parallel operation of boilers.

Tests of the auxiliary boilers on mooring trials are generally final tests (refer to also 9.7.3.1.3).

9.7.2.1.2 Mooring trials of the main boiler plant shall generally be limited by external examination (refer to 9.7.2.2) and trials in starting and shutdown modes (refer to 9.7.2.3). The remaining categories of trials shall be conducted in conjunction with the trials of the ship's main propulsion plant (refer to 9.7.3).

9.7.2.1.3 Waste heat boiler plants shall be generally tested within the full scope on the sea trials of the ship's main propulsion plant (refer to 9.7.3).

9.7.2.2 External examination.

9.7.2.2.1 External examination of boilers complete with the fittings, equipment, supporting machinery and heat exchangers, systems and piping shall be conducted with the steam up, at working pressure.

9.7.2.2.2 During external examination it is necessary to check:

- .1 proper condition of the water level gauges (water level gauge glasses, test cocks, remote water level indicators, etc.) and operation of the manual drive for closing shut-off devices of the water level gauges from the boiler room floor;
- .2 proper condition of the remote operated shut-off valves of the main and auxiliary steam lines;
- .3 proper functioning of the blow-down and scum valves;
- .4 possibility of shutting down the fuel pumps from a space outside the boiler room;
- .5 adjustment of the safety valves (refer to 9.7.2.2.3), their discharge capacity (refer to 9.7.2.2.4), as well as proper functioning of the hand-operated easing gear for lifting the safety valves from the boiler room and outside thereof;
- .6 operation of the automatic equipment of the boiler (refer to 9.7.2.2.5);
- .7 quality of the boiler insulation.

9.7.2.2.3 Adjustment of the boiler safety valves shall be checked under manual operation of the boiler by raising the steam pressure in boiler until the safety valves adjusted with due account of the requirements of 3.3.6.4, Part X "Boilers, Heat Exchangers and Pressure Vessels" of the Rules for the Classification and Construction come into action. Operation of each valve shall be checked three times. In so doing, it is necessary to record the values of the valve lifting and seating pressure, which shall be within the limits stated in the technical documentation.

Safety valves of the steam superheaters shall open slightly before the main safety valve installed on the steam and water header.

9.7.2.2.4 On the prototype boiler it is necessary to check the discharge capacity of the safety valves. Such check shall be performed at full burning in the furnaces and with the shut-off valves closed. The maximum permissible pressure during the operation of the safety valve shall not exceed the steam working pressure by more than 10 %, unless the pressure value to which the valve is set is especially specified.

9.7.2.2.5 When checking the boiler automatic systems in operation, it is necessary to make sure that the alarms, protection and interlocking devices operate trouble-free and come into action in proper time when the water level in the boiler drops below the permissible one, air supply to the furnace is cut off, flame-jet is cut off at the burner and in other cases provided for by the automatic system.

9.7.2.2.6 Where the results of the external examination and check of the safety valve adjustment are satisfactory, one of the boiler main safety valves shall be sealed by the RS surveyor to which effect an appropriate note shall be made in the Register documents.

9.7.2.3 Trials of the boiler in starting and shutdown modes.

9.7.2.3.1 It is necessary to check the cold starting of an automated boiler from a local control station. In so doing, attention shall be given to the ignition cycle: duration of pre-ventilation of the boiler furnace, duration and time of switching-on and off of the ignition spark, as well as time of pilot and main fuel supply.

In the event of ignition failure or flame-jet cut-off, re-ignition may be permitted if provided for by the algorithm.

9.7.2.3.2 It is necessary to check the shut of the boiler from remote and local control stations. In so doing, attention shall be given to the positive operation of the quick-closing valves of the oil burner unit. The quick-closing valves shall close simultaneously with the shutdown of the boiler (time of operation not more than 1 s). Time of flame extinction shall not exceed that specified in the RS-approved technical documentation. Such check shall be performed three times.

9.7.2.4 Trials of the boiler in steady modes.

9.7.2.4.1 A mode shall be considered as steady if no changes in bleeding-off are made.

The steady mode shall be reckoned not less than in 20 min after the boiler has been put in the prescribed mode and shall be defined by three (successively taken) measurements of the following values: fuel consumption, steam capacity of the boiler, superheated steam temperature, steam pressure in the boiler, flue-gas temperature, air head at the oil burner unit inlet.

Fluctuations of the values of measured parameters shall not exceed the permissible values stipulated by the technical documentation.

9.7.2.4.2 Trials of the boiler in steady mode shall be carried out in accordance with Table 9.7.2.4.2 unless otherwise provided in the RS-approved technical documentation.

The total duration of the trials of an automated boiler plant shall be not less than 6 h for prototype ships and 4 h for ships of a series, in case of unattended operation under all possible operational conditions and operation for regular consumers.

Table 9.7.2.4.2

Mode	Steam loading of boiler, in %	Duration of mode, in h, not less than
Zero	0	0,5 (1)
Minimum	10 — 20	1 (2)
Medium	approx 50	1 (2)
Full	approx 100	1 (2)
Note. The time of trials of prototype boilers is given in brackets.		

9.7.2.4.3 For boilers operating on "on – off" cycle, in the zero load mode, the following parameters shall be monitored: steam pressure (at the beginning and end of the cycle) in the boiler and steam super-heater; fuel temperature at the burner inlet (at the beginning and end of the cycle); fuel viscosity; and water level in the boiler.

9.7.2.4.4 In the modes of minimum, medium and full load the following parameters shall be monitored:

steam capacity (only for the prototype boiler);

steam pressure in the boiler;

steam pressure and temperature in the steam superheater;

fuel pressure at the burner inlet (only for the pressure-jet burners);

pressure of the atomizing medium (for the steam-assisted pressure-jet burners) and feed water pressure;

air pressure difference at the air heater;
fuel viscosity;
fuel temperature at the burner inlet, feed water and air temperature in the boiler room and air temperature at the air heater outlet and exit gas temperature;
water level in the boiler;
salt content of the boiler water; and
fuel and feed water consumption.

9.7.2.4.5 To measure the parameters, standard gauges shall be used and for the prototype boilers, control gauges verified by a competent organization shall be used in addition.

9.7.2.4.6 The number of measurements of each parameter in each mode shall not be less than five for the full load mode and not less than three — for the remaining modes.

9.7.2.4.7 The time interval between two regular measurements shall not exceed 20 min.

9.7.2.5 Manoeuvring trials of boilers.

9.7.2.5.1 The manoeuvring trials of a boiler shall be conducted under the following variations in the steam load: 0 — 100 %; 100 — 0 %; 50 — 100 %; 100 — 50 %, as well as at other loads if this is contemplated by the trial program.

9.7.2.5.2 The trials for each variation in load shall be conducted not less than two times in case of serial boilers and not less than three times — for prototype boilers.

9.7.2.5.3 The time of load variation shall be taken as specified in the RS-approved technical documentation.

9.7.2.5.4 Boilers with automatic feed water and combustion regulation shall undergo the trials under an automatic control.

9.7.2.5.5 During manoeuvring, it is necessary to monitor the steam pressure and water level in the boiler. Change of the said parameters may be allowed within the levels which do not cause actuation of the highest steam pressure and water level alarms and the operation of safe valves.

9.7.2.6 Trials of a boiler under manual control.

9.7.2.6.1 When an automated boiler is subjected to trials under manual control, it is necessary to check:

cold starting of the boiler (two times);
increase of the boiler steam load up to the full one;
operation of the boiler at full load;
reduction of the boiler load from the full down to minimum one;
shutdown of the boiler.

The duration of the trials shall be not less than 1 h and the boiler prototype shall undergo all checks not less than three times with the total duration of not less than 2 h.

9.7.2.6.2 Operation of the interlocking and protective devices of the oil burner unit shall be checked (refer to 9.7.1.9).

9.7.2.7 Trials of the parallel operation of boilers.

9.7.2.7.1 Parallel operation of boilers shall be checked when the ship is fitted with two and more boilers operating to a common steam line. It is necessary to check: parallel operation of boilers under automatic control in the modes specified in 9.7.2.4 (except the position control mode), change-over from the parallel operation of boilers to a single boiler operation and vice versa (with a corresponding change of load) and emergency shutdown of each boiler by one of the parameters.

9.7.2.7.2 During the parallel operation of boilers and during change-over from one mode to another, safety valves as well as the steam pressure and water level alarms shall not be actuated.

9.7.3 Sea trials.

9.7.3.1 General.

9.7.3.1.1 During sea trials it is necessary to check the operation of the main and waste-heat boilers, as well as their supporting machinery, systems and equipment in accordance with the RS-approved trials program.

9.7.3.1.2 As regards the trial modes and duration, the trials programs of the main and waste-heat boiler plants shall be co-ordinated with the pertinent trials of the main propulsion plant of the ship (refer to Section 5).

9.7.3.1.3 During the sea trials of the ship, it is necessary to monitor also the operation of the auxiliary boiler plants to serve their direct service.

9.7.3.2 Main boiler plant.

9.7.3.2.1 The main boiler plant shall be tested during the sea trials of the main steam power plant of the ship within the following scope:

- .1 testing of the boilers in steady modes in accordance with 9.7.2.4 and 9.7.3.2.2 — 9.7.3.2.4;
- .2 manoeuvring trials of boilers in accordance with 9.7.2.5;

.3 check of operation of boilers under manual control in accordance with 9.7.2.6;

.4 trials of parallel operation of boilers in accordance with 9.7.2.7.

9.7.3.2.2 During the trials of main boilers in steady modes, in addition to the modes indicated in Table 9.7.2.4.2, it is necessary to conduct trials of boilers in the maximum steam load (approx. 110 %) mode with a duration of not less than 1 h, if such trials are contemplated also for the main steam power plant.

9.7.3.2.3 Steam capacity and feed water consumption (refer to 9.7.2.4.4) for the main prototype boilers shall be measured by flowmeters, while for the serial boilers these parameters may be determined by calculations using the approved procedures.

9.7.3.2.4 The total duration of the trials of the main boiler plants on board ship assigned an automation mark added to the character of classification shall be not less than 4 h in case of unattended operation.

9.7.3.3 Waste-heat boiler plants.

9.7.3.3.1 The trials of the waste-heat boiler plants shall be conducted within the following scope:

external examination;

checks of safety valve settings and operation of the governing and alarm system in operation; operation of the plants in starting and stopping modes, in steady modes, under manual control; parallel operation of the waste-heat boilers as well as the waste-heat and auxiliary boilers (if this is contemplated by the technical documentation).

9.7.3.3.2 During the external examination of a waste-heat boiler plant it is necessary to check proper functioning of water level indicators, blow-down valves and feeding devices, as well as the gas damper.

9.7.3.3.3 The settings of the safety valves shall be checked in accordance with 9.7.2.2.3.

9.7.3.3.4 For the unattended waste-heat boiler plants it is necessary to check the operation of the alarms to warn of the minimum and maximum water level in boiler or steam collector (depending on the waste-heat plant design). The check shall be effected by blowing down the boiler or steam collector (minimum level) and by filling it with water by the feed-water pump controlled manually (maximum level). In case of composite boilers fitted with a change-over device, operation of this device shall be checked when the exhaust gas heating is changed over to the fuel oil heating. The check shall be effected by creation of working conditions where the change-over is performed.

9.7.3.3.5 Automated waste-heat boiler plants shall be checked for automatic starting of the boiler according to the automatic control algorithm. Along with that, attention shall be given to smooth movement of the gas duct damper, if any, as well as to the proper functioning of the damper position ("closed — open") indicator.

Similar check shall be performed in case of automatic shutdown of the boiler (stoppage). It is necessary to monitor the exhaust gas temperature at which the waste-heat boiler is automatically started and shut down.

9.7.3.3.6 It is necessary to check the operation of the waste-heat boiler plant in steady modes specified in the approved technical documentation.

In so doing, the steam pressure in the boiler (steam collector), exhaust gas temperature at the boiler inlet and outlet, as well as the boiler (steam collector) water level and steam pressure alarms shall be monitored.

Under steady mode conditions, the safety valves and the boiler (steam collector) water level and steam pressure alarms (if such alarms are provided) shall not be actuated.

9.7.3.3.7 If the technical documentation provides for the operation of an automated waste-heat boiler plant under manual control, this shall be checked by testing in all steady modes specified in the technical documentation, as well as in starting and shutdown (stoppage) modes and parallel operation modes.

9.7.3.3.8 Where provision is made on board the ship for parallel use of several waste-heat boilers, their joint operation shall be checked on sea trials. Similar check shall be performed, if provision is made for parallel operation of a waste-heat boiler and auxiliary boiler.

The check shall be performed in steady modes, specified in the technical documentation. The values of the major parameters (steam pressure, exhaust gas temperature at the waste-heat boiler inlet and outlet), as well as the water level in the boiler (steam collector) shall be within the limits established by the RS-approved technical documentation. No actuation of the safety valves as well as the alarms provided for by the design circuit to warn of the plant faults shall take place.

9.8 CHECK OF HEAT EXCHANGERS AND PRESSURE VESSELS IN OPERATION

9.8.1 Heat exchangers and pressure vessels shall be checked during the mooring and sea trials in operation according to a program approved by the Register.

9.8.2 Readiness for the trials shall be confirmed by a document issued by the inspection body.

9.8.3 Heat exchangers shall be verified in operation together with supporting systems, piping and devices.

In so doing, it is necessary to check:

quality of installation;

operation at specified parameters of the working medium;

performance of the fittings, gauges and governors;

adjustment of the safety devices, their fastening and possibility for thermal expansion.

9.8.4 Verification of the pressure vessels in operation shall provide for the check of their installation quality and performance reliability.

In so doing, it is necessary to check: proper functioning of the fittings, gauges and governors, as well as discharge capacity and adjustment of the safety devices.

The discharge capacity of the safety valves shall be checked on the prototype pressure vessels. When the discharge capacity is checked, the maximum permissible pressure during operation of the safety valves shall be such that under no conditions the working pressure is exceeded by more than 15 %.

Safety valves shall be set to a pressure which exceeds the working pressure by not more than 10 %, unless the pressure to which the safety valve is set is especially specified.

When lifted, safety valves shall be completely closed in case of the pressure drop in the air receiver by not more than 15 % of the working pressure. The safety valves, adjusted and checked in operation, shall be sealed by the RS surveyor. Performance of the drainage devices shall be also checked.

9.9 ISSUANCE OF DOCUMENTATION

9.9.1 The results obtained from the technical supervision during the installation and tests of boilers and pressure vessels shall be identified in the reports or checklists issued on the basis of the initial survey.

10 ELECTRICAL EQUIPMENT

10.1 GENERAL

10.1.1 The provisions of this Section specify the scope and procedure for technical supervision during installation and testing of electrical installations on board the ships under construction, and of essential electrical equipment referred to in 1.3.2, Part XI "Electrical Equipment" of the Rules for the Classification and Construction and in the RS Nomenclature.

10.1.2 General provisions for the organization of the technical supervision are given in Section 1.

10.1.3 Technical documentation.

10.1.3.1 Installation and testing of electrical installations and essential electrical equipment on board the ship shall be performed under the Register technical supervision according to the RS-approved technical documentation.

10.1.4 Technical supervision of the Register.

10.1.4.1 Surveys during installation and testing of electrical installations and essential electrical equipment shall be performed according to the examination and testing plan developed by the shipyard according to 10.2.1, taking into account 10.3.

10.1.5 Tests and checks specified in this Section are based on an assumption that the electrical plants and critical electrical equipment have been tested at the firm (manufacturer) in compliance with the requirements of Section 10, Part IV "Technical Supervision during Manufacture of Products" of the Rules for Technical Supervision.

In case some tests were not conducted at the firm (manufacturer) and it is confirmed by an entry in the RS certificate, then these tests shall be conducted.

Additional checks and tests may be assigned by the surveyor upon results of examination of the electrical plants and critical electrical equipment in substantiated cases.

10.1.6 The following definitions and explanations have been adopted for the purpose of this Section:

.1 essential electrical equipment are essential services defined in 1.2, Part XI "Electrical Equipment" of the Rules for the Classification and Construction;

.2 supporting structures are metal structures attached to bulkheads, ceiling, hull framing, etc., where electrical equipment is fitted.

These structures include: brackets, panels, angles, frames, earthing supports, cable supports, suspensions, as well as busbar supports, pipes, shafts, sockets, trays, boxes for cable penetrations, and similar structures.

10.1.7 Patrols are carried out by the RS surveyor independently of the list and are not associated with the official presentation of items of technical supervision by the shipyard's technical control body.

10.1.8 Survey of the ship's electrical equipment shall be carried out by the RS surveyor at the stage of installation, and of mooring and sea trials. All types of electrical equipment, installation jobs, fittings, materials, etc., which, upon installation, completion of work, going into operation, etc., become inaccessible for survey, shall be submitted to the RS surveyor at a stage when survey is still possible.

10.1.9 The survey shall determine compliance of the electrical equipment and electrical installation as a whole with the RS-approved technical documentation.

10.2 SURVEY PLANNING

10.2.1 Prior to commencement of survey of the electrical plants and critical electrical equipment of the ship under construction, the RS Branch Office shall agree the examination and testing plan developed by the shipbuilder taking into account the RS Nomenclature and 10.3. The shipbuilder shall be informed about that at a kick off meeting prior to commencement of construction according to 1.7.1.

The builder shall agree to undertake ad hoc investigations during construction as may be requested by RS where areas of concern arise and the builder to agree to keep RS advised of the progress of any investigation. Whenever an investigation is undertaken, the builder shall be requested, in principle, to agree to suspend relevant construction activities if warranted by the severity of the problem.

10.2.2 During approval and agreement of the examination and testing lists a note shall be taken of specific published Administration requirements and interpretations of statutory requirements.

10.2.3 The shipyard shall be requested to advise of any changes to the activities agreed at the kick off meeting and these shall be documented in the examination and testing plan. E.g. if the shipbuilder chooses to use or change sub-contractors, or to incorporate any modifications necessitated by changes in production or inspection methods, rules and regulations, structural modifications, or in the event where increased inspection requirements are deemed necessary as a result of a substantial non-conformance or otherwise.

10.2.4 Quality standards for installation and testing of the electrical plants and critical electrical equipment shall be reviewed and agreed during the kick-off meeting. The work shall be carried out in compliance with the RS rules and under the RS technical supervision.

10.2.5 Any changes to the kick-off meeting records shall be agreed and documented.

10.3 SURVEY OF ELECTRICAL EQUIPMENT AT INSTALLATION

10.3.1 The following shall be checked at verification of electrical equipment mounting on seatings and other supporting structures:

.1 conformity of arrangement to general arrangement plans;

.2 inadmissibility of fitting of electrical equipment on hull plating, walls of fuel oil tanks, lube oil tanks, water tanks, and pressure vessels;

.3 adequacy of distances between electrical equipment and hull plating, combustible materials, sources of heat, emissions of gas, vapour, water, as well as pipelines, tanks, valves and other fittings capable of bringing about conditions that may cause damage to the electrical equipment or cause ignition of the ambient materials.

10.3.2 The following shall be checked at survey of electric propulsion plants:

.1 availability of bilge system suctions in dry compartments for propulsion electrical machines, availability of cable runs prepared for lighting of these compartments and heating of electrical machines when they are not in operation;

.2 absence of flanged and threaded joints in pipelines, valves and other fittings except for bilge systems and general ship systems under seatings, in dry compartments or above electric propulsion plant electrical machines.

10.3.3 The following shall be checked at survey of cabling against the requirements in force:

.1 the cable runs were selected such that the distances are as short as practicable, they go in straight lines and are clear of locations subject to prolonged effect of lubricating oil, fuel oil, water, and excessive external heating;

.2 cable supporting structures;

.3 adequacy of and spacing between cable fastenings to supporting structures as well as the material of which clips, holders, hangers, etc. are made for fastening of cables;

.4 separate laying of cables intended for different purposes, of different types and designed to different voltages;

.5 construction and methods of installation of pipes, expansion joints and methods of attachment of cables therein, conduits, trays, shafts, sockets, busbar supports, boxes for cable penetrations, glands and similar arrangements for cable penetrations through bulkheads and decks;

.6 cable laying in hazardous spaces and areas and in spaces having a fire hazard;

.7 protection of cable runs comprising cables that were not tested for flame retardation.

The purpose of survey at this stage of technical supervision shall ascertain that all the pieces of electrical equipment have appropriate brands and documents confirming manufacture under the Register supervision, and that their workmanship, completeness, number, protection, electromagnetic compatibility parameters, cabling, arrangement in ship's spaces and areas, maintenance-friendliness, control and regulation devices, enclosures, fire protection and explosion protection arrangements tightness protection against electric shock, protective earthing, and other characteristics and parameters are such that they fit their intended purpose and ensure: safety of ship's navigation as far as equipment and use of electrical power are concerned

Methodological recommendations for this Chapter are set out in Appendices 2 and 3 to this Section.

10.4 MOORING AND SEA TRIALS

10.4.1 General.

10.4.1.1 Mooring and sea trials shall be carried out in accordance with the program approved by the Register.

10.4.1.2 The test program shall comprise tests of all the ship's electrical equipment, including electrical machines, systems, arrangements, apparatuses, and other items, when these are operated both individually and together with ship machinery according to their intended purpose.

10.4.1.3 The test program shall address the scope, conditions, duration and succession of tests, specify the parameters and characteristics to be checked, and list the devices, apparatuses, load banks and other auxiliary equipment required for the performance of the tests.

10.4.1.4 Notwithstanding the procedures for testing of electrical equipment in the Guidelines, the Register may require that additions and/or amendments to existing procedures be developed and included in the test program, or that new methodologies be developed, depending on the novelty and complexity of the ship's electrical installation to be tested. The recommendations given in Appendices 1 and 2 to this Section are not exhaustive and all-embracing, their purpose being to set out the key principles for the RS surveyor to follow when performing survey of equipment.

10.4.1.5 Testing of the electrical equipment directly associated with ship's machinery, arrangements and systems, shall, as far as practicable, be performed simultaneously with testing of such equipment for its intended purpose.

10.4.1.6 Prior to commencement of the tests, the RS surveyor shall be provided with technical documentation for electrical equipment to be surveyed as follows:

- .1 certificates and other documents confirming the RS technical supervision of the electrical equipment during manufacture;
- .2 specifications, files and instruction manuals;
- .3 electrical equipment test programs and procedures;
- .4 documents showing results of tests performed by the shipyard's technical control body, if such tests were performed.

10.4.2 Mooring trials.

10.4.2.1 Mooring trials shall be carried out with all the consumers supplied from ship's generators or from shore-based sources of electrical power having appropriate parameters.

10.4.2.2 Electrical equipment mooring trials may be shifted to coincide with sea trials in justified cases and subject to agreement with the RS surveyor.

10.4.2.3 A comprehensive list of the tests, measurements, checks, examinations, etc., to be included in the mooring trials program is set out in Appendix 4 and the duration of checks and tests is set out in Appendix 7.

The scope of external examination of the entire set of the electrical propulsion plant equipment may be reduced or increased at the discretion of the RS surveyor depending on the work performed by the surveyor.

10.4.2.4 At testing of the equipment for the electric propulsion plant and electric propulsion system, the following checks and measurements shall be performed:

- .1 air gaps in fore and aft parts of machines;
- .2 cooling and lubricating systems (availability of lubricating oil level indicators, protective gratings and air intake filters, air and water temperature gages, etc.).

10.4.2.5 The following measurements and checks shall be performed when preparing for starting and at operation tests of the electric propulsion plant:

- .1 insulation resistance of all the electrical devices of the electric propulsion plant;
- .2 proper operation of the starting and protective devices, switchgear and control gear;
- .3 operation of electrical and mechanical protection devices: maximal, differential, minimal protection, protection against generator overloading, protection against electrical machines and prime movers overspeed, etc.;
- .4 availability of electrical measuring instruments and their operation, including insulation monitoring devices in main and auxiliary circuits of the electric propulsion plant, as well as availability of seals, brands and documents of instrument calibration;

.5 availability and operation of interlocks of: switchgear doors in case of application of voltage in excess of 1000 V, shaft-turning gear, possibility of prompt switching with the main circuit energized, shunting of circuits of stopped electric propulsion plant generators in case of series connection of several generators, possibility of connecting of other consumers to electric propulsion plant exciting units;

- .6 operation of control and monitoring desks switch;
- .7 operation of electric propulsion plant distribution gear and control desks;
- .8 activation of visual and audible alarms, including water level alarms in electric propulsion plant spaces, cooling air humidity; bearings temperature; lube oil pressure, machines overloading, availability of power supply to control circuits, operation of exciting units, ventilators, etc.

10.4.2.6 The following shall be checked at electric propulsion system operation test:

- .1 starting of electric propulsion plant generators and their loading under various circuit operation modes;

.2 starting, braking (regenerative, if any) and reversing of electric propulsion motors, reversible shaft generators running in motor mode at all intended propulsion plant operating modes and at all possible circuit arrangements, moreover, all electric drives of auxiliary machinery, both main and standby, and all the onboard exciting units shall be operation tested;

.3 proper operation of local and remote controls, alarms, interlocking and protective devices with the propulsion plant running;

.4 proper and reliable operation of power takeoff system used by consumers taking power from electric propulsion plant generators, at all propulsion plant operating modes (if any).

10.4.2.7 The following checks, measurements and tests shall be performed at ship's electric power plant testing:

.1 main generators running in parallel, devices to change generator driving motor speed from the station from which synchronization is effected; voltage regulation, operation of synchronizing devices and other instruments;

.2 load sharing between main generators when running in parallel, and between generators operated from the main engine (engine-driven generators, shaft generators, turbogenerators operated from exhaust gas boilers during load transfer), including electric power plant short-term unloading, as well as when electric drives of commensurable power operated in regenerative modes (if any);

.3 operation of devices for automatic starting and connection to main switchboard busbars of automated power plant standby generator;

.4 operation of automatic starting system for standby electrical power sources at switching over, shutoff and other operations involving generators operated from main engines (shaft generators, engine-driven generators);

.5 steady operation of main generators running in parallel when loaded in steps to 70 and 30 % (50 and 50 %) of the rated power and when 100 % of the rated power is suddenly thrown off, including electric power plant short-term unloading, as well as when electric drives of commensurable power operated at regenerative modes (if any). Where the power balance is such that a single generator shall supply the ship under running and emergency conditions, this test shall be performed for each individual generator. Moreover, it shall be ascertained that the most powerful electric motor having the greatest starting current and the most severe starting conditions can be started with a single generator running;

.6 operation of automatic devices for generator unloading, frequency and voltage regulation, synchro-nizing, reactive power compensation, protection against phase break-off, etc.;

.7 operation of protection devices of generators and outgoing feeders;

.8 operation of essential electric drives, including remote starting and shutoff controls (for fire pumps, ventilators, steering engines, anchor and mooring machinery, fuel, fuel transfer, lube oil transfer pumps, separators, etc.);

.9 operation of interlocks and of electric drive sequential starting arrangements after interruption in power supply from the main switchboard (for steering engine, automated machinery, etc.);

.10 operation of emergency installations, including automatic starting of emergency diesel generator, loading, connection of accumulator batteries serving as transitional source of power, emergency accumulator battery and all consumers operating under emergency conditions; measurements shall be taken of the voltage, speed, current strength of the above sources when loaded simultaneously by all emergency consumers. In case of a prototype ship, it shall be checked that the emergency accumulator battery capacity is sufficient to supply all emergency consumers within the specified time period;

.11 operation of boat winch electric drive interlocks;

.12 main and emergency lighting, including lighting in way of all essential machinery, ship's spaces and areas, lifeboats, liferafts, places of stowage of personal life-saving appliances, etc. In the case of a prototype ship, provision shall be made for measurement of luminous intensity according to the standards given in Table 6.7.1, Part XI "Electrical Equipment" of the Rules for the Classification and Construction;

.13 alarm systems: general alarm system, fire detection system, warning alarm of extinguishing system release, automated power plant alarm, etc.;

.14 navigation lights and fault signaling;

.15 internal communication systems: telephone, public address system, electric engine room telegraph;

.16 operation of interlocking circuits of electric heaters of large electrical machines;

.17 availability and proper functioning of electrical power sources and consumers, their electromagnetic compatibility;

.18 operation of charging devices of essential accumulator batteries and their interlocking circuits with accumulator battery room fans.

Brief instructions on mooring trials are set out in Appendix 4.

10.4.3 Sea trials.

10.4.3.1 During sea trials, the ship's electric power plant shall be functionary tested under all conditions referred to in 10.4.3.5, under actual loads and conditions occurring during ship propulsion, and check shall be performed of the electrical equipment that was not fully tested during mooring trials. The duration of electrical equipment tests and checks shall take into account the time afforded in relevant sections of this Part of the Rules for tests and checks of machinery, systems and arrangements powered by electrical power.

10.4.3.2 During sea trials, functional test of the entire ship's electrical installation and individual pieces of electrical equipment shall be performed according to their intended purpose, and the following shall be checked:

.1 under manoeuvring conditions, operation of electrical equipment associated with change of speed and direction of rotation of main engines, change of pitch and thrust of CPP blades, change of angle of azimuth thruster, and with two or more azimuth thrusters change of mutual angles of azimuth thrusters at different propeller speed, starting and shutting off of thruster electric drives, main engine shutoff;

.2 under emergency conditions with the main generators running, the operation of electric drives of fire pumps, bilge and ballast pumps, sprinkler system pumps and compressors, shutoff of machinery space fans; shutoff of fuel and fuel transfer pumps from remote control desks; operation of sluice doors, alarms, public address system, service telephones, warning alarm of extinguishing system release, etc.¹;

.3 under emergency conditions, with emergency sources of electrical power running, the operation of all types of electrical equipment designed to be supplied by these sources of electrical power.

10.4.3.3 At testing of the equipment for the electric propulsion plant and electric propulsion system, the following shall be checked:

.1 electric propulsion plant generators starting and circuit arrangement at all intended generator operating conditions;

.2 shutoff of individual generators and circuit operation with the remaining generators running;

.3 operation of exciter sets, rectifying units and static excitation converters;

.4 starting, shutoff, speed variation, braking and reversing of each electric propulsion motor for each possible (design) combination of generators and electric propulsion motors;

.5 control of electric propulsion plant from all remote and local control stations and desks;

.6 operation of all the electric drives, machinery and arrangements associated with the electric propulsion plant; cooling, lubricating, excitation, ventilation, temperature control systems, electrical measuring instruments, tachometers, etc.;

.7 actuation of alarm systems warning of exceeding the permissible deviation limits of electric propulsion plant parameters from rated parameters.

10.4.3.4 The above tests of equipment for the electric propulsion plant and electric propulsion system shall be carried out under all the conditions referred to in 10.4.3.2.1 — 10.4.3.2.3. Moreover, the following shall be done:

.1 the electric propulsion plant parameters shall be measured, as follows: voltage, current in main and auxiliary circuits, speed, reversing time, shaft torque, etc.;

.2 electric propulsion plant local and remote control stations and their switches shall be checked to ascertain that control can be effected only from one station, and that a control station to be disconnect-ed or connected can only be switched via "stop" position; engine room telegraphs shall also be checked;

.3 electric propulsion system shall be operation tested to ascertain that it can simultaneously supply power to electric motors and other ship's consumers in a steady manner, including regenerative braking modes provided for by the design, if this kind of power takeoff from the electric propulsion plant generators is provided for by the design;

.4 the electric drives of electric propulsion plant essential machinery and electrical installations, such as exciter sets, semiconductor frequency converters, static converters, rectifiers, cooling oil pumps, etc., shall be checked for reliable and steady operation.

10.4.3.5 At testing of the electric propulsion system, the following shall be checked:

.1 steady operation of main generators under all design combinations of running in parallel and individually for each generator, as well as transfer between generators of load due to operation of all consumers under running, manoeuvring and emergency conditions;

.2 steady operation of shaft generators, engine-driven generators at change of main engines speed, as well as their running in parallel for load transfer to main generators with independent motors;

.3 stable operation of shaft generators with reversible semiconductor frequency converters when the changeover from generator to motor mode occurs, in the motor mode — separately and together with the main engine or propulsion motor to the ship's propeller;

¹"etc" shall here and after be interpreted as other checks, tests, conditions, measurements, types of equipment, as may be required by the RS surveyor.

.4 steady operation of turbogenerator from exhaust gas or auxiliary steam boiler and load transfer arrangement to independently driven generator;

.5 possibility of diesel generator starting within the time of turbogenerator operating from exhaust gas boiler after main engine shutoff without interruption of power supply to ship's consumers unless provision of made for automatic starting of standby generator.

In case of a prototype ship, actual load of ship's power plant shall be checked under all operating conditions on the basis of the power balance calculation, with the main sources of electrical power on.

10.4.3.6 At all the checks referred to in 10.4.3.5.1 — 10.4.3.5.4, the following electrical installation parameters shall be measured: voltage and its variation limits when connecting and disconnecting loads under all conditions referred to in Section 18, current, generator driving motors speed, active power, frequency, power factor, etc.

All the measurements shall be taken by means of standard instruments for each running generator or generators.

Measurement of voltage variation limits of shaft generators:

driven by main engines with controllable pitch propeller shall be taken at the same time as main engine load is changed by putting the rudder over to the greatest allowable angles and of the CPP blades from the "full ahead" position to the "full astern" position;

driven by main engines with fixed pitch propeller and semiconductor frequency converter shall be taken at the same time as main engine speed is changed within the specified speed limits.

10.4.3.7 Electric drives of pumps, compressors, separators, ventilators and other auxiliary machinery shall be tested for their intended purpose, in particular, the following shall be checked: reliability and unfailing performance, starting and shutoff, changeover to emergency set (if any), operation of remote controls starting and shutting off the electric drive, automatic starting of standby electric drives on receipt of signal from the controlled parameters of the operating environment on automated installations, etc.

The above checks shall be carried out through external examination of running electrical equipment and through ascertaining by means of relevant devices that there are no overloads, unacceptable overheating of enclosures, sheathing, panels, bearings, etc. Also to be checked are proper vibrations and the vibrations caused by ship's propulsion and operation of main and auxiliary machinery (refer to Appendix 6).

10.4.3.8 Steering gear electric drives, their power supply systems (main and backup feeders), control systems, rudder angle indication, electric drive operation and shutoff alarm, automatic starting of electric drives after voltage is restored following a power supply interruption, etc., shall be checked with the steering gear operating under all intended control modes.

10.4.3.9 The check shall be performed both with the two steering gear power units (if fitted) running, and for each individual power unit. These checks shall be performed from all the remote and local control desks with the power unit electric drives and control systems supplied by the main and reserve feeders.

10.4.3.10 The ability of the steering gear to keep steady the ship of a course shall be checked both by means of simple manual, follow-up remote control, and by means of automatic pilot in the case of automatic control, with check of changeover to manual control (refer to Section 16).

10.4.3.11 Check of the arrangement of local control (in steering gear compartment) of electric drive of steering gear main power units shall be performed by the use of standard means of communication between the steering gear compartment and the wheelhouse.

10.4.3.12 Operation of limit switches shall be checked by putting the rudder over to more than 35° on any side.

10.4.3.13 Operation of rudder angle indicators shall be checked in all stations where steering gear remote control desks are fitted simultaneously with testing of steering gear electric drives and control systems.

This check shall be performed by comparing the readings of the mechanical indicator rigidly connected to rudder stock with the readings of electrical indicators.

10.4.3.14 Check of electric drives of anchor and mooring arrangements, boat winches, liferaft davits, shall be performed during the testing of the above arrangements when dropping and heaving up anchor, when leaving berth, when mooring and during anchorage, respectively.

10.4.3.15 Measurements of equipment's insulation resistance shall be taken during the sea trials of the electrical equipment, both by means of panel-mounted instruments for insulation resistance measurement with the equipment running, and by means of a portable megohm meter after putting the equipment out of operation when it is in hot condition and at steady-state temperature.

10.4.3.16 All direct current electrical machines and alternating current commutator machines shall be checked for commutation quality when operating for their intended purpose at a rated load and for condition of commutator and brushes after putting out of operation.

10.4.4 Inspection and check trials.

10.4.4.1 After the sea trials, the RS surveyor shall specify the scope of inspection. The inspection shall comprise the following:

.1 dismantling of electrical machines bearings that were heated in excess of the rated value. When dismantling an electrical machine, attention shall be paid to the following:

condition of stator winding supporting structures and their fastening;

possible displacement of stator winding slot wedges;

possible displacement or detachment of the pole winding; possible reduction in winding insulation resistance;

possible malfunction of rotating parts fastening;

damage of painting and anticorrosive protection;

function of protective ralleys in operation;

.2 opening, dismantling and repair of electrical equipment with a reduced insulation resistance if compared with standards;

.3 control of different ralleys, measuring instruments and blocks, the operation of which is not accepted.

10.4.4.2 The necessity and scope of final tests are specified by the RS surveyor.

RECOMMENDATIONS ON INSPECTION OF ELECTRICAL EQUIPMENT DURING THE SHIP CONSTRUCTION

1 Inspection is one of the most important stages of survey of ship's electrical equipment during its construction.

2 Inspection shall include external and internal inspections of electrical equipment.

3 External inspection is the inspection of external parts of the electrical equipment itself and external installation on board the ship.

4 Internal inspection — inspection of internal parts and internal mounting of electrical equipment.

5 Inspection shall not cover the matters of electrical or mechanical measurements of any parameters or characteristics, except line measurements of distances regulated by the Rules for the Classification and Construction and related to location and fastening of electrical equipment.

6 Mainly, external inspection shall be visual. All the measurements and tests interesting for the RS surveyor shall be carried out by the representative of the shipyard in the witness of the surveyor.

Survey by the inspection shall be applied at each stage of the supervision, starting with the preparation of rooms and spaces of the ship for installation of electrical equipment up to the sea trials inclusive.

7 During the external inspection the following checks and measurements shall be provided:

.1 arrangement of electrical equipment in the rooms and spaces of the ship;

.2 completeness of electrical equipment installed;

.3 compliance of design of electrical equipment housings with the ambient environmental conditions in the rooms and spaces of the ship;

.4 arrangement of guards from moving parts, components under voltage or subject to heating above 90 °C;

.5 measures for protection of electrical equipment from ingress of water, oil, fuel, vapor and other harmful media;

.6 provision of the possibility and convenience of maintenance of electrical equipment;

.7 technical condition of electrical equipment regarding the absence of presence of external damages.

8 Instructions to paras 7.1 — 7.7.

8.1 Arrangement of electrical equipment.

8.1.1 Arrangement of electrical equipment shall comply with the general arrangement drawings, working drawings and requirements of effective RS rules. Depending on functional purpose of arrangements and machinery which include electrical equipment this equipment shall be located in compliance with the requirements of such rules to which arrangements and machinery related to. For general purpose electrical equipment the RS surveyor shall check compliance with the requirements of Part XI "Electrical Equipment" of the Rules for the Classification and Construction while its installation.

8.1.2 Check of location of the equipment shall give a comprehensive idea of fulfillment of the requirements of safety, reliable and functionally correct operation of equipment with its accepted location on board the ship.

8.2 Completeness of electrical equipment.

8.2.1 Completeness of each type of electrical equipment shall be checked according to submitted technical documentation, working drawings, certificates, files, etc, as well as the evaluation of adequacy of a set based on the use of equipment by proper purpose.

8.2.2 A set shall include all the separate devices, products and units, including controls, controlling and signaling means both local and remote. At the same time the availability of the Register approval for the inspected equipment for application of such equipment on board ships shall be checked.

8.3 Forms of enclosures.

8.3.1 Forms of enclosure of electrical equipment in respect of protection against ingress of water, restrictions, contacts with moving and live parts shall meet the requirements of 2.4.4.2, Part XI "Electrical Equipment" of the Rules for the Classification and Construction.

8.3.2 Besides mentioned in 8.3.1, version of housings shall be checked for compliance with the implosion protection degree established in explosive risk spaces stipulated by 2.9, Part XI "Electrical Equipment" of the Rules for the Classification and Construction. During such inspection the RS surveyor shall be guided also by the documents of a competent and recognized by the Register authority regarding the type and degree of implosion protection of various kinds of electrical equipment and information of the customer or shipyard in respect of the nature of highly explosive mixtures which may take place in ship's rooms and spaces.

8.4 Protection guards.

8.4.1 Protection guards such as handrails, enclosures, panels, shields, railings, etc. shall be checked for strength and reliability of their fixed installation, applicable materials and insulated coatings, adequacy of dimensions and distances from equipment to be guarded, convenience of their location based on the necessity of equipment maintenance, etc.

8.5 Protection against external actions.

8.5.1 Protection of electrical equipment against detrimental effect of water, oil, fuel, vapors and gases, high temperatures, magnetic and other physical fields, as well as harmful interference shall be checked based on the requirements to remove the sources of such effects from the installed electrical equipment.

8.5.2 Minimum distances to which the sources of detrimental effects shall be removed from electrical equipment are specified in the appropriated parts and paragraphs of the RS rules, as well as in the effective standards.

During the inspection the measurements of distances may be performed, which shall not be less than those given in Appendix 2.

8.6 Maintenance access.

8.6.1 Maintenance access of electrical equipment shall be provided by compliance of the requirements on dimensions of passages and free spaces near electrical equipment, requirements for access to doors, detachable covers, hatches, manholes and the possibility of their opening, extraction of detachable components, parts, cassettes, units, etc.

8.6.2 Conditions and possibilities of maintenance shall be checked by the surveyor by means of full-scale tests and measuring distances which shall be no less than those specified in Appendix 2.

8.7 Technical condition of electrical equipment.

8.7.1 Electrical equipment shall be checked for absence of visual damage of enclosure, framework or casing, such as cracks, dents, bends, chips and other defects. At the same time the RS surveyor shall be sure that the controls may be switched on, rushed through and fixed in proper way, rotating parts have easy smooth running, without excessive backlash or jamming, detachable parts have tight fastening at standard places, fixing devices are properly tighten and have tools against self-unfastening.

8.7.2 Open live parts of equipment, as well as windings, coils, cores, terminal blocks and other components shall be checked for absence of visual damage, taking into consideration that their electrical intactness will be checked during the tests and work by the proper purpose.

8.7.3 Electrical equipment which, as a result of mounting or installation, became inaccessible for visual inspection of the RS surveyor and which was not surveyed earlier shall be dismantled, opened or all the structures blocking the access to inspection of such equipment shall be removed regardless of the extent of work required.

9 In addition to checks stated in 8.7 during the visual inspection the following checks and measurements shall be provided:

.1 fastening of electrical equipment to foundations and other bases and supporting structures including mounting on shock-absorbers;

.2 laying of cables from electric power sources to the switchboards and from the latter to consumers: laying of control, communication, signaling cables, as well as cables for installation between the devices;

.3 quality and ways of contact protective seal termination of cable strands and connection them to the equipment;

.4 deck and bulkhead cable penetrations on board the ship; quality of sealing the penetrations through watertight and fire bulkheads;

.5 performing of all the types of grounding of electrical equipment and ship structures;

.6 ship rooms and spaces in respect of the requirements on installation of electrical equipment.

10 Instructions to paras 9.1 — 9.6

10.1 Fastening of electrical equipment.

10.1.1 Fastening of electrical equipment to foundations and other bases and supporting structures which are specified in 10.1.4.2 shall be strong and secure equipment at its standard place.

During the installation all the holes, pins and other devices provided by the structure shall be used by proper purpose: bolts, screws, nuts, etc. shall have appropriate dimensions, be properly tightened and secured against self-unfastening.

10.1.2 In places of location of electrical equipment where the excessive vibration, shaking, knocks and other mechanical impacts on equipment the RS surveyor may require to reinforce structures of foundations, bases and other supporting structures, application of additional fastenings or shock-absorbers.

Realization of such measures may be postponed till receipt of the results of full-scale tests during the sea trials.

10.1.3 The RS surveyor shall check compliance with the requirements of Part XI "Electrical Equipment" of the Rules for the Classification and Construction referred to fastening of electrical equipment.

10.2 Cable laying.

10.2.1 Check of single, single-row, multi-row and bunch cable laying, correctness of cable path selection, ways of grooming, cabling, intersection of cables in the paths, availability of gaps between crossing paths, fastening of cables on the supporting structures, protection of cables against mechanical damage, inadmissibility of laying the cable of essential circuits through fire risk spaces, joint laying of one bunch of cable intended for over 1000 V with low voltage cables, cables with different types of signals (from the point of view of electromagnetic compatibility (EMC)), with different outer shield or various allowable temperature characteristics, spark-proof circuits or explosion-proof circuits with normal circuits, etc. shall be carried out generally for compliance with the requirements of 2.2, Part XI "Electrical Equipment" of the Rules for the Classification and Construction.

10.2.2 Visual inspection of cables shall be carried out by the RS surveyor on the ship in general, on separate consumers and electric power sources. In all the cases cable paths, cables themselves, cable fastenings, their intactness and absence of visual defects shall be examined, where possible, along the full length from the electric power source to consumer or distribution device, as well as the control cables shall be examined between the starting devices, local and remote, signaling and communication cables and cables from control devices to the objects under control.

10.2.3 Hidden layed cables shall be submitted for inspection in compliance with 8.7.3 of the Appendix.

10.2.4 When measuring the allowable distances of cable paths to the adjacent structures one shall be guided by the values stated in Appendix 2.

10.3 Cable conductors termination.

10.3.1 When laying the cables the reliability shall be checked of contact termination of strand connected to electrical equipment. Termination shall be checked both at outlet and inlet cable ends at power sources, distribution devices and essential and non-essential consumers.

Contact termination shall be checked for strength of connection of terminal clamp with a cable core, permissibility of the applied method and quality of work performed.

While checking the contact terminations by permissible methods the surveyor shall be sure that:

soldered and tinned joints have good infill, surfaces are smooth, clean, glossy, without porosity, influxes, blistering, sharp edges and other deficiencies, typical for low-quality soldering;

welded connections cover all the wires of the core when welding to the terminal clamp, fused metal has tear-shape with clean surface, without porosity, blistering, influxes, sharp edges, etc.;

crimped connections effectively fix the core in the terminal clamp bushing, dimple in the terminal clamp has sufficient depth not cutting the crimped core.

Permissible methods of contact termination depending on the section of cable cores are given in Table 10.3.1.

Table 10.3.1

Permissible methods of contact termination

Core section, in mm ²	Type of electrical equipment	Type of contact terminal clamp	Way of terminal clamp fastening
from 0,5 up to 0, 75 from 1 up to 2,5	essential and non-essential Ditto	Strip, with bushing, circular, from core Ditto	Soldering, tinning Soldering, tinning, welding, crimped
from 1 up to 2,5	Non-essential	Circular, from core	Crimping by copper ring
from 4 up to 300	Essential and non-essential	Strip, without bushing	Welding
400	Ditto	Strip, with bushing	Soldering
All sections above 2,5	— " —	Strip, with tubular bushing	Crimping
All sections	— " —	Strip, with tubular bushing	Crimping
		Pin, with bush sleeve	Soldering, crimping
		Pin, from core with wire band or without it	Soldering

10.3.2 During the cable laying all the protective and sealing terminations of cable cores shall be checked. Sealing terminations shall be made by banding from polyvinylchloride strips by plastic terminations or by other means enabling safe closure of cuts of cable sheaths and cuts of core insulation against ingress of moisture inside cable and core.

Protective termination of cores shall be provided for all cores with rubber insulation connected to electrical equipment with significant heat evolution (lighting fixtures and heating appliances, etc.).

This termination shall be made by means of covering the cores on the top of insulation with tubes to protect rubber insulation against premature drying up and ageing.

10.3.3 While checking terminations of cables and cores fastening of cable and its inputs in the electrical equipment shall be checked. The RS surveyor shall be sure that cable is secured in such a way that permits to

eliminate all mechanical loads from clamps of electrical equipment resulted from tension of cable connected (availability of slacks, fastening of cable with cramps, etc.).

10.4 Bulkhead and deck cable penetrations.

10.4.1 Special attention shall be given to ship bulkhead and deck cable penetrations. The RS surveyor shall be sure that structure of straight cable boxes, group and individual glands, performance of work on filling free spaces of such penetrations with packing compound, glands, sealings, etc. provide proper sealing against ingress of water, vapor, gases and other media from adjacent rooms and spaces and conversely.

10.4.2 Sealing of penetrations and stand pipes for deck cable penetrations shall be also checked. Packing compound shall uniformly fill boxes, stand pipes and other penetration arrangements for cables, have no cracks, cavities, voids and other visible leaks. Penetration boxes and glands in the bulkheads and class A decks shall be covered by proper fire insulation.

10.4.3 Engineering procedure of sealing glands and boxes for cable penetration shall be approved by the Register.

10.4.4 Cables in penetration boxes shall be laid with compactness to ensure proper filling of intercable spaces with cable mass and for cable sheath not to touch walls of penetration box.

10.4.5 Cables coming from penetration cable boxes and glands shall have the required slacks to compensate mechanical loads which may occur during the resilience of hull structures.

10.4.6 Means of checking the tightness of penetration cable boxes, group and individual glands are specified in Appendix 2.

10.4.7 Cable penetrations through expansion connections of hull structures shall have the appropriate slacks (loops) for compensation of bends and twists of the ship's hull at roughness.

When pipes, ducts, wells, etc. are used for cable laying through such connections, these steel structures shall have proper compensators.

10.5 Earthing.

10.5.1 All the earthing arrangements of electrical equipment and hull structures shall be surveyed by visual examination for compliance with the requirements of Part XI "Electrical Equipment" of the Rules for the Classification and Construction.

10.5.2 Earthing of enclosures of electrical equipment shall be checked by means of direct contact with hull structures, with the help of earthing conductors of earthing cores in the power supply cable.

10.5.3 Attention shall be given to the fact that direct contact grounding of the enclosures of equipment to hull structures of the ship shall be performed with proper treatment of contact surfaces and their corrosion protection. Section and material of the earthing conductors shall meet the requirements of the Rules for the Classification and Construction (refer to Table 10.5.3), metal sheath of cables — shields, armature, armors, as well as pipelines, ducts, chutes, metal casings for protection of cables from mechanical damage shall be effectively grounded and the access for inspection and continuous supervision of integrity and reliability of electrical contacts of earthing shall be provided.

10.5.4 Also earthing of rigging, static protection device, earthing of superstructures from light-metal alloys shall be checked by means of inspection of earthing points and measurement of transient resistance, etc.

10.6 Inspection of rooms and spaces of the ship according to the requirements on installation of electrical equipment.

10.6.1 The RS surveyor shall perform external inspection of all the rooms and spaces to make sure that:

.1 all the rooms and spaces where people may be located are equipped with proper electric lighting, and lighting fixtures, switches, sockets meet the requirements of the Rules for the Classification and Construction and are installed properly;

.2 emergency lighting is available in all rooms and spaces where required by the Rules for the Classification and Construction, there are no individual switches in the emergency lighting circuits, besides lighting fixtures specially mentioned in the Rules for the Classification and Construction;

.3 power supply of the groups of lighting fixtures in one room where people may be located or are always located is carried out by different group distribution boards and via different circuits;

.4 emergency lighting fixtures are installed in such a way that essential equipment located in the room or on the deck is properly illuminated;

.5 ventilation and heating, where necessary, conform the purpose and ensure normal operation of essential equipment;

.6 in the dangerous rooms and spaces the appropriate explosion-proof equipment is used and there are no transit cable paths or prohibited electrical equipment;

.7 access to cables laid under the space plating or, at least, to terminal and cable boxes;

Table 10.5.3

Required sections, earthing cable cores and outer conductors for equipment grounding

Nos.	Type of electrical equipment and structures	Power cable core section, in mm ²	Type of earthing connection		Material and section, in mm ²	
			outer earthing connection	earthing core in power cable	outer copper flexible wire, bus-bar or core	outer copper earthing wire, single line
1	Fixed	Up to 2,5	+	—	No less than 1,5	No less than 2,5
		Above 2,5 up to 120	+	—	1/2 section of power cable core, but no less than 4	—
		Above 120	+	—	70	—
		Up to 16	—	+	full section of power cable core, but no less than 1,5	—
		Above 16	—	+	1/2 section of power cable core, but no less than 16	—
2	Mobile, portable and hand	Up to 16	—	+	Full section of power cable core	—
		Above 16	—	+	1/2 section of power cable core, but no less than 16	—
3	Fixed. Metal sheaths, cable armors, screens	No less than 2,5	No less than 2,5	No less than 2,5	No less than 1,5	Wire from special material no less than 2 and 16 in each
4	Fixed. Structures from light alloys, insulated from steel enclosure	—	—	—	No less than 4	
5	Fixed. Connections and earthings of gas pipelines of oil tankers and gas carriers	—	—	—	—	
6	Fixed. Down conductors of lighting conductor	—	—	—	No less than 16	—
					No less than 70	No less than 100

.8 plating of spaces, bulkheading, pockets, cabinets, recesses, etc., where electrical equipment is installed, are effectively protected from heating due to heat generation of electrical equipment. When such plating is made of combustible material, they have non-combustible plating at the required distances and areas;

.9 no communication or signaling: general alarm, fire alarm, warning, talk-back, service, command broadcasting, etc. cables are laid through the dangerous spaces (galleys, machinery casing, etc.);

.10 special electric spaces are not adjacent with explosive rooms and spaces are properly equipped by protective grids and other things for prevention of open live parts; they do not include pipelines carrying combustible media, etc.

10.7 The Recommendations do not cover all the checks to be performed by the RS surveyor by external examination because, depending on the ship's type, the checks in larger extent may be required.

11 Internal examination

11.1 All electrical equipment subject to survey carried out by the RS surveyor shall be checked by internal examination.

11.2 Internal examination shall not foresee special dismounting of equipment, except the cases when the RS surveyor may have doubts that electrical equipment is in fit technical condition.

11.3 Internal examination shall be performed through opening windows, hatches, covers, manholes in the enclosure of electrical equipment.

11.4 During the internal examination of generators and electrical motors of propulsion plant being the main sources of electrical power, emergency generators the following shall be checked:

.1 quality of contacts of electrical connections, termination of cables in terminal boxes, grooming of free cable lengths of terminated cores, which exclude their friction on enclosure or between them;

.2 availability of means against self-unfastening on the terminals and contact screws and bolts;

.3 condition of grooming and insulation of winding, absence of dents, chip and disruptions of insulation on the front sections of stator, rotor and armature windings;

.4 condition of collectors or collecting rings, quality of soldering of armature coil ends to collector solder pads;

.5 condition of electrical connections of generator with arrangements and devices of self-oscillation, voltage control system and rotating exciters mounted on the generators;

.6 availability and setting of safely fuses in the self-oscillation systems, where equipped.

11.5 Special attention shall be given to electrical machines subjected to assembling on board the ship. For such machines the following shall be checked in addition:

.1 fastening of active steel of poles, pole and phase winding;

.2 brush gear condition;

.3 compliance of air gaps at various positions of armature and rotor, from their both ends and between all stator poles with the values given in the firm (manufacturer) logbook;

.4 axial displacement of armature or rotor in friction bearings.

11.6 During the internal examination of switchboards the following shall be checked:

.1 fastening of automatic switches, switches, fuses and their electrical connection with busbars and switchboard jumper;

.2 listening of switchboards mains, condition of busbar insulators, absence of too small distances between busbars and between busbars, absence of bends and damage of busbars, reliability of intersectional connections of busbars;

.3 fastening of cables and wires of switchboard internal mounting; absence of mounting wires contact with bare busbars of different polarity;

.4 installation, proper fastening and connection of all switchboard devices; splitting and termination of connecting cables, their fastening to commutation and protective equipment; availability of means against self-unfastening.

11.7 During the internal examination of electrical drives of essential machinery the following shall be checked:

.1 connection of power cables to the clamps of electrical motors and laying of free lengths in the terminal boxes, starters, remote control panels;

.2 reliability of contact terminations and availability of means against self-unfastening;

.3 reliability of fastening of contactors, relays of thermal protection, resistors and other components in solenoid starters.

RECOMMENDATIONS ON TESTING FOR TIGHTNESS OF CABLE PENETRATIONS AND PIPES

1 Respective test procedures on cable penetration boxes and glands may be used at the discretion of the RS surveyor.

2 Once group glands, cable penetration boxes, group and individual glands are sealed and externally examined testing shall be performed in accordance with one of the procedures listed below.

Procedure 1. The space through which the cables are run is flooded, whereas on the other side of the bulkhead the structures intended to seal cable penetrations are visually examined to detect water seepage through them. This procedure is used in respect of special category spaces, subject to flooding during normal operation of ship. Duration of the test shall be specified in a test program.

Procedure 2. The doors and scuttles in spaces through which the cables are run shall be closed and an increased pressure of approximately 3×10^4 Pa shall be built up. The evidence for passing of air through sealing structures is provided by the drop in pressure as shown by the pressure gauge indicating the space pressure. The same result can be obtained by visual examination of cable penetrations covered with soapy liquid solution. This procedure is used in boiler rooms with forced general blowing and a number of other gastight spaces. Duration of the test shall be specified in a test program.

Procedure 3. The sealing structures of cable penetrations are subjected to a jet of compressed water 20×10^4 Pa. The water is discharged at a 5 m distance over 5 min. The opposite side of sealing structures is being visually examined for the signs of water. This procedure is used to test the sealing arrangements located on the upper decks.

Procedure 4. The sealing structures of cable penetrations are subjected to compressed air blasting from a hose with a diameter not less than 12,5 mm with a pressure of $30 - 40 \times 10^4$ Pa at a 100 mm distance. Passing of air through the sealing structures is determined by visual examination of cable penetrations covered with soapy liquid solution. This procedure is used to check the sealing arrangements located in service and accommodation spaces which can not be tested using the above three procedures.

3 The quality of sealing is considered satisfactory where no passing of air or water is observed in cable penetrations through bulkheads and decks or inside electrical equipment.

4 The RS surveyor may consider and approve other test procedures proposed by the shipyard where their efficiency is not inferior to that of the above procedures.

5 Where sealing epoxy compounds with complete polymerization within 6 — 8 days are used, the tightness quality test shall be performed as a minimum within 2 days after sealing.

6 A pipe with a cable for safe-type electrical equipment is leak tested by air pressure with 15×10^4 Pa and soapy liquid solution test of all screw and flange joints.

APPENDIX 3

RECOMMENDATIONS ON MEASUREMENT OF ELECTRICAL EQUIPMENT INSULATION RESISTANCE DURING CONSTRUCTION OF SHIP

1. Insulation resistance condition of shipborne electrical equipment and cabling characterizes to a great degree the technical intactness of ship's electrical installation on the whole and separate types of equipment and allows to decide on the possibility of their further use according to their direct purpose.

2. Insulation resistance shall be measured after the external visual examination of electrical equipment and before it is put under load or voltage. Where the insulation resistance complies with the Table, electrical equipment may be subjected to further testing.

Where the insulation resistance values are below those specified, measures shall be taken to eliminate prohibitive leakages.

Table

**Minimum values for insulation resistance between poles (phases) and to ship's hull
for plants with rated voltage up to 500 V**

Nos.	Electrical equipment	Insulation resistance R^1 at ambient temperature 20 ± 5 °C and normal humidity, in MOhm
1	Electrical machine or transformer:	
.1	with power up to 100 kW (kV A):	
	in hot condition	2,0
	in cold condition	5,0
.2	with power 100 up to 1000 kW (kV A):	
	in hot condition	1,0
	in cold condition	3,0
.3	with power more than 1000 kW (kV A) or with voltage ¹ more than 500V in hot condition	R^2
2	Switchboards	1,0
3	Switch gear, protective and starting devices (automatic devices, starters, contactors)	5,0
4	Telegraphs and indicators, telephone switchboards, telephones, bells etc.	20,0
5	Cooking and heating appliances	1,0
6	Semiconductor converters	10,0
7	Power and lighting feeders, cabling for group telephones, telegraphs, bells and other types of direct-current alarm systems	1,0 ³
¹ For voltage more than 500 V the insulation resistance shall be 2000 Ohm per every V of rated voltage. ² Insulation resistance is determined by the following formula: $R = \frac{3v}{p + 1000}$ where v = rated resistance of winding (phase), in V; p = rated power, in kW (kV·A). ³ For voltage less than 24 V the insulation resistance shall not be less than 0,3 MOhm, for alternating-current voltage insulation resistance shall be 1,4 times higher than that for direct-current voltage.		
Note. Lightning discharger (between mast top and point of down conductors connection to the metal hull or earthing point on the shell plating of a wooden or composite ship) electric connections to the earth termination networks and superstructures made of light alloys to the steel hull shall have resistance not less than 0,02 Ohm.		

3. Insulation resistance of substantially heated electrical equipment (electrical machines, cooking and heating appliances, transformers, reactors, ballast resistors etc.) shall be measured immediately after deactivating at steady-state temperature reached during operation under rated load.

4. Insulation resistance of each type of shipborne electrical equipment and of every set of such equipment shall be measured across the terminals of the input and output circuits of each unit, device etc. either part of a set or installed individually. Feeding and connecting cables shall be disconnected.

5. Insulation resistance of all supply feeders for essential and non-essential fixed equipment installed between the switchboard and the consumer or its starting device and between the source and the switchboard shall be measured.

During this measurement supply feeders shall be disconnected from the terminals of consumers and switchgear and protective devices of the switchboards, or such equipment may alternatively be in the "open" position or removed from the switchboard.

6. During insulation resistance measurement of feeders, lighting cables, communications cables, alarm cables, control cables etc., lamps, telephones and other equipment shall be disconnected, or pole-to-pole and phase-to-phase connection circuit units shall be removed from either end of cables for these devices.

7. Insulation resistance of main, section, distribution and other switchboards shall be measured with automatic circuit breakers disconnected, fuses removed, voltage coils disconnected etc.

8. Insulation resistance shall be measured:

.1 between input and output circuit phase or pole terminals and metal hull or metal parts of electrical equipment;

.2 between every insulated busbar of the switchboard, busbar system and the hull;

.3 between busbars of different polars or phases, and also between junction terminals or conductors of coils, reactors, current transformers, main contacts of automatic circuit breakers and other switchgear and the hull;

.4 between every insulated cable conductors and the hull and between conductors of different poles, phases.

9. Insulation resistance measurement shall be performed with the use of generator type megohmmeter exerting not less than 500 V direct-current voltage. It is allowed to use measuring devices for voltage not less than 100 V with regard to equipment intended for operation with safely voltage (up to 50 V).

10. The measurement of insulation resistance value shall be performed as a minimum within 1 min after test voltage application.

11. During insulation resistance measurement of electric circuits with incorporated electric capacitors with total capacity of more than 2 microfarad, meters and testers operating with constant voltage shall be used or capacitors shall be disconnected.

12. Minimum permissible values of shipborne electrical equipment insulation resistance are given in the Table.

13. The efficiency of electrical equipment enclosure earthing shall be checked along with insulation resistance measurements. The measurements shall be made between the enclosure of electrical equipment, cable braid or armour, cable earthing conductor, earthing socket outlet etc. and the hull. Earthing resistance value shall not exceed, in Ohm:

for earthing core in the feeding cable — 0,4;

for earthing with external earthing conductors — 0,1.

14. It is allowed to perform insulation resistance measurement of equipment, cables constituting the circuit and system cables either separately or as a whole with the use of switchboard insulation resistance measuring devices located on the generator or distribution panel of main or emergency switchboard.

RECOMMENDATIONS ON PERFORMANCE OF MOORING TRIALS OF ELECTRICAL EQUIPMENT

1 Tests of electric propulsion system

1.1 Prior to the beginning of mooring trials, the check of the electric propulsion plant shall be carried out including inspections of:

- .1** propulsion plant generators;
- .2** exciter sets including static devices of generators and electric motors excitation;
- .3** switchboards and control panels;
- .4** electric drives of essential machinery;
- .5** alarm, interlock and protection devices.

1.2 Once the RS surveyor has made sure that the technical condition of the equipment is satisfactory, and checks and measurements conducted according to the Recommendations (refer to Appendix 1) have not revealed the discordance with the requirements of the Rules for the Classification and Construction and technical documentation of the ship's design, and the additional checks according to 10.4.2.4.2 — 10.4.2.4.4 have demonstrated the satisfactory results, the preoperational checks in the scope specified in 10.4.2.5 shall be carried out.

1.3 Thereafter the electric propulsion plant is started and tested according to 10.4.2.6.

1.4 In starting the electric propulsion plant, the following shall be ascertained:

.1 the main current circuit is designed and consistent with all the required modes of electric propulsion system operation including the mode at the heaviest characteristic of mooring conditions;

.2 loads of driving motors, generators and propulsion motors in all modes of operation including the mode at the transition from the characteristic "open water" to the one "mooring conditions" are within tolerable limits;

.3 the maximum locked-rotor current of propulsion motors, the allowed time under stalling conditions, as well as the locked-rotor torque do not produce an adverse effect on the electric propulsion system;

.4 systems of generators and motors excitation, main changeovers of main current circuits, feedbacks on electric propulsion system current and voltage regulation function properly;

.5 the following interlocks are provided in the devices, blocks or control stations which:

prevent potential changeovers in main current and field circuits during plant operation;

prevent the changeover of control stations and the start of propulsion motors from any position, but "stop";

prevent the start of a propulsion motor with the shaft-turning gear engaged;

provision is made for the signalling system indicating the position of selective switches, of switches of control stations and exciters, the opening and closing of doors of electric propulsion plant switchboards, as well as the presence of water in the cooling system of generators and propulsion motors, the temperature rise of bearings, cooling air, etc. evidencing the break in operation of equipment for electric propulsion plant.

Red lamp signals switching-on shall be supplemented with a sound signal;

.6 arrangements preventing potential hazards for propulsion motors, generators and prime motors are ensured in the protection circuits provided. Regulators of electric propulsion system provide for: the limitation of current to the rated value under normal operational conditions, the limitation of torque in locking the propulsion shaft, the maintenance of a certain propulsion motors speed, the limitation of transient processes in starting, braking and reversing, the limitation of reverse power in propeller braking, etc.;

.7 the quick-acting electrical protection against overloads and overvoltage of semiconductor converters, rectifiers, etc. for electric propulsion systems of the dual-type current is provided and operates properly;

.8 a forced-feed lubrication system for machines of the electric propulsion plant is served with one of the two lubricating pumps fitted and a gravity tank in case of the lack of electrical power;

.9 provision is made for at least two cooling pumps in the cooling system of propulsion motors and generators of the electric propulsion plant, which may be switched to separate air coolers of the machines.

1.5 All the checks and measurements needed to determine the characteristics specified in 1.4 of this Appendix shall be performed with use of measuring devices being part of the electric propulsion plant as well as by means of other devices not related to the plant.

1.6 Other checks relating to switchgear, the electric protection of generators and electric motors, to the cable network, control panels, etc. are identical to the checks applied to ship's electrical installations (refer to Section 2 of this Appendix).

1.7 The insulation resistance of the entire electrical equipment of the electric propulsion plant specified in 10.4.2.5.1 shall be measured in accordance with Appendix 3, and the d.c. machines commutation performance is checked as per Appendix 5.

2 Test of ship's electric power plant

2.1 Prior to the beginning of mooring trials, the check of the ship's electrical installation shall be carried out including inspections of the following:

.1 main and emergency sources of electrical power, i.e. main generators, emergency generators and accumulator batteries;

.2 electric power converters, i.e. transformers, rotating and static converters;

.3 switchgear, i.e. main and emergency switchboards, remote and local control panels for electrical equipment, control gear, etc.;

.4 electrical drives of essential machinery;

.5 main and emergency lighting, navigation lights;

.6 all systems of intercommunications and alarm;

.7 heating and cooking appliances;

.8 cable network;

.9 earthing devices of all the types and purposes.

2.2 Once the RS surveyor has made sure that the technical condition of the electrical equipment is satisfactory, and checks and measurements conducted according to the Recommendations (refer to Appendix 1) have not revealed the discordance with the requirements of the Rules for the Classification and Construction and technical documentation of the ship's design, and the additional checks according to 10.4.2.4 — 10.4.2.6, if these are needed for the ship's electrical insulation, have demonstrated the satisfactory results, the tests and checks in the scope specified in 10.4.2.7 shall be carried out.

2.3 Prior to the performance of tests and checks specified in 2.2 of this Appendix, the insulation resistance of each type and piece of the electrical equipment under test shall be measured. These measurements shall be performed in accordance with Appendix 3.

2.4 The check of electrical starting for main generators is carried out as follows:

.1 where the movers of main generators are fitted with electrical starting devices, the start of the generator (generators) prime mover by means of the electrical starting device shall be made after measuring the insulation resistance of generators and the main switchboard or its generator panels;

.2 prior to the start, the condition of a starter accumulator battery (batteries), the density and level of electrolyte, voltage shall be determined;

.3 prime movers shall be cold-started both from local and remote starting panels;

.4 each prime mover of a generator shall be started at least six times on the type ship and at least three times on series-built ships. In so doing, the first three starts may follow one after another in 1 min to 1,5 min, the follow-up ones may be staggered in time within 30 min;

.5 after starting prime movers of all generators with use of the electric starter, the voltage of the starter accumulator battery and the electrolyte density shall be measured. The battery voltage therewith shall correspond to 0,9 of the rated one;

.6 when other additional essential consumers (lighting, alarms, etc.) are supplied from the starter accumulator battery, after all the starts of movers the battery voltage shall remain nominal and additional battery-supplied consumers shall properly operate within the set time.

2.5 Generators check.

2.5.1 After starting and setting the rated values of each generator parameters, the following shall be determined:

.1 limits of voltage variations in regulating the generator excitation with use of automatic or manual regulators at the loading of 50 % of the generator rating, from the formula

$$\Delta U = \frac{U_{\max(\min)} - U_n}{U_n} \cdot 100 \% ; \quad (2.5.1.1)$$

.2 limits of speed variations in the manual action on the prime mover regulator at the loading of 50 % of the generator rating, from the formulae:

$$\Delta f = \frac{f_{\max(\min)} - f_n}{f_n} \cdot 100 \% ; \quad (2.5.1.2-1)$$

$$\Delta n = \frac{n_{\max(\min)} - n_n}{n_n} \cdot 100 \% . \quad (2.5.1.2-2)$$

2.5.2 Voltage and frequency time variations arising in transient modes of drives operation shall be such that the normal operation of all essential consumers supplied from these generators may remain intact and deviation values may not exceed those specified in 10.6 and 10.7, Part XI "Electrical Equipment" of the Rules for the Classification and Construction.

2.5.3 The field killing device shall be checked three times according to its direct functions. The process of field killing shall be monitored by a standard voltmeter. In so doing, attention shall be given to the stability of initial generator excitation and to switchgear and alarms operation.

2.5.4 When the generator runs in the nominal mode, the functioning of its control equipment at all types of control (local, remote, manual and automatic) shall be checked, the voltage of the generator and exciter (if any), armature (stator) current, field current, speeds, active power, power factor (to be computed if a measuring device is lacking) shall be measured. The power factor shall not differ from the rated value for more than by $\pm 5\%$.

2.5.5 The bearings temperature shall be measured at the end of a mode.

Measurements shall be carried out with use of thermometers and thermocouples. After the continuous running of a machine (till a steady-state temperature), the bearings temperature shall not exceed:

- for plain bearings — 80 °C;
- for rolling bearings — 100 °C.

2.5.6 If needed, the axial displacement of an armature or a rotor shall be checked after the stop of the machine with plain bearings in order to determine axial loads on the latter.

2.5.7 For the check specified in 2.5.6, the bearing cover and top shell shall be removed, the shaft position relating to bearing projections shall be noted and a pointer-type indicator for determining a potential shaft displacement shall be fitted at the rear face of the shaft. Following the bearing assembly and the start of the generator mover, the limits of displacements, which shall be within the range determined with the indicator for the inoperative machine, shall be checked by indicator readings. Dynamic measurements shall be performed at various loadings. If the axial shaft displacement revealed in checking is such that shaft shoulders are carried by the bearing shell, the machine shall be stopped to rectify a fault. Permissible standards of the axial displacement are given in Table 1 of Appendix 6.

2.5.8 If water coolers are used, the functioning of a flow relay shall be checked by the temporary suspension of water circulation.

2.5.9 For every electrical machine, to be measured is a temperature of:

- .1 cooling medium at the machine inlet and outlet;
- .2 stator windings;
- .3 an armature or a rotor;
- .4 a commutator or contact rings.

All these measurements shall be performed with thermometers or thermocouples (refer to 2.5.9.2 and 2.5.9.3) if embedded temperature sensors are provided in the machine design.

2.5.10 Generators shall be tested for sudden loading and unloading being 70 and 100 % of the generator rating respectively.

For the complete set of main sources according to 2.5.19.1, such tests shall be applied to each generator, and according to 2.5.19.2, to generators running in parallel. In this case, the value of the loading carried shall be at least 70 % of the total rated power of running generators.

For the complete set according to 2.5.19.3, such tests for generators driven by main engines are not needed.

Sudden loading of the generator(s) at the level of 70 % of the generators rating shall be carried out for completely-unloaded generators preset for the rated voltage, frequency and speed.

2.5.11 When the parallel running of generators is not provided at zero or very small loads, the 70 % loading for generators running in parallel shall be carried out at the lowest loading possible for the stable operation of generators, but not more than 20 % of the total rated power of generators..

2.5.12 After loading and the recovery of the mode of the generator set, the generators shall be loaded up to 100 % of the rated power and then suddenly to be completely unloaded or down to the initial loading (refer to 2.5.11) of running in parallel generators.

2.5.13 The results of tests according to 2.5.10 — 2.5.12 shall be consistent with the requirements of 2.11.3.1 — 2.11.3.4 and 2.11.4, Part IX "Machinery" of the Rules for the Classification and Construction. The tests may be performed with the parameters of a suddenly-applied load equal to 50 % of the rated one with the follow-up application of the remaining 50 % load.

2.5.14 In prototype ships, and in ships of a series if needed, the start from generators of the largest electric motor fitted in the ship and having the most severe starting conditions shall be checked.

2.5.15 Such a start of the largest electric motor shall be performed at least two times at the following initial conditions:

- .1 generators) runs at 25 — 30 % of the rated power;
- .2 generators) runs at 65 — 70 % of the rated power.

The above checks shall be conducted simultaneously with those specified in 2.5.19 and under all the conditions specified therein.

2.5.16 In the tests specified in 2.5.14 — 2.5.15, any failures in systems supplying the consumers connected, any protection actuations, continuous drastic drops of voltage and speed, changes of switching positions of control equipment, etc. are inadmissible.

2.5.17 In the tests specified in 2.5.10 — 2.5.15, oscillography shall be used in prototype ships for transient processes. Oscillograms shall evidence that variations of single parameters, voltage, current strength, speed, time characteristics of recovery, system damping, new steady-state modes, etc. are within the tolerable limits and consistent with the Rules for the Classification and Construction.

2.5.18 All the synchronization devices shall be tested in operation (synchronizing lamps, synchrosopes, frequency meters, phase meters, speed regulators, etc.) for determining an opportunity of the following:

.1 synchronizing and starting the generator for running in parallel when the operating generator is under the load corresponding to the rated power of the smallest generator, as well as of switching the load to each installed generator with the remote and local control from all the stations on board the ship;

.2 synchronization and steady operation of all the generators fitted in the ship in parallel connection one to another and to the land-based network (if provided) within the time needed to switch the load between generators and to the land-based network and back;

.3 synchronization and steady operation of the generator driven by the main engine with the one having the independent prime mover within the time of load switching;

.3 synchronization and steady operation of the shaft generator, driven by the main engine, directly with the generator having the independent prime mover within the time of load switching;

.4 synchronization and steady operation of the generator, having the independent prime mover, with reversible frequency converter (e.g. semiconductor frequency converter of the shaft generator supplying the ship mains);

.5 checking the possibility of manual synchronization of the generators installed by an operator.

2.5.19 The sufficiency of unit and aggregate power of main generators shall be determined by one of the following ways:

.1 if only two generators are fitted, the most powerful one shall be rendered inoperative and the other running generator shall be loaded to its maximum corresponding to the most severe mode specified: running, manoeuvring or emergency. Loading conditions are established with use of the loading table submitted by the ship's designer. Loading devices shall be used when the load required for the generator cannot be provided by ship's services at the time of mooring trials. Water rheostats and, for synchronous generators, special devices providing loading with a calculated [weighted-mean power factor, may be used as such devices for dc generators by the special agreement with the RS surveyor;

.2 if more than two generators are fitted, the most powerful one also shall be disabled and the rest shall run in parallel and be loaded to its maximum according to 2.5.18.1 of this Appendix;

.3 if one of the generators installed is driven by the main engine, the former shall carry the full loading of all the consumers used in operating conditions. This requirement also covers the generators of which prime movers are turbines operating from exhaust-heat boilers. The remaining one or more generators fitted in the ship and having independent prime movers in separate or parallel running respectively shall be loaded at its maximum under the most severe conditions as specified in 2.5.19.1 of this Appendix.

2.5.20 In the tests specified in 2.5.19 of this Appendix, generators shall operate without overloading accordingly distributed among the generators running in parallel with the rated voltage (and frequency) kept stable. The total or unit load of generators which in all the cases specified in 2.5.19 shall not exceed 100 % of the rated power of one or more running generators shall also be determined. These loads desirably shall not exceed 80 — 85 % of the relevant generator ratings, i.e.

$$P \leq 0,85 \Sigma P_g$$

where P = power of all types of loads determined by the loading table in the most severe conditions;

P_g = aggregate power of all running generators.

2.5.21 The load distribution shall be checked in both type and ships a of a series:

.1 between main generators when only two are fitted, each being capable to supply all the ship's services, and when their parallel operation is provided either for improved reliability (navigation in narrow waters, special manoeuvring, prevention of incidents) or for load switching;

.2 between main generators when more than two are fitted with one of the most powerful generators disabled. In this case, the load sharing shall be checked between any generators running in parallel of which one is disabled in turn;

.3 between generators with independent prime movers and directly between the generators (shaft generators) driven by main engines, as well as between turbine generators and diesel generators if such modes of main generators operation are provided for continuous or short-time running;

.4 between generators with independent prime movers and reversible frequency converters of the shaft generators driven by main engines.

2.5.22 In all the ships with the main generators intended for running in parallel including the cases in 2.5.21, the parallel running of generators shall be checked so that the RS surveyor may make sure that:

.1 machines are properly balanced and inadmissible vibrations are prevented. If needed, the vibration frequency and amplitude shall be determined with use of the relevant devices;

.2 the speed regularity of running generators is maintained, the speed swing between generators and arbitrary redistribution of loading are lacking. Such a check shall be performed with use of electric measuring instruments;

.3 the static stability of generators and the uniform sharing of loading are maintained in parallel running.

2.5.23 The uniformity of loading sharing shall be checked in the variation of the total loading at, as a minimum 25, 60, 85 and 100 % of the running generators rating. In this check, loading shall supplemented with its removal.

The limits of nonuniformity in dividing active and reactive loads without the manual regulation of running generators shall be set..

2.5.24 The nonuniformity in dividing active and reactive loading between generators shall be determined from the formula

$$P = (p/p_r - \Sigma p / \Sigma p_r) \times 100 \% \quad (2.5.24)$$

where p = given generator loading, in kW;

p_r = given generator rated power, in kW;

Σp = aggregate loading on all generators running in parallel, in kW;

Σp_r = aggregate rated power of all generators running in parallel, in kW.

$$P = \left(\frac{p_{13}}{p_{n1}} - \frac{p_{13} + p_{23}}{p_{n1} + p_{n2}} \right) \times 100 \%$$

Example of calculation

Aggregate load of electric power plant, in %	Generator loading	
25	p_{11}	p_{21}
60	p_{12}	p_{22}
85	p_{13}	p_{23}
100	p_{14}	p_{24}
85	p_{15}	p_{25}
60	p_{16}	p_{26}
25	p_{17}	p_{27}

2.5.25 The nonuniformity of reactive load distribution between generators shall be determined by the formula

$$Q = (Q/Q_n - \Sigma Q / \Sigma Q_n) \times 100 \% \quad (2.5.25-1)$$

where Q = reactive load on a given generator, in kVA;

Q_r = rated reactive power of a given generator, in kVA;

ΣQ = aggregate reactive load on all generators running in parallel, in kVA;

ΣQ_r = aggregate rated reactive power of all generators running in parallel, in kVA.

The reactive power is determined by the formula

$$Q = P \operatorname{tg} \varphi. \quad (2.5.25-2)$$

2.5.26 All calculations shall be performed by the shipyard's personnel and presented to the RS surveyor at his request.

2.5.27 If one of the ship's specified generators or additional generator is automatically started and connected to the main switchboard busbars, the one shall be checked and tested in the presence of the RS surveyor. The checks and tests shall demonstrate the following:

.1 the generator is automatically started and connected to the main switchboard busbars in overloading or with the voltage collapse across busbars.

For this check, the voltage across the main switchboard busbars shall be reduced down to 70 % of the rated one or the prime mover of the running generator shall be stopped. A circuit breaker in both cases shall cut out the running generator of the main switchboard busbars.

After the automatic cutting-out of the running generator of the busbars, the standby generator shall be automatically started in about 2 s and on reaching 98 % of the rated voltage be connected to the main switchboard busbars. The total time shall be within 45 s;

.2 loading of the running generators) is brought up to 105 — 110 % of the rated one using ship's consumers or loading devices, and the time of starting, synchronizing and taking the load by the standby generator, which shall not exceed the one specified in 2.5.27.1, is monitored.

2.6 Check of emergency source of electrical power.

2.6.1 The emergency source of electrical power shall be tested to confirm its adequacy and operation reliability in the collapse of voltage across the main switchboard busbars, namely:

.1 sufficiency of the emergency source of electrical power to supply consumers during the set time as specified in 9.3 and 19.1.2, Part XI "Electrical Equipment" of the Rules for the Classification and Construction shall be ascertained;

.2 where the emergency source is an accumulator battery, then after its examination (refer to 2.1 of this Appendix) all the emergency services shall be connected to it in accordance with the loading table and the fully-loaded battery shall be tested until its voltage drops to 0,88 of the rated one.

The test results are recognized satisfactory if the loading duration therewith is not inferior to that set in the Rules for the Classification and Construction;

.3 where the emergency source is a generator, it shall be tested by the load corresponding to all the emergency services within the whole time set¹. After the generator stop, the fuel oil in the emergency generator tank shall be measured; the remaining fuel oil shall be sufficient for at least 2 h of additional operation of the generator prime mover;

.4 the accumulator battery being the transient emergency source of electrical power shall be tested for supply of the specified consumers within half an hour. Following that time period, the battery voltage shall be at least 0,88 of the rated one;

.5 the accumulator batteries voltage shall be measured with the consumers connected.

2.6.2 In checking, the electrical start of the emergency generator shall be tested at least six times with use of both an automatic device and a local start from a starter battery.

The local electric start of the emergency generator shall be checked in accordance with the provisions in 2.4 of this Appendix.

The automatic start of the emergency generator shall be checked by deenergizing the main switchboard busbars. It is recommended that the total time since the voltage collapse across the main switchboard busbars until the closing of the circuit breaker of the emergency switchboard and taking the load does not exceed 45 s.

2.6.3 If the accumulator battery is used as the emergency source, its instantaneous connecting to the emergency switchboard after deenergizing shall be checked.

Such a check shall also be performed for the accumulator battery being the transient emergency source of electrical power.

2.6.4 In checking, the requirements on the automatic instantaneous closing of emergency consumers of the accumulator batteries specified in 2.6.3 with the voltage drop across the busbars of the main or emergency switchboards down to 60 % of the rated one shall be met.

Such a check shall be performed by reduction of a prime movers speed or by another approved way.

2.7 Check of transformers, converters, rectifiers and other devices of electric power conversion.

2.7.1 The adequacy of power of a transformer or transformers being operative, while the most powerful one fitted in the ship is disconnected, shall be checked. This check shall be performed by closing all the services supplied from transformers and by determining the actual load of the operative transformer or transformers. The reliability of maintaining the transformer output voltage at tolerable variations of generators voltage and frequency also shall be checked.

2.7.2 When emergency services are supplied from the transformer supplied from the emergency switchboard, the check according to 2.7.1 shall be performed for such a transformer as well.

¹The duration of emergency generator testing may be reduced with the steady and reliable operation under the load of all the emergency services, but in all cases it shall be at least 1/3 of the time the emergency generator operation is designed for.

2.7.3 An opportunity to supply essential emergency services both from the transformer supplied by the main generators and from the transformer supplied by the emergency generator shall be checked. This check shall be carried out by the relevant switching and alternate supply of services from both transformers.

2.7.4 The connection of transformers to the main and emergency switchboard busbars, the availability of the necessary switchgear in primary and secondary circuits, of protection equipment and its rating, measuring instruments, etc. shall be checked simultaneously with the above checks of transformers. If oil transformers are used, the availability of pans, expansion devices, etc. shall be checked.

2.7.5 In cases, other than those recommended for ship's electrical plants, when the transformers fitted may operate in parallel, to be checked are switching and protective equipment, and the load sharing between transformers which shall be within the tolerable limits specified for generators running in parallel.

2.7.6 The uniformity of load sharing between single transformer phases at all potential loads of 25 — 100 % of the rated power, if the latter provided by the consumers fitted in the ship, shall be checked. Such a check shall be carried out by phasewise measurements of current with instruments of the main and emergency switchboards.

2.7.7 Rotating converters shall be tested in combination with panels for control, feed and distribution of electric power from converters and in all the loading conditions specified for converters.

In testing shall be checked:

- .1** accuracy of output parameters maintenance;
- .2** functioning of the speed and voltage regulation system in a sudden change of loading;
- .3** functioning of controls, switch-on and switch-off elements of the converter both at local and remote control panels;
- .4** functioning of the automatic switching of converter supply, the parallel operation of converters and load sharing between them if appropriate devices and modes are provided.

2.7.8 The static stability of rotating converters operating in parallel shall be determined at total loadings within 25 — 200 % of the output power rating of converters. The uniformity of load sharing in this test shall be checked.

2.7.9 Static converters (including semiconductor ones) shall be checked under load. In this case, input and output parameters, an accuracy of their maintenance and the tolerable limits of their deviations from the rated values shall be monitored.

An impact of static converter operation in the load mode, and of reversible semiconductor frequency converter — in the regenerative modes as well as in the reactive power compensation mode (if provided for by the design), on the distortion of the shape of a curve of voltage in the ship's electrical network shall be ascertained in the prototype ship.

2.7.10 The functioning of rectifiers, charging devices, inverters, etc. shall be checked when they operate according to their duties, at rated loads and in combination with all their distributing, regulating, starting and protective devices.

2.7.11 The test results are considered satisfactory if the proper functioning of electrical equipment, the conformity of its characteristics and parameters with the requirements of the Rules for the Classification and Construction and with the ship's demands specified are demonstrated.

2.8 Check of switchgear, switching, protective and control equipment.

2.8.1 Provision shall be made for checks and tests of main, emergency, sectioned, grouped and other switchboards of essential and nonessential services.

2.8.2 In checking, it shall be ascertained and, if needed, evidenced by tests:

- .1** presence of switching and protective equipment in each outgoing feeder, their proper and reliable functioning;
- .2** availability of instruments for measuring all the crucial parameters of electrical power, their proper and reliable functioning;
- .3** presence of all types of audible and visual alarm on faults in the distribution system or on variations of electrical power parameters beyond the tolerable limits and their proper functioning;
- .4** conformity of circuit breakers with the requirements on protection against short circuits and over-loads;
- .5** conformity of circuit breaker settings on protection against short circuits and overloads with the characteristics of consumers, supply feeders, breaking and making capacities of circuit breakers and the total rating of generators which may be connected to switchboard busbars;
- .6** correct selection of fuse elements for fuses depending on the characteristics of a protected feeder, the magnitude and type of load;
- .7** satisfaction of the requirements on arrangement of switching and protective equipment on outgoing feeders of essential services fitted in the double quantity on different distributing sections.

2.8.3 The external and internal examinations of switchgear shall be carried out according to Appendix 1. Any nonconformities with the requirements of the Rules for the Classification and Construction associated with the subjects listed in 2.8.2 shall be revealed by examinations.

2.8.4 Following the external examination, the functioning of controls, switching and protective equipment, and alarms shall be checked and, if faults are lacking, power shall be applied to the switchboard or other switchgear being tested.

2.8.5 The switchgear may be checked being powered from both its own regular sources of electrical power and the land-based network.

2.8.6 When the switchgear is alive, all the versions of switchings provided in the ship's design, the correct alternation of phases or poles of busbars, feeders, the functioning of switching equipment, alarms, measuring instruments, etc. shall be checked.

2.8.7 The uniformity of load sharing between single phases by phasewise measurements of load current shall be checked using the instruments on the main, emergency and sectioned switchboards.

2.8.8 Electrical protection equipment and devices shall be checked with the use of the proper instruments in compliance with the manufacturer's instructions and due regard to the requirements of 8.1.8, Part XI "Electrical Equipment" of the Rules for the Classification and Construction.

2.8.9 The proper adjustment of protection equipment of adjusting circuit breakers and hot-wire relays shall be checked for compliance with settings for:

.1 operating current of the release in the short circuit zone — for adjusting circuit breakers with the electromagnetic overcurrent release;

.2 operating current — for overcurrent relays;

.3 operating current of the release in the short circuit zone, as well as operating current and time in the overload zone — for adjusting circuit breakers with the combined release.

2.8.10 The proper adjustment of protection equipment of selective circuit breakers shall be checked for compliance with settings for the following:

.1 operating current and time for overload releases;

.2 operating current and time for overcurrent releases.

2.8.11 The reverse power (current) relay shall be checked for operation using special devices or during the parallel running of generators (refer to 2.5.22 of this Appendix) reducing the speed of one of generator prime movers, and for dc generators, reducing the voltage of one of generators running in parallel.

The time since reverse power emergence equal to the relay setting till the moment of operation of the circuit breaker of the generator running at reduced parameters shall be determined by a stopwatch.

Relay settings shall be consistent with those given in 8.2.4, Part XI "Electrical Equipment" of the Rules for the Classification and Construction. Reverse power and reverse current protection relays of each generator shall operate with the above settings within not more than 10 s.

2.8.12 Hot-wire relays of circuit breakers or magnetic starters shall be checked for operating current. The check of a dc relay shall be carried out by supplying from a dc source with regulated characteristics or with a special ac device for ac hot-wire relays.

The relay is preheated with the current equal to 150 — 200 % of the rated current of electric motors until the relay operates (heating shall be within 3 min). Then it shall be cooled down until relay contacts take the initial position. Thereafter check tests with the current equal to 150 % of the rated one shall be performed 2 — 3 times. If relay preheating is not used in the check, the operating current is computed from the formula

$$I_{op} = k \cdot I_r \quad (2.8.12)$$

where I_{op} = operating current of a relay, in A;

I_r = rated current of a relay, in A;

k = correction factor for an ambient air temperature:

k ...	1,58	1,51	1,43	1,35
t_{amb} , in °C ...	10	20	30	40

The operating time of the relay shall be within 90 to 120 s.

2.8.13 Aside from the shortcut method of hot-wire relays testing given in 2.8.12, the following method may be used.

Hot-wire relays at an ambient air temperature of 40 °C are heated with the rated current of an electric motor during 2 h. Then the current value is increased up to 135 % of the rated one, the relay therewith shall operate (disconnect the electric motor) within 20 min.

2.8.14 The phase-failure and low-voltage protection device shall be checked at the rated load current of the land-based network feeder. The test is carried out as follows: the break of one feeder phase is simulated at the current strength of at least 25 % of the rated one, and the rated load current for the feeder is maintained in two remaining phases.

The operating time for protection is determined since the phase break moment till the signal at the block output. The functioning of the low voltage alarm shall be checked at a time.

2.8.15 Checks as applied to the phase-failure and low-voltage protection device of 30ΦH type shall be carried out for determining sensitivity at the following parameters:

.1 in operation of the relay block with current transformers rated at 800 A, 50 Hz or 400 Hz at motor or combined load currents the sensitivity is within 15 A, and for the active load, within 20 A;

.2 in operation of the relay block with current transformers rated at 1500 A, 50 Hz at motor or combined load currents the sensitivity is within 30 A, and for the active load, within 50 A;

.3 in operation of the relay block with current transformers rated at 1500 A, 400 Hz at motor or combined load currents the sensitivity is within 60 A, and for the active load, within 100 A;

.4 the signaling block shall generate a pulse on low voltage at the voltage drop down to 85 — 80 % of the rated one equal to 380 V.

2.8.16 The off-loading device shall be checked by disconnecting nonessential services. This check shall be performed by connecting consumers with the total loading of at least 110 % of the running generators rating to these latter. The first level of nonessential consumers at such a load shall be disconnected within 10 s after load application.

2.8.17 The functioning of the following signaling devices (if any) shall be checked for operation within 5 s and 10 min respectively:

.1 on generator frequency increase above 105 % of the rated one;

.2 on load reduction down to 35 % of the generators rating.

The above checks shall be carried out by the increase of a generators prime mover speed and by off-loading.

2.8.18 All the checks, tests and measurements performed with regard to switching and protective equipment shall evidence that all the settings on operating currents, time delays, selectivity, breaking and making capacities of circuit breakers are consistent with design and technical characteristics of the protective equipment used.

2.8.19 In single cases, when all the above specified checks of switching and protective equipment for correspondence with the short-circuit currents expected or the calculations of short-circuit currents are questioned, the RS surveyor can demand the performance of tests at full-scale short-circuits.

The program and procedure for such tests shall be developed by the shipyard (ship's designer) and approved by the Register.

2.8.20 The check of short-circuit protection shall be carried out for the following:

.1 selectivity of protection operation;

.2 electrodynamic stability of electrical equipment elements;

.3 proper selection of protective equipment by switching capacity and pickup settings in protection zones;

.4 stability of electric generating plant operation under transient operational and emergency conditions.

2.8.21 In performance of full-scale short-circuit tests, oscillography shall be used for the following:

.1 currents and voltages in each phase at the point of fault, the voltage (in one phase) at the main switchboard and secondary switchgear, which supply essential services;

.2 speeds of prime movers of generators;

.3 time of protection operation in the short circuit and supply circuits of essential services of the largest installed power.

2.8.22 Following each full-scale short-circuit test, the switching position of protective equipment of essential services, the proper condition of main and secondary switchboard busbars being part of the short circuit shall be checked.

2.8.23 During functional tests of electrical equipment, infrared thermography shall be used for electrical contact joints in switchboards, boxes and starting devices.

2.9 Check of electric drives of essential machinery.

2.9.1 All the electric drives of essential machinery shall be checked both in idle running and in loading the machine according to its duty if such a load may be applied during the mooring trials.

2.9.2 Where it is impractical to apply the rated or like load to the machine, the electric drive of the machine may be checked for operation according to its duty during the sea trials.

2.9.3 In idle running the electric drive of the machine the following is checked:

.1 functioning of switching and control equipment by opening and closing a switch or circuit breaker on a switchboard;

.2 manual start and stop of the electric drive at the local control board;

.3 remote start and stop of the electric drive at all remote control boards, as well as the stop of electric drives of fuel oil, lubricating oil, fuel oil transfer pumps, fans, etc. which shall be provided with such opening devices;

.4 automatic start and stop of the electric drive of a back-up (standby) machine by the stop of the main running electric drive;

.5 activation of an audible and visual alarm by signals of the sensor of medium parameters, e.g. air and lubricating oil pressure, temperature, level, etc. The check shall be performed by the variation of the relevant parameters of the medium under control;

.6 smoothness of electric drive running, the proper alignment of the electric drive and machine, the lack of beats and intolerable vibrations, and of heating of electrical motor end shields;

.7 values of starting currents, reliable operation of contactors in electric drive switching on and off, the lack of arcing, sparking and burning of contact surfaces, switching performance of dc motors and the condition of a commutator after the electric motor stop;

.8 functioning of electric motors at all the speeds specified with checking the operation of the zero protection, as well as the repeated automatic switching-on after voltage recovery where it is provided.

2.9.4 The electric drives start and stop specified in 2.9.3 shall be checked at least 3 – 4 times for each electric drive.

2.9.5 The parameters of electric drive operation shall be monitored using standard regular measuring instruments. Clip-on instruments, as well as portable devices may be used.

2.9.6 The check of electric drives functioning at the rated load of the machine shall provide:

.1 determination of the load factor and consumed power of the electric motor (in prototype ships);

.2 determination of a speed and, if needed according to the conditions of electric drive operation, of the range of tolerable variations of electric dc drives speed as well;

.3 determination of starting currents of electric motors of electric drives being switched on under load;

.4 check of automatic starting electric motors of electric drives with supply voltage recovery after failure, where such starts are provided;

.5 determination of the adequacy of technical parameters of the electric drive to maintain the operational modes specified for the machine.

2.9.7 Electric drives operating under variable loads, e.g. of cargo winches, capstans, windlasses, etc. shall be checked in operation under the heaviest conditions.

2.9.8 The survey and tests of electric drives of machinery are carried out in their operation according to their duty in combination with the unit (diesel, boiler, systems, arrangements, etc.) under test.

2.9.9 In checking the operation of single electric drives of essential machinery, the requirements of 2.9.9.1 — 2.9.9.7 shall be met.

2.9.9.1 Steering gear.

2.9.9.1.1 Following power applying to the steering gear, to be checked are:

consistency of all electric indicator readings with reference to the mechanical rudder angle indicator, automatic starting the electric motor of a pump (for hydraulically-driven steering gear) at the automatic switching (if provided) of supply from the main source to the backup one and vice versa;

consistency of rudder angle indicators readings, in deg., in putting the rudder over through each 5° from each control station, i.e. a mismatch value shall not exceed:

in centerline..... ± 1;

at rudder angles from 0 to 5°..... ± 1,5;

at rudder angles from 5 to 35°..... ± 2,5;

the time of transition from the main control station to the backup one shall not exceed 2 min for the prototype ship;

proper functioning of limit switches, audible and visual alarms. The electric drive overload alarm shall be checked by the opening of hot-wire relay contacts or by the button of signal checking and the button of signal picking off;

functioning of the electric drive of the steering gear power unit and of the remote control system supplied from each of two available feeders by their switching in the steering compartment or on switchboards;

functioning of the main and standby electric drives of the main unit of rudder from the emergency generator (if provided) by starting at the emergency load of the generator or with the load removed;

putting the rudder from hard over to hard over from all the remote control stations;

start and stop of the steering gear power unit from the wheel house, independent supply of the rudder angle indicators system and the remote control system from the power units supply system, the opportunity to individually disconnect the supply of the remote control system;

speed of putting the rudder over with one, two and the backup power units of the steering gear. The check shall be carried out by measuring the time of putting the rudder over according to the requirements in 2.9.2 and 2.9.3, Part III "Equipment, Arrangements and Outfit" of the Rules for the Classification and Construction. The insulation resistance

specified in 2.3 of this Appendix for electrical and electrohydraulic steering gear shall be measured on electrical gear, automatic steering devices, feeders, rudder angle indicator circuits, remote control and alarm circuits.

The electrical equipment of the steering gear with direct electrical dc drive shall be checked under stalling conditions during 1 min. The commutation of electrical dc machines shall be checked during putting the rudder from hard over to hard over. Completing the survey, the condition of a commutator and brushes shall be checked, as well as a temperature of electrical machine bearing caps by touch.

2.9.9.2 Anchor arrangement.

2.9.9.2.1 Following powering the anchor arrangement in idle running, the electric drive shall operate within at least 30 min whereupon to be checked are:

functioning of limit and lockout switches;

operation of electromagnetic brakes at the abrupt travel of the handle at the control station from limiting positions to the zero one;

drive reversal. If the electric drive of the anchor arrangement is provided with the remote control, to be additionally checked are: functioning of the servomotor control circuit, operation of limit switches and the alarm of jaw clutches and belt brakes position. Each servomotor shall be individually checked from the remote control station; time of transition from one control station to another in the prototype ship;

functioning of the torque-limiting clutch in operation of jaw clutch servomotors. In this case, the limit switches, which limit the jaw clutch movement, shall be by-passed. If the anchor arrangement has the remote control, the automatic switching of an electric motor speed and the automatic stop of the electric motor at anchor entering the hawse pipe shall be checked in heaving the anchor;

the brake shall be checked under load in heaving and dropping the anchor;

stalling conditions during the set time for the given type of a heated electrical motor of the anchor or mooring arrangements. The electric drive loading shall be provided by screwing up the cable (rope);

temperature of electric machine bearing caps;

degree of commutator sparking of an electric dc machine and, after the stop, the condition of brush and commutator surfaces;

electrical anchor cable indicators by comparing with readings of the mechanical indicator in every 10 m.

2.9.9.3 Mooring arrangement.

2.9.9.3.1 In surveying the mooring machinery, the checks according to 2.9.9.2, as appropriate, shall be performed additionally to the general checks of electric drives as per 2.9.3 and 2.9.6.

2.9.9.4 Cargo-handling gear.

2.9.9.4.1 The general checks of the cargo-handling gear are defined in 10.3 of the Rules for the Cargo-Handling Gear. In surveying the cargo-handling gear during the mooring trials, supplementing the general checks of electric drives specified in 2.9.3 and 2.9.6, the following shall be checked:

functioning of safety switches (buttons) on the cargo winch (control board, controller). The check shall be carried out at least 3 — 4 times for each winch both in idle running and with the loaded pendant;

functioning of limiters of crane cabin rotation and other limiting electrical devices, as well as of switching devices disconnecting the supply of electric drives of the crane in the cabin;

functioning of braking devices. The simultaneous operation of cargo winches for union purchase with the supply from the ship's electric generating plant shall be checked in the prototype ship only.

2.9.9.5 Electric drives of watertight doors and of holding devices of fire-resisting doors.

2.9.9.5.1 The check of each watertight or fire-resisting door shall be effected by the five-fold opening and closing from the local station under manual control. The time of warning signal actuation and the time of door closing are determined in the prototype ship.

If the centralized remote control of watertight and fire-resisting doors is provided, the doors closing and the functioning of the audible and visual alarm on the watertight doors position when supplied from the main and emergency sources of electric power shall be checked. Electrical devices releasing fire-resisting doors shall be checked for operation 4 — 5 times each both from the remote panel and the local one at the door.

2.9.9.6 Electrical equipment of lifts.

2.9.9.6.1 In operation of the electrical equipment of lifts, the functioning of interlock switches of locks and trunk doors shall be checked by pushing the call button with one of the trunk doors opened, and the functioning of the interlock switch of the lift car door, by pushing the up (down) button with the lift car door opened (2 — 3 times).

The lift car travel shall be checked by its calling and directing to each platform. Special attention shall be given to the potential sticking of call and up (down) buttons when pushed, and their coming-off with the car stop, to the functioning of floor switches and the foot-operated switch, as well as to the functioning of electric brakes by stopping the moving car with the "stop" button.

Prior to checking the functioning of the switch of an emergency limitation in the upward movement, it is necessary:

- move the car till the uppermost entrance station;
- set the handle of the winch drive switch in the "Manual" position;
- shunt up the uppermost floor switch;
- start the electric motor for the upward movement and make sure in switch turning off and motor stopping.

The switch of an emergency limitation in the downward movement is checked in the same manner.

In checking the switches of overspeed governors and gripping devices in movement of the car overloaded by 10 %, the overspeed governor rope shall be prepassed over the pulley of a lesser diameter, and the lift car shall be set on gripping devices by starting the electric drive.

The check of the interlock switch of car securing shall be performed with the car secured in guides with the following attempt to start the electric motor.

2.9.9.7 Electric drives of classed refrigerating plant machinery.

2.9.9.7.1 In operation of the above drives, the checks specified in 2.9.3 and 2.9.6 shall be supplement-ed with the following ones:

- functioning of the emergency protection and remote control with building up the pressure in the compressor system, and the activation of the audible and visible alarm by changing the pressure in the compressor until the relevant sensor is activated;

- functioning of the audible alarm from refrigerating chambers, holds and other refrigerated spaces if such an alarm is fitted according to the requirements of the Rules for the Classification and Construction. The check shall be performed by manual closing the buttons in all spaces;

- functioning of the interlock preventing the start of a compressor motor with a cooling water pump being inoperative. The check shall be performed by test starts (3 — 4 times);

- functioning of the system of automatic connecting and disconnecting the refrigerating plant for maintain-ing the specified temperature in refrigerated spaces. The check shall be performed in combination with the refrigerating plant test for functioning according to its duty;

- functioning of automatic devices for connecting standby electric drives of compressors, pumps and fans if such an automatic change-over is provided. The check shall be effected by stopping the running electric drive. Where ammonia is used as a refrigerant in refrigerating plants, to be additionally checked is the functioning of devices for remote emergency disconnecting the refrigerating plant switchboard from their locations (refrigerating machine spaces, places outside these spaces) which may be contaminated with ammonia at entrances in the refrigerating machines space;

- functioning, in combination with the above disconnection, of the system for connecting the emergency ventilation, drenching system, water screen and standby lighting;

- functioning of the above systems without disconnecting the refrigerating plant switchboard. Where the group II refrigerant is used in refrigerating plants, to be additionally checked is the functioning of devices for remote disconnecting the refrigerating plant switchboard from their locations;

- from the permanent place of refrigerating plant control in the refrigerating machines space;

- from the place outside the space of potential contamination with the group II refrigerant in accident in the refrigerating machines space;

- from outside and close to each exit from the refrigerating machines space.

2.10 Check of functioning of main and emergency lighting and navigation lights.

2.10.1 Supplementing the checks specified in 10.6.1.1 — 10.6.1.4 of Appendix 1 to this Section, the following shall be checked in main electrical lighting systems:

- .1** functioning of the main lighting of ship's spaces and areas for compliance of the intensity of lighting using general lighting fixtures. This check shall be effected with use of special devices (luxometers) at the level of 800 mm above the space floor. The check shall be carried out in prototype ships and ships of series if the arrangement, number or type of lighting fixtures, lamp parameters were changed. The illuminance characteristics shall be consistent with those in Table 6.7.1, Part XI "Electrical Equipment" of the Rules for the Classification and Construction;

- .2** proper distribution of lighting fixtures by supply groups to provide the uniform lighting of a space or an area when any supply group fails. The check shall be effected by the sequential disconnection of single groups of lighting fixtures supply and by the visual determination of illuminance adequacy for the unimpeded control of personnel over machinery and arrangements. It shall be considered sufficient if the general illuminance with any group of lighting fixtures disconnected accounts for 30 – 40 % of the required in Table 6.7.1, Part XI "Electrical Equipment" of the Rules for the Classification and Construction;

.3 functioning of the switchgear on grouped lighting panels by disconnecting/connecting single lighting groups, proper selection of fuse ratings, if any, and of settings of adjusting circuit breakers.

The RS surveyor can demand short circuiting in the single group of lighting fixtures to check the operation of the adjusting circuit breakers. The procedure and methods of such a check shall be developed at the shipyard and approved by the surveyor;

.4 lack of the unacceptable quantity of lamps in lighting fixtures connected to one end branch of the circuit. This check shall be effected by counting the lamps and their power, and by determining fuse ratings or circuit breakers settings. Table 2.10.1.4 contains the data on the maximum permissible values of the above characteristics.

Table 2.10.1.4

Nos.	Space or lighting duty	Maximum permissible values		
		Number of filament lamps, 60 W	Circuit current	Settings of protective device
1	Accommodation and public spaces at voltage, in V:			
	up to 50	10	—	By load current
	51 to 120	14	—	Ditto
	121 to 250	24	—	Ditto
2	Decorative lighting	Any	—	Within 10 A
3	Engine rooms, holds, open decks	Any	Within 20 A	By load current

.5 functioning of the main lighting in corridors, passageways, at exits to the open deck and in other escape routes for people in accident, of embarkation stations for boarding lifeboats and liferafts, of locations for storage personal life-saving appliances, overboard spaces, etc. The check shall be effected by switching on and off the lighting, by switching off single grouped panels on the main switchboard to evidence the presence of lighting in those places being supplied from the other grouped panel;

.6 an opportunity to remotely switch off the outside lighting from the wheelhouse, availability of a visual alarm on grouped panels of holds lighting, proper operation of door switches, if fitted. Checks are effected by test switchings-off and visually;

.7 values of voltage losses or drops at the most remote lighting fixtures connected to the end branch of a circuit. The check shall be performed in the prototype ship only if no changes are made in the main lighting system in ships of a series. The check shall be effected by comparing the voltage values across the terminals of the transformer, or main or emergency switchboards and the terminals of the most remote lighting fixture. The permissible voltage losses or drops shall not exceed those given in Table 2.10.1.7;

Table 2.10.1.7

Nos.	Consumer	Voltage, in V	Maximum permissible voltage losses or drops, in %
1	Lighting and alarm	≤ 50	10
2	Ditto	> 50	6
3	Power, cooking and heating consumers	Ditto	6
4	Power consumers with short-duration and intermittent operation	Ditto	10
5	Radiostation, radio and electric navigational de-vices, charging circuits of accumulator batteries	Ditto	5
6	Ac electric motors with direct starting	Ditto	25 (at starting, during an accelerating period)

.8 insulation resistance of the end branches of circuits of the lighting network shall be measured after the RS surveyor is satisfied that all the lighting fixtures supplied from that branch are switched on and functioning; then the protection on the grouped switchboard is switched off and measurements are carried out using a megohmmeter.

2.10.2 Supplementing the checks specified in 10.6.1.1 — 10.6.1.4 of Appendix 1 to this Section, the following shall be checked in emergency electrical lighting systems:

.1 functioning of the automatic switchover of emergency lighting network supply to the emergency source with the voltage failure on the main switchboard. The check shall be performed for emergency networks of lighting from the emergency generator, emergency battery or transient emergency battery by stepping the voltage down to 50 — 60 % or by deenergizing the main switchboard busbars or another way. The time of switching on the emergency lighting from the emergency generator shall be within 45 s, and from accumulator batteries, practically instantaneous;

.2 illumination of lighting fixtures of the emergency lighting at all control stations, illumination of indicators of exits to the deck, of corridors, passageways, manual fire detectors, embarkation stations for boarding lifeboats, overboard spaces and other places according to Part XI "Electrical Equipment" of the Rules for the Classification and Construction. The illumination of lighting fixtures of the emergency lighting shall be checked in combination with the checks specified in 2.6 of this Appendix during the time period set therein;

.3 intensity of overboard spaces illumination in places of life-saving appliances launching;

.4 values of voltage losses or drops at the most remote lighting fixtures and at those of which lamp filaments glow seems to be inadequate.

2.10.3 Check of navigation lights.

2.10.3.1 Following the visual examination of the navigation lights commutator, supply and protection system, cable lines, contact and protection termination of cable conductors, plug-and-sockets, earthings of light housings and cable sheaths, etc., which shall evidence the fulfilment of the requirements of the Rules for the Classification and Construction, the following shall be checked:

.1 insulation resistance of all parts and cables of navigation lights;

.2 supply of the commutator from the both feeders provided and functioning of the feeders switch;

.3 protective devices in switchboards in power feeders and in the commutator in all feeders;

.4 functioning of switches in each outgoing feeder;

.5 functioning of an alarm on serviceability in circuits of single navigation lights;

.6 conformity of the lamps fitted with the types and ratings required.

2.10.3.2 All the checks specified in 2.10.3.1 shall be carried out with the supply from the ship's sources of electrical power using built-in and portable devices, as well as checking instruments. The checks shall be performed for each of the commutators and lights fitted.

2.10.3.3 Where it is possible, the cuts-off of a light flux of navigation lights shall be checked during the mooring trials. Otherwise those checks shall be postponed until the sea trials.

2.10.3.4 The voltage drop or loss across terminals of the most remote navigation lights shall be checked in prototype ships.

2.10.3.5 Methods of the above checks are as follows:

.1 navigation lights are checked by switching on each light, the functioning of a commutator alarm is checked therewith;

.2 alarm on lamps burnout is checked by setting the control switch on the commutator in the "Check" position or by switching off the protection in each feeder circuit both with lamps fitted in or removed from lanterns, or by another way recognized by the RS surveyor;

.3 flashing light is checked using a key;

.4 impulsive flashing lamps are checked by signalling;

.5 daytime signalling lamps are checked by signalling, the functioning of a rotary mechanism of lamps and the screens positioning are checked therewith.

2.11 Check of internal communication and alarm systems.

2.11.1 Following the visual examination of internal communication and alarm systems, including the sources of their supply and cable runs, which has demonstrated the satisfactory results, and the measurement of insulation resistance, which has evidenced its consistency with the minimum values according to the Rules for the Classification and Construction, the internal communication and alarm systems shall be subjected to checks.

The methods of these checks are as follows:

.1 engine room telegraphs shall be surveyed for a smooth movement of handles and a reliable operation of locks. The functioning of engine room telegraphs shall be checked by several transmissions of all the orders and by obtaining responses for them. To be checked is the interlock of a mishandled order if provided;

.2 telephones shall be checked by calling and talking with each subscriber in person and, if provided in the circuit, simultaneously with a group of subscribers as well;

.3 electric tachometers of the propeller shaft are checked with a clock-type tachometer at 4 — 5 points of the scale in the headway and sternway rotation of propeller shafts. The adequacy of electric indicator scales illumination is determined;

.4 fire detection system is checked by simulating fire factors depending on the type of the fire detectors fitted. These actions, excepting manual detectors, shall be performed for heat detectors by the simulation of temperature raising (with local drying fans having a thermometer), for smoke detectors by smoke simulators of the aerosol type, with a smoldering wick and etc., for flame detectors by flame simulators. The check shall be effected with supply from the main and backup sources of power. The supply failure alarm at the station and the faults alarm shall be checked;

.5 at least 50 % of the detectors fitted shall be checked in each section of detectors if their pre-check at the shipyard is documented. Otherwise, all the detectors fitted shall be checked;

.6 alarm on starting the smothering means is checked by the test operation of contact devices coupled with the release controls of fire-extinguishing agents, and by the visual and audible control over the time of alarm activation, sound intensity and panel visibility.

2.12 Check of cooking and heating appliances.

2.12.1 Cooking appliances are checked in operation in the same manner as lighting, but they are switched on for 1 – 2 h only. In surveying, attention is given to the observance of safety measures (distances from combustible materials, type of enclosures).

2.12.2 Electric heaters are checked during the time needed for reaching the maximum possible temperature on the heater housing. The temperature is assumed steady when the results of three measurements are practically the same.

2.13 Check of cable network and earthings.

2.13.1 The check of a cable network and earthings in the mooring trials shall be performed in the scope which allows to ascertain that the requirements of the Rules for the Classification and Construction are met, and in combination with the electrical equipment being checked.

RECOMMENDATIONS ON CHECKING PERFORMANCE OF ELECTRICAL MACHINES COMMUTATION

1. The check of performance of electrical d.c. machines commutation shall be carried out for the following:
 - .1 machines operating in continuous and intermittent conditions — after a lapse of time needed for reaching a steady temperature of the machine windings and frame, but not earlier than in 2 h for machines rated up to 100 kW inclusive;
 - .2 machines rated over 100 kW (not earlier than in 4 h).
2. Commutator machines shall operate without sparking at any load from zero to 100 % of the rated one. With the required overloads, reverses and starts of machines, the brush sparking shall not reach a point when the machine brushes and commutator may be damaged.
3. Electrical dc machines intended for operation in continuous conditions at the set rated load shall operate practically without sparking (commutation class 1 – 1,25). Class commutation 1,5 may be permitted under particularly severe conditions.
4. The check of machines commutation on board a ship, including also the machines of the electric propulsion plant, shall be performed with machines operating according to their duties at a practically steady temperature of the machine and the existing environmental conditions (at a temperature of air, cooling water, humidity, vibrations, shocks, inclinations, etc. specified in 2.1, Part XI "Electrical Equipment" of the Rules for the Classification and Construction).

A commutation class therewith shall not be below the one specified in 2 and 3 above.
5. Commutation classes depending on the nature of commutator brushes sparking are given in the Table.
6. The characteristic of a sparking degree given in the Table shall be determined visually by watching the sparking under the running-down edge of a brush.

Table

Sparking degree (commutation class)	Description of sparking degree	Commutator and brushes condition
1	No sparking (sparkless commutation)	—
1,25	Light point sparking under the small part of a brush	No blackening on the commutator and carbon deposit on brushes
1,5	Light sparking under the large part of a brush	Emergence of blackening traces on the commutator, which are readily wiped out with petrol, as well as of carbon deposit traces on brushes
2	Sparking under the entire brush edge. Allowed in short-time load and overload kicks only	Emergence of blackening traces on the commutator, which cannot be wiped out with petrol, as well as of 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, which cannot be wiped out with petrol, as well as burning and failure of brushes

APPENDIX 6

DATA ON CHECKS AND TESTS OF SHIP'S ELECTRICAL EQUIPMENT

Table 1

Standards for permissible axial shaft displacements in plain bearings of electrical machines

Power, in kW	Shaft displacement, in mm	
	to one side	to both sides
Below 10	0,5	1,0
10 – 30	0,75	1,5
30 – 70	1,0	2,0
70 – 125	1,5	3,0
Over 125	2,0	4,0

Notes: 1. The displacement is set to both the sides from the central position of an armature (a rotor) determined by a magnetic field.
2. For machines with a shaft journal diameter over 250 mm, the displacement may be up to 2 per cent of the journal diameter.

Table 2

Standards for permissible natural vibrations of electrical machines

Rotor shaft speed, in rpm	1000	1500	2000	2500	3000	4000	5000
Natural vibrations swing, in mm	0,1	0,09	0,075	0,060	0,050	0,030	0,020

Table 3

Conditional depths of anchorage

Anchor chain diameter, in mm	Conditional depth of anchorage, in m
Up to 14	1/3 of the entire anchor chain length
15 — 17	65
18 — 28	80
Over 28	100

Table 4

Table of conversion of power ratios and voltage ratios to decibels

Attenuation		← — Decibels → +	Amplification	
Voltage ratio	Power ratio		Voltage ratio	Power ratio
1,00	1,00	0	1,00	1,00
0,89	0,79	1	1,12	1,26
0,79	0,63	2	1,26	1,58
0,71	0,50	3	1,41	1,99
0,63	0,40	4	1,58	2,51
0,56	0,32	5	1,78	3,16
0,5	0,25	6	1,99	3,98
0,45	0,20	7	2,24	5,01
0,4	0,16	8	2,51	6,31
0,36	0,13	9	2,82	7,94
0,32	0,10	10	3,16	10,00
0,28	0,08	11	3,55	12,6
0,25	0,06	12	3,98	15,8

Table 4— continued

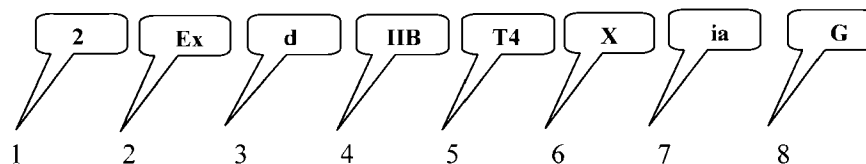
Attenuation		← — Decibels → +	Amplification	
Voltage ratio	Power ratio		Voltage ratio	Power ratio
0,22	0,05	13	4,47	19,9
0,20	0,04	14	5,01	25,1
0,18	0,03	15	5,62	31,6
0,16	0,025	16	6,31	39,8
0,14	0,020	17	7,08	50,1
0,13	0,016	18	7,94	63,1
0,11	0,013	19	8,91	79,4
0,10	0,010	20	10,00	100,0
0,056	$3,16 \times 10^{-3}$	25	17,8	316,0
0,032	10^{-3}	30	31,6	1000,0
0,018	$3,16 \times 10^{-4}$	35	56,2	$3,16 \times 10^3$
0,010	10^{-4}	40	100,0	10^4
0,006	$3,16 \times 10^{-5}$	45	177,8	$3,16,10^4$
0,003	10^{-5}	50	316	10^5
0,002	$3,16 \times 10^{-6}$	55	562	$3,16 \times 10^5$
0,001	10^{-6}	60	1000	10^6
0,0006	$3,16 \times 10^{-7}$	65	1770	$3,16 \times 10^6$
0,0003	10^{-7}	70	3160	10^7
0,0002	$3,16 \times 10^{-8}$	75	5620	$3,16 \times 10^7$
0,0001	10^{-8}	80	10000	10^8
0,00006	$3,16 \times 10^{-9}$	85	17800	$3,16 \times 10^8$
0,00003	10^{-9}	90	31600	10^9
0,00002	$3,16 \times 10^{-10}$	95	56200	$3,16 \times 10^9$
0,00001	10^{-10}	100	100000	10^{10}

Table 5

Marking of safe-type electrical equipment

Protection of electrical equipment	Mark of conformity to protection standards	Type of protection	Group of explosive gases	Temperature class	Application of equipment	Spark-proof circuit	Group of substance
0 1 2	Ex or EEx	d p q o e n m	IIA IIB IIC	T1 T2 T3 T4 T5 T6	X U	ia ib ic Exd[i..] [Ex i..]	G D

Example of marking and its interpretation: 2 Exd IIB T4 X ia G



Designations:

1. Protection:

- 0 — particularly safe-type electrical equipment;
- 1 — safe-type electrical equipment;
- 2 — electrical equipment of increased safety.

2. Mark of protection:

Ex or EEx.

3. Types of protection:

- d — flameproof enclosure;
- p — pressurized enclosure;
- q — sand-filled enclosure;
- o — oil-immersed enclosure;
- e — "e"-type protection;
- n — "n"-type protection;
- m — compound encapsulation.

4. Group by the typical representative of explosive gases:

- IIA — propane;
- IIB — ethylene;
- IIC — acetylene, hydrogen.

5. Temperature class:

- T1 — maximum surface temperature of 450 °C;
- T2 — maximum surface temperature of 300 °C;
- T3 — maximum surface temperature of 200 °C;
- T4 — maximum surface temperature of 135°C;
- T5 — maximum surface temperature of 100 °C;
- T6 — maximum surface temperature of 85 °C.

6. Application of equipment:

- X — special conditions of application;
- U — partially-certified Ex components cannot be applied.

7. Spark-proof circuit:

- ia, ib, ic — levels of spark-proof circuits, differing by the number of accountable damages in the spark-proof circuit resulting in the most hazardous conditions;
- Exd[i..] — designation of protection for the associated equipment (terminal boxes, connectors) in a flameproof enclosure, which may be installed in a hazardous area;
- [Ex i..] — designation of protection for the associated equipment (terminal boxes, connectors) which shall be installed in a safe area.

8. Group of substance:

- G — gas;
- D — dust.

TEST OF ELECTRICAL INSULATION STRENGTH

1. In performance of the technical supervision of electrical equipment during ship's construction, the test of electric insulation strength of single types of equipment is carried out only in the following cases:

.1 if an electrical machine is delivered on board the ship in parts (in assembly on board the ship, coils fitting, their electrical connection or laying of the winding part are carried out);

.2 if switchgear (main, emergency and other large switchboards) is delivered on board the ship in parts, and their mechanical and electrical connection and other assembly works need the fitting and removal of coils, transformers, busbars and bus arrangements, the disconnection of (non-plugged) switchgear and protection equipment or the change of insulation distances;

.3 if there is a reason to think by visual appearance of the cables laid (nicks, twisting, kinks, intolerably small radii of bends and other defects) that insulation integrity may be broken;

.4 if there is a reason to think that any electrical equipment insulation sustained damages during transportation and storage;

.5 if the part of insulation of windings, coils and the other were repaired on board the ship.

2. In all the above cases, the test voltage shall not exceed 1,3 times the rated voltage of equipment, and only those sections which were disassembled, repaired, connected, replaced or damaged shall be tested.

3. If the complete disassembly of a machine, the coils removal, rewinding, etc. were carried out on board the ship, such a machine shall be tested for electric insulation strength by the test voltage equal to at least 0,75 of that set for the given type of winding for new machines (refer to Part IV "Technical Supervision during Manufacture of Products" of the Rules for Technical Supervision).

4. The test shall be performed by 50 Hz alternating current with the practically sine curve at the above-specified effective value of voltage applied between the circuit section being tested and the earth (frame) during 1 min.

DURATION OF CHECKS AND TESTS OF ELECTRICAL EQUIPMENT IN SHIP'S MOORING AND SEA TRIALS

Table

Nos.	Check item	Time, in h	Notes
1	Generators, electric motors of the electric propulsion plant, generators of the ship's electric generating plant, rotary converters under rated conditions at a rated speed, rpm: below 750 750 – 1000 1000 – 1500 over 1500	3,0 2,5 2,0 1,0	Testing the generators, the test duration shall be assumed as the largest value specified in this Appendix and in Appendix 1 to Section 5 for the relevant drive machinery
2	Electric motors of drives under rated conditions at a rated speed, rpm: below 750 750 – 1000 1000 – 1500 over 1500	3,0 3,5 2,5 3,0 4,0 2,0 3,0 3,0 1,0 1,5 2,0	Enclosure IP 21 to IP 44 Enclosure IP 55 and above, a.c. current Enclosure IP 21 to IP 44 Enclosure IP 55 and above, a.c. current Ditto Enclosure IP 21 to IP 44 Enclosure IP 55 and above, a.c. current Ditto, d.c. current Enclosure IP 21 to IP 44 Enclosure IP 55 and above, a.c. current Ditto, d.c. current
3	Switchgear and control panels	Sufficient for performance of all checks	
4	Accumulators, transformers	As per the Rules for the Classification and Construction of Sea-Going Ships	
5	Static converters: idle running running under rated load	0,5 2,0	
6	Electromechanical battery chargers: idle running running under rated load	0,5 2,0	
7	Lighting: main emergency	As needed for checking According to 2.6.1.2 and 2.6.1.3 of Appendix 6 As needed for checking	
8	Electric engine room telegraphs, rudder angle indicators, CPP blades position indicator, propeller shaft tachometers		
9	Navigation lights	1,0	
10	Service telephone communication and command broadcasting	As needed for checking	
11	Alarm systems: general alarm system fire detection system warning alarm of smothering system release indication of closure of watertight and fire doors alarm system for unattended machinery spaces alarm of emergence of dangerous explosive gas concentrations	Ditto Ditto Ditto Ditto Ditto Ditto Ditto	
12	Safe-type electrical equipment	Sufficient for survey performance	The test duration is assumed in accordance with the type of safe-type electrical equipment

Table — continued

Nos.	Check item	Time, in h	Notes
13	Cable network	Until the largest temperature on the housing is reached, but at least	
14	Cooking and heating appliances: fuel oil and lubricating oil heaters cooking and heating devices	1,0 Until the largest temperature on the housing is reached, but at least 0,5 h	
15	Lightning conductor, earthing, cathode protection	As needed for checking	

11 REFRIGERATING PLANTS

11.1 GENERAL

11.1.1 The provisions of this Section shall apply in technical supervision of the marine refrigerating plants (MRP) listed in the RS Nomenclature.

11.1.2 The Section defines the scope, procedure and methods of surveys to be conducted in the process of technical supervision during installation and testing of the MRP on board ships under construction.

11.1.3 When performing the technical supervision of MRP, the RS surveyor shall be guided by the provisions of this Section, Part I "General Regulations for Technical Supervision" and Part II "Technical Documentation" of the Rules for Technical Supervision.

11.1.4 In order to perform technical supervision during the installation and testing of MRP, the shipyard shall submit the documentation approved by the Register within the scope specified by Rules for the Classification and Construction according to the examination and testing plan as specified in 11.1.8.

The related products shall have documents and brands according to the type of technical supervision given in the RS Nomenclature.

11.1.5 The related products and equipment of MRP supplied to the shipyard shall be verified by the RS surveyor against certificates or documents of the firm (manufacturer) in accordance with the type of technical supervision.

11.1.6 The refrigerating equipment and products indicated in the RS Nomenclature and manufactured by the shipyard, which is the builder of the ship, shall be subject to survey and testing prior to their installation in compliance with Part IV "Technical Supervision during Manufacture of Products" of the Rules for Technical Supervision.

11.1.7 Technical supervision during the installation and testing of the refrigerating equipment shall be performed in accordance with Table 11.1.7. The scope of individual examinations, measurements, verifications and tests provided for by Table 11.1.7 shall be established on the basis of the requirements of the Rules for the Classification and Construction and the Guidelines.

Table 11.1.7

Nos.	Item of technical supervision	Checks of		Tests			
		documen- tation, certificates, RS brands and seals	instal- lation	hydraulic test for leak	pneumatic test for leak	vacuum - tight test	test in opera- tion
1	2	3	4	5	6	7	8
1 Machinery							
1.1	Refrigerant compressors	+	+		+	++	++
1.2	Pumps:						
.1	refrigerant	+	+		+	++	++
.2	secondary refrigerant	++	++	++			++
.3	cooling water	++	++	++			++
1.3	Fans of:						
.1	ventilation system	+	+				+
.2	air cooling	++	++				++
2 Heat exchangers and pressure vessels							
2.1	Heat exchangers, pressure vessels, cooling, freezing and ice making facilities under refrigerant pressure	+	+		+	++	++
2.2	Heat exchangers, pressure vessels, cooling, freezing and ice making facilities under secondary refrigerant pressure	++	++	++			++
3 Fittings, piping and air conduits							
3.1	Fittings of:						
.1	refrigerant	+	+		+	++	++
.2	secondary refrigerant	++	++	++			++
.3	cooling water	++	++	++			++
3.2	Piping of:						
.1	refrigerant	+	+		+	++	++
.2	secondary refrigerant	++	++	++			++

Table 11.1.7 — continued

Nos.	Item of technical supervision	Checks of		Tests			
		documen- tation, certificates, RS brands and seals	instal- lation	hydraulic test for leak	pneumatic test for leak	vacuum - tight test	test in opera- tion
1	2	3	4	5	6	7	8
.3	cooling water	++	++	++			++
3.3	Safety devices and valves	+	+		+		+
3.4	Air conduits of:						
.1	cooling system	++	++		++ ¹		++
.2	ventilation system	+	+		+ ¹		+
4	Automation system						
4.1	Alarm						
.1	process	++					++
.2	warning	++					++
.3	emergency	+					+
4.2	Remote measuring of performance parameters	++					++
4.3	Safety automatic devices	+	+				+
4.4	Automatic control devices	++	++				++
5	Insulation						
.1	of refrigerated spaces	++	++				++
.2	of refrigerating equipment	++	++				++
.3	of piping	++	++				++
6	Gauges	+ ²	+ ²				+ ²
7	Spaces						
7.1	Refrigerating machinery spaces	+	+		+ ^{1,3}		
7.2	Refrigerant storerooms	+	+		+ ¹		
7.3	Refrigerated cargo spaces with cooling arrangements under refrigerant pressure	+	+				
7.4	Refrigerated cargo spaces with cooling arrangements under secondary refrigerant pressure	++	++				
7.5	Spaces containing process equipment under refrigerant pressure	+	+				
7.6	Spaces containing process equipment under secondary refrigerant pressure	++	++				
¹ Gas-tightness tests. ² For non-classed MRP — only in refrigerant system. ³ Tests are intended only for the spaces of refrigerating machinery working with Group II refrigerants.							
Notes: 1. Surveys marked "+" are intended for classed and non-classed MRF. 2. Surveys marked "++" are intended for classed MRP only. 3. Checks indicated under column 3 — in accordance with 11.1.4, 11.1.5. 4. Tests indicated under columns 5, 6 and 7 are conducted upon finalization of installation within systems. 5. Tests indicated under column 7 are intended only for Group I refrigerant systems.							

11.1.8 The scope and procedure of the Register technical supervision of MRP during construction of the ship shall be defined by the examination and testing plan developed in accordance with 13.3, Part I "General Regulations for Technical Supervision" of the Rules for Technical Supervision, taking into account Table 11.1.7 and Chapters 11.2 and 11.3 of the Guidelines.

The List shall be compiled by the shipyard on the basis of the RS Nomenclature, Part I "Classification" and Part XII "Refrigerating Plants" of the Rules for the Classification and Construction (with due account of the MRP installation and ship construction processes adopted at the shipyard) and agreed with the Register.

11.1.9 The List for the MRP of a series-built ship shall be updated on the basis of the results of technical supervision during construction of a prototype ship and MRP of ships of the design concerned in service. When compiling the List, account shall be taken of surveys at the intermediate and final stages of manufacture of the items of technical supervision.

11.2 SURVEY DURING INSTALLATION

11.2.1 MRP spaces, arrangement and installation of refrigerating equipment.

11.2.1.1 When surveying the MRP spaces, it is necessary to check the fulfilment of the requirements for gas-tightness, equipment of control stations and maintenance positions, arrangements of passageways, main and emergency escape routes (including ladders), as well as their closing arrangements.

11.2.1.2 Test of the MRP spaces for gas-tightness shall be conducted on completion of the major assembly-welding hull work prior to installation of insulation; in so doing, the test positive air pressure shall be of 2 kPa and the permissible standard for the compressed air pressure drop within one hour shall be not higher than 25 % of the initial test pressure, that is, on the expire of one hour the pressure in the tested space shall be not less than 1,5 kPa.

11.2.1.3 In the course of survey of the MRP installation it is necessary to check:

.1 compliance of the arrangement of the refrigerating equipment (including control, monitoring, alarm and protection devices) with the requirements of the approved technical documentation;

.2 correctness of piping installation and reliability of their protection against damages;

.3 fastening of the refrigerating equipment (the adopted fastening methods shall be suited to the requirements of Section 5);

.4 alignment of the MRP machinery;

.5 installation of the insulation (only for classed MRP).

11.2.2 Survey of safety valves and devices.

11.2.2.1 Prior to installation on board the ship, the safety valves intended for protection of the MRP machinery, heat exchangers and pressure vessels shall be surveyed and tested, in so doing:

.1 the valve shall be set to initial opening pressure not exceeding the design pressure by more than 10 %. When the safety valve is open, the pressure shall not rise by more than 10 % of the initial opening pressure;

.2 the valve shall close under the pressure not less than 0,85 the design pressure;

.3 the tightness of closure of the valve under water shall be checked by repeat rise of the pressure up to the design pressure after the valve is closed due to its operation.

11.2.2.2 Survey of the change-over fittings of the safety devices shall be carried out in conformity with the requirements of Section 11, Part IV "Technical Supervision during Manufacture of Products" of the Rules for Technical Supervision.

11.2.2.3 Laboratories performing adjustment and tests of the safety valves shall be recognized by the Register in accordance with the requirements of Section 9, Part I "General Regulations for Technical Supervision" of the Rules for Technical Supervision.

11.2.3 Survey of refrigerant system.

11.2.3.1 Inspection of the welded butt joints of the refrigerant piping shall be performed by one of the non-destructive testing methods permitted and accepted by the Register at the shipyard concerned. The lap welded joints and others the quality of which cannot be verified by non-destructive testing may be tested by hydraulic pressure of 1,5P adopted in accordance with 12.1.2, Part XII "Refrigerating Plants" of the Rules for the Classification and Construction.

If the RS surveyor has any doubt concerning the quality of a weld, he shall reserve the right to require that hydraulic tests are conducted.

11.2.3.2 Particular emphasis shall be placed on verification whether the flow area of the pipes for refrigerant dumping and carrying off from the safety valves complies with the documentation approved by the Register. Possibility of the pipes for carrying off the refrigerant from the safety valves shall be checked by delivery of compressed air thereinto, with the pipes disconnected from the safety valves.

11.2.3.3 The shut-off fittings and piping of the classed MRP shall be checked during the leak test of the system by stage-by-stage connecting the system sections to cold consumer groups and raising the pressure in these sections up to 1,1 the design pressure.

11.2.3.4 On completion the installation work, the refrigerant system shall be tested for leak by a test pressure equal to the design pressure, during 18 h. In so doing, the total pressure drop during the test shall be not more than 2 % of the initial pressure. The test shall be conducted using nitrogen, carbon dioxide or dried air with the steam saturation temperature (dew point) not higher than -45°C .

After the leak tests, in order to verify the refrigerant dumping system the pressure shall be released by alternate opening of valves at the emergency drain station.

11.2.3.5 The refrigerant system shall be tested for tightness as stipulated for the classed refrigeration plants using Group I refrigerants by vacuum test at a residual pressure adopted in accordance with the requirements of 12.2,

Part XII "Refrigerating Plants" of the Rules for the Classification and Construction. On completion the vacuum test, the system shall be kept under vacuum during 12 — 18 h. In this period, the pressure in the system shall not rise by more than 0,65 kPa; during the first hour — by not more than 0,15 kPa.

Prior to the tightness test, the system shall be dried, as a rule, by a vacuum test. The vacuum test shall last for 6 h after the pressure in the system reaches the value stipulated for the tightness tests.

11.2.3.6 The system may be filled with the refrigerant only if the results of the tightness and leak tests are satisfactory, the secondary refrigerant system was filled, as well as the ventilation, secondary refrigerant and cooling water system and the fixed gas analyzers (if any) for detecting presence of refrigerant vapours in the MRP spaces were completely surveyed.

After the system is filled with the refrigerant, information on check of the system assemblies for leak with the use of portable leak detector shall be submitted to the RS surveyor.

11.2.4 Survey of secondary refrigerant and cooling water system of classed MRP.

11.2.4.1 Secondary refrigerant and cooling water systems shall be tested for leak by a hydraulic pressure equal to the working pressure with the time of keeping under the pressure not less than 1 h.

11.2.4.2 When surveying the systems, it is necessary to check condition of the expansion compensators, secondary refrigerant and cooling water draining arrangements, bulkhead sockets, piping securing and protection against mechanical damages, cathodic corrosion protection and insulation, local and remote driving gear of fittings, side fittings. It is necessary to check reliability of the shut-off fittings by stage-by-stage connection of the system sections during the hydraulic tests to the cold consumer groups and cooling water circuits, accordingly.

11.2.5 Survey of air cooling systems of classed MRP and space ventilation systems.

11.2.5.1 The installation of air cooling and ventilation systems shall be submitted to the surveyor two times: prior to insulation work and after insulating the air conduits.

11.2.5.2 When surveying the air cooling and space ventilation systems of the MRP, it is necessary to check:

- .1 air conduit and trunk penetrations through the watertight and fire-resistant divisions;
- .2 presence of flame-arresting fittings at ventilation outlets of dangerous spaces;
- .3 intrinsically safe design of fans in dangerous spaces;
- .4 location of inlets of the supply ventilation in relation to the deck of cargo compartments, venting pipes, etc.;
- .5 location of outlets of exhaust ventilation of dangerous spaces in relation to the air intakes;
- .6 gas- and air-tightness of the air conduits (tests shall be carried out in accordance with 11.2.1.2);
- .7 insulation of the air conduits of the air cooling systems.

11.2.6 Survey of insulation of the refrigerated spaces, systems and apparatus of classed MRP.

11.2.6.1 When surveying the insulation to verify its compliance with the RS-approved documentation, it is necessary to check the applied types (grades) of insulation materials, thickness and attachment of the insulation, assembly units in way of framing and penetrations of pipes, as well as the design of the insulation assemblies of hatches and doors, as well as the reliability of the insulation and lining fastening.

11.3 OPERATIONAL TESTS OF MRP

11.3.1 Scope and procedure of tests.

11.3.1.1 Operational tests of MRP shall be conducted by the shipyard in accordance with a program approved by the Register, in the presence of the RS surveyor.

11.3.1.2 The operational tests of non-classed MRP shall be conducted solely to determinate the safety in operation of the equipment which influence the ship safety. When conducting such tests of the MRP, it is necessary to check in operation:

- .1 the electrical equipment in accordance with the requirements of Section 10;
- .2 the main and emergency ventilation of the refrigerating machinery space and refrigerant storeroom, spaces containing process equipment under refrigerant pressure and cargo spaces with cooling devices under refrigerant pressure (including determination of the capacity of fans);
- .3 the drying systems of the MRP spaces in accordance with the requirements of Section 8;
- .4 the water screen systems of the exits from the MRP spaces in accordance with the requirements of Section 4;
- .5 the protection automatic devices and remote machinery shutdown devices in accordance with the requirements of Section 12. The maximum permissible settings of the protective devices shall be in agreement with the instructions of the manufacturers of refrigerating equipment and the Register-approved technical documentation on the refrigerating plant (the protective device setting for compressor discharge pressure shall not exceed 0,9 of the design pressure).

11.3.1.3 The tests of classed MRP shall confirm effectiveness in operation of the plant under prescribed environment temperature conditions including the minimum design ones at full design heat load of the refrigerating equipment, as well as the reliability and safety of the plant.

The operational tests of classed MRP shall consist of the following major stages:

.1 check of the overall operability of the components in serving their intended services;
.2 check of the MRP capability of reaching the temperatures in refrigerated cargo spaces, freezing apparatus and other items of refrigeration down to the lowest specified value. The duration shall be established on the basis of the time actually spent;

.3 tests to maintain the specified values of air temperatures in the refrigerated cargo spaces and temperatures of refrigerated media in other items of refrigeration during not less than 24 h. During the said tests it is necessary to check the capacity of the freezing, ice making and cooling facilities (water and process media coolers, etc.). The duration of check shall depend on the design features of a particular facility or device and MRP;

.4 determination of the averaged heat gain factor of an insulation structure of the refrigerated cargo spaces using methods approved by the Register;

.5 determination of the rate of air temperature change in the refrigerated cargo spaces with the MRP put out of action. Duration of the test is 12 h.

11.3.1.4 When checking the overall operability of classed MRP components, in addition to the equipment and devices specified in 11.3.1.2, it is necessary to survey the machinery, apparatus and systems of the refrigerant, secondary refrigerant, cooling water and cargo space refrigeration, etc.

11.3.1.5 During the tests it is necessary to determine the time required to reach the specified temperatures in the cargo spaces and the refrigerated media temperatures in other items of refrigeration since the MRP is put into operation, as well as the duration of defrosting.

11.3.1.6 When surveying the secondary refrigerant systems, it is necessary to check consistency of the secondary refrigerant density and acid number with the required values, operation of the shut-off and regulating fittings (including those on the secondary refrigerant heater), steam supply to the secondary refrigerant heater, operation of the regulating and protective automatic devices.

11.3.1.7 When surveying the cooling water system it is necessary to check the operation of cooling arrangements, shut-off and regulating fittings; device to provide re-circulation and temperature regulation of water delivered for cooling (or its flow rate change); regulating and protective automatic devices.

11.3.1.8 When surveying the air cooling system it is necessary to check capacity of the fans, circulation ratio and uniformity of air distribution in the cargo spaces, alarm devices to warn of the fan damages and ozone generators (if any).

11.3.1.9 The test conditions are given in Appendix 1 and the requirements for measurement of the MRP performance parameters — in Appendix 2 to this Section.

11.3.1.10 During the operational tests of MRP it is necessary to check the stand-by equipment of the system by disabling individual components of the main equipment and by actuation of corresponding components of the stand-by equipment. In so doing, the main and stand-by equipment shall be in service not less than 12 h.

11.3.1.11 The tests of MRP shall be conducted with the automatic control and regulating devices functioning. During the tests, local control (if provided) shall be also checked.

11.3.1.12 Measurements of the vibration level under various modes shall be made in accordance with 18.7.

11.3.1.13 The averaged heat gain factor of the insulation structure of the refrigerated cargo spaces shall be determined in accordance with 11.3.1.3.4 on board the prototype ships, and as regards the series-built ships, the factor shall be determined only when the insulation structure and/or insulation material is changed as compared to the prototype ship.

11.3.1.14 On board the series-built ships, if no significant modifications have been made in the MRP design of the prototype ship (e.g. replacement of the main equipment), the duration of the tests under 11.3.1.3.3 may be reduced down to 16 h.

11.3.2 Processing, presentation and evaluation of classed MRP test results.

11.3.2.1 Test results shall be processed and presented by the shipyard immediately upon finalization of the tests.

11.3.2.2 The processed test results shall be submitted to the RS surveyor prior to final delivery of the MRP with necessary data for execution of the RS documents. A conclusion on the compliance of the MRP and its equipment characteristics with the specified ones shall be attached to the delivery documents on the test results.

11.3.2.3 The specified values of the averaged heat gain factor of insulation structure of the refrigerated cargo spaces shall be considered as confirmed if the values obtained during the tests differ from the design ones by not more than 10 %.

11.3.2.4 For the series-built ships, where the insulation structure of the refrigerated cargo spaces has not been significantly modified as compared to that of the prototype ship, the thermal properties of insulation shall be evaluated by comparison of the rate of change in the air temperature in the refrigerated cargo spaces of the ship being tested and prototype ship without especial determination of the averaged heat gain factor value. Along with that, if the obtained value of change of the air temperature in the refrigerated cargo spaces differs from the corresponding value for the prototype ship by not more than 10 % the specified values of the heat gain factor shall be considered as confirmed.

In case where the environment temperatures during the series-built ship tests differ from those during the prototype ship tests, the results of the check on the rate of change of the air temperature in the refrigerated cargo spaces of the series-built ship shall be re-calculated to the environment temperature during the tests of the prototype ship using the procedure to be submitted by the ship designer within the program (procedure) of the series-built ship MRP tests.

11.3.3 Documents of the Register.

11.3.3.1 Based on the satisfactory results of the survey and tests, the RS surveyor shall draw up:

for classed MRP, Report on Survey of Classed Refrigerating Plant (form 6.3.47) and Classification Certificate for Refrigerating Plant (form 3.1.4);

for non-classed MRP, Report on Survey of Machinery Installation, Systems after Completion of Ship Construction/Initial Survey (form 6.3.3).

TEST CONDITIONS FOR CLASSED MRP

1. During tests of the MRP it is necessary to check the maintenance of all air temperatures in the refrigerated cargo spaces, on board fishing ships — also the air and process media temperatures in other items of refrigeration, provided for by the design, when all the cold consumers operate under the design heat load at the specified refrigerant boiling and condensing temperatures.

2. When during the tests the sea water temperature differs from the design temperature, the condensing temperature can be maintained through re-circulation of water incoming to cool the water condenser or reduce the consumption thereof.

3. If MRP is designed for aftercooling (afterfreezing) the products in the cargo spaces or for cooling the unprecooled products therein, then, when conducting tests for the maintenance of the specified values of air temperatures, heaters of the required capacity shall be installed in the refrigerated cargo spaces to simulate the heat load due to cooling (aftercooling, afterfreezing).

The heaters shall be installed in the refrigerated cargo spaces also in case when the tests are conducted at the environment temperatures differing from the specified ones (to simulate the design heat load under specified conditions).

The capacity of the heaters installed during the tests shall be calculated by the Ship Designer for various possible values of the environment temperatures during the period of testing according to Appendix 3 to this Section and submitted within the MRP test program (procedure)

4. The design heat load of the refrigerating equipment may be achieved by means of infra-red or radiant heaters fitted with their own fans used in the cargo and other refrigerated spaces, as well as by heating the liquid process media: water, salt brine, etc.

In case where air cooling system is used in the cargo and other spaces, the heaters used need not be fitted with their own fans.

5. The prescribed temperature in the refrigerated cargo spaces (including the temperature difference at various points of the hold volume) shall be maintained in consistency with the values set by the specifications of the refrigerating plant for particulars kinds of cargoes carried on board ship. When such specifications are lacking, the variations in the prescribed temperature shall be within ± 2 °C.

6. When determining the averaged heat gain factor of the insulation structure of the refrigerated cargo spaces, the averaged air temperature difference in the refrigerated spaces and the averaged environment temperature difference shall be not less than 30 °C.

Depending on the environment temperatures during the tests, the averaged heat gain factor of the insulation structure of the refrigerated cargo spaces may be determined either by heating the air in the spaces being tested or by cooling the same. Preference (if the environment temperatures during the tests permit this) shall be given to the determination of the heat gain factor by heating the air because this method is the simplest and provides superior fidelity of the results.

MEASUREMENT OF THE CLASSED MRP PARAMETERS

1. Prior to the tests, a list (in tabular form) of the gauges used during MRP tests with an indication of the value (parameter) to be measured, gauge type, GOST and/or specifications, measurement ranges, scale division value, accuracy class and date of the last gauge verification shall be submitted to the RS surveyor.

2. Each gauge shall be installed in a fixed position where measurements shall be taken during the entire period of test. The gauge may be replaced only with the consent of the RS surveyor or at his request to which effect an entry shall be made in the log book.

3. During the tests referred to under 11.3.1.3.1 — 11.3.1.3.3, the MRP performance parameters shall be generally measured by regular gauges every 2 h.

4. Additional means shall be provided during the tests referred to under 11.3.1.3.4 and 11.3.1.3.5 to measure the air temperature in the spaces adjacent to the spaces being refrigerated, outdoor and sea water temperatures, as well as, where necessary, in the refrigerated cargo spaces (including measurements to be taken to verify the fulfilment of the requirements under para 5 of Appendix 1 to this Section).

5. Measurements of the air temperatures in the refrigerated cargo spaces and spaces adjacent thereto, as well as of the outdoor and sea water temperatures when the rate of change of the air temperature is determined (refer to 11.3.1.3.5) shall be made every hour.

6. In case when the averaged heat gain factor of the insulation structure of the refrigerated cargo spaces is determined (refer to 11.3.1.3.4 of this Section and paragraph 6 of Appendix 1 to this Section) by cooling method, for the purpose of measuring the MRP performance parameters during the period of tests it is necessary to install additional gauges with the required accuracy of measurements.

Measurements shall be made every hour.

TESTS OF THE CLASSED MRP WITH THE USE OF SIMULATION MEANS

1. General

1.1 Classed MRP shall be tested at full design heat load. Because during the MRP tests the environment temperature can differ significantly from the design temperature, heat leakage into the refrigerated cargo spaces will also differ from the design ones. Moreover, during the MRP tests, the opportunity of real cooling (aftercooling, afterfreezing) of the cargo (thermal treatment of cargo and tare) is generally not offered. In such cases, the generation of the full design heat load shall be provided by simulation means — by installation of electrical heaters of required capacity in the refrigerated cargo for the period of test.

The additional heat load generated by the heaters includes two components — variable (ΔQ_{var}) and permanent (ΔQ_{perm}).

The variable component of the additional heat load depends on the environment temperatures during the tests and may be different on acceptance tests of various ships of a series and for the same ship during different periods of service.

The permanent component of the additional heat load does not depend on the environment temperature and is the same for all ships of the same type (design) provided that the ship has not undergone conversion or modernization with the resulting alteration of the cargo storage or thermal treatment conditions.

2. Calculation of the variable component of the additional heat load

2.1 The variable component of the additional heat load ΔQ_{var} , in kW, shall be determined by the formula

$$\Delta Q_{var} = 0,001 \cdot \Sigma F_i K_{av} (\Delta t_{av,des} - \Delta t_{av,test}) \quad (2-1)$$

where ΣF_i = area of all cooling surfaces of the refrigerated cargo space, in m²;

K_{av} = design averaged heat gain factor of the insulation structure of the boundaries, in W/m²h;

$\Delta t_{av,des}$ = averaged air temperature difference between the refrigerated space and the environment according to design, in °C;

$\Delta t_{av,test}$ = averaged air temperature difference between the refrigerated space and the environment during tests, in °C.

The calculation of Δt_{av} is tabulated. The calculation of ΔQ_{var} is displayed below the table (refer to Table 2.1).

Δt_{av} mentioned in Table 2.1 is a correction to the temperature of the boundary surface for the solar radiation, which shall be taken into consideration only in calculation of $\Delta t_{av,des}$.

Calculation of the variable component of the additional heat load ΔQ_{var} shall be made for each refrigerated cargo space provided with its own refrigerating system (adjacent hold and tweendeck separated by a perforated deck and

Table 2.1
Calculation of the averaged air temperature between the refrigerated space and the environment according to design and during tests and of the variable component of the additional heat load (model form)

External boundaries	Adjacent space or medium	Cooling surface area, in m ²	Air temperature in cargo space, in °C	Medium temperature in adjacent space, in °C		Temperature difference Δt_i , in °C		$F_i \times \Delta t_i$ value	
				according to design	during test	according to design	during test	according to design	during test
Ceiling	Fish-processing shop	269	−28	20	15	48	43	12912	11567
Bottom	Diesel oil tanks	265	−28	11	0	39	28	10335	7420
Starboard side: above waterline below waterline	Outdoor air	11,5	−28	15	−10	43	18	495	207
	Sea water	65,3	−28	11	0	39	28	2547	1828
Port side: above waterline below waterline	Outdoor air with due account of Δt_{av}	11,5	−28	29	−10	57	18	656	207
	Sea water	65,3	−28	11	0	39	28	2547	1828
Forward bulkhead	Bow thruster trunk	24	−28	15	5	43	33	1032	792
Aft bulkhead	Fresh water tank	16,5	−28	15	5	43	33	710	544
	Fire pump room	14,7	−28	23	0	51	28	750	412
	Engine room	56	−28	23	15	51	43	2856	2408
		$\Sigma F_i = 798,8$				$\Delta t_{av,des} = 43,6$	$\Delta t_{av,test} = 34,1$	$\Sigma(F_i \times \Delta t_i) = 34840$	$\Sigma(F_i \times \Delta t_i) = 27213$

$$\Delta Q_{var} = 0,001 \cdot \Sigma F_i \cdot K_{av} (\Delta t_{av,des} - \Delta t_{av,test}) = 0,001 \cdot 798,8 \cdot 0,4 (43,6 - 34,1) = 3,0 \text{ kW.}$$

having a common refrigerating system shall be considered as an one space). Depending on the larger Δt_{av} value (design or test), ΔQ_{var} may be both positive and negative.

3. Calculation of the permanent component of the additional heat load

3.1 The permanent component of the additional heat load shall be determined from the formula

$$\Delta Q_{perm} = Q_{tc} + Q_{tt} + Q_h + Q_m + Q_b \quad (3.1)$$

where Q_{tc} = heat leakage due to thermal treatment of cargo, in kW;

Q_{tt} = heat leakage due to thermal treatment of tare, in kW;

Q_h = heat leakage due to human occupancy, in kW;

Q_m = heat leakage due to running equipment of in-hold mechanization (if any), in kW;

Q_b = heat leakage due to "breathing" of vegetables and fruits, in kW.

For reefer transport ships Q_h and Q_m shall be neglected. For fishing ships (catching and processing) Q_m shall be neglected in cases when during the MRP tests the in-hold mechanization equipment is in operation or such equipment is not provided on board ship. Q_h shall be taken into account only for the universal reefer transport ships intended also for the carriage of fruits and vegetables.

3.2 Heat leakage due to thermal treatment of cargo shall be determined by the formula

$$Q_{tc} = G_c \times (i_{ic} - i_{fc}) / 3600Z \quad (3.2-1)$$

(for frozen meat and fish, as well as butter and fats) or from the formula

$$Q_{tc} = G_c \times C_r(t_{ic} - t_{fc}) / 3600Z \quad (3.2-2)$$

(for refrigerated kinds of cargo)

where G_c = capacity of the refrigerated space for a particular cargo for the reefer transport ship or daily delivery of produce into the refrigerated space for the catching and processing fishing ships, kg;

i_{ic} and i_{fc} = enthalpy, in kJ/kg, and temperature, in °C, of the cargo (product) incoming into the refrigerated space respectively;

The enthalpy and specific heat of the basic kinds of cargo carried on the reefer transport ships and kinds of produce on the fishing ships are given in Tables 3.2-1 and 3.2-2.

3.3 Heat leakage due to thermal treatment of tare shall be determined by the formula

$$Q_{tt} = G_t \times C_t(t_{it} - t_{ft}) / 3600Z \quad (3.3)$$

where G_t = mass of tare necessary for packing cargo (products) C_t (refer to 3.2), in kg;

C_t = specific heat of tare material, in kJ/kg°C;

t_{it} and t_{ft} = initial and final temperature of tare, in °C (correspond to t_{ic} and t_{fc} under 3.2);

Z = same as under 3.2.

The mass of the cardboard tare for frozen fishery products, dressed meat, poultry and meat semiproducts, as well as vegetables and fruits (including banana) shall be assumed to be 10 % of the mass of cargo, i.e. $G_t = 0,1G_c$.

Table 3.2-1

Enthalpy of basic kinds of cargo at various temperatures, in kJ/kg

Temperature of cargo, in °C	Frozen meat, poultry	Frozen fish	Butter, fats
20	—	—	182,8
15	—	—	155,3
12	—	—	138,6
10	—	—	129,8
8	—	—	121,4
6	—	—	114,4
4	—	—	106,5
2	—	—	101,4
0	—	—	95,0
-2	—	—	60,4
-4	—	—	44,8
-6	—	—	36,4
-8	—	—	29,3
-10	30,2	74,3	23,5
-12	22,2	66,4	17,6
-15	13,0	56,2	10,1
-18	4,6	47,4	3,8
-20	0	42,0	0
-25	—	29,9	—
-30	—	19,1	—

The specific heat of some tare materials is given in Table 3.2-2.

Table 3.2-2

Specific heat and "breathing" heat of fruit and vegetable products and specific heat of the tare materials		
Description of cargo	Specific heat, in kJ/kg°C	"Breathing" heat, in W/kg
Banana	3,35	0,105
Fruits, vegetables	3,8	0,035
Tare:		
corrugated board	2,5	—
Wooden	2,5	—
Cans:		
Aluminium	0,88	—
Tin	0,45	—
Note. The average "breathing" heat in the temperature range: for bananas, from 30 to 15 °C, for fruit and vegetables, from 20 to 0 °C.		

3.4 The heat leakage due to human occupancy shall be determined by the formula

$$Q_h = a \cdot n \quad (3.4)$$

where a = heat release from one person when performing work of medium intensity, ($a = 0,35$ kW/pers.);
 n = number of persons simultaneously working in the refrigerated cargo space.

3.5 Heat leakage due to running equipment of in-hold mechanization shall be determined by the formula

$$Q_m = \Sigma(N_i \frac{1}{\eta_i}) \quad (3.5-1)$$

where N_i and η_i = consumed power and efficiency of the electric motor of the in-hold mechanization equipment respectively.

This heat leakage may be determined also by a simplified formula

$$Q_m = \Sigma N_i \quad (3.5-2)$$

where ΣN_i = rated power of all electric motors of the in-hold mechanization equipment.

3.6 The heat leakage due to "breathing" of vegetables and fruit shall be determined by the formula

$$Q_b = 0,001 \cdot q_b \cdot G_c \quad (3.6)$$

where q_b = "breathing" heat of vegetables and fruit, in W/kg;
 G_c = capacity of refrigerated cargo space for a particular kind of vegetables and fruits, in kg.

The "breathing" heat of the fruit and vegetable products is given in Table 3.2-2.

3.7 For ships under construction, the data on the elements of the permanent component of an additional heat load (Q_{ic} , Q_{it} , Q_h , Q_m , Q_b) shall be taken on the basis of thermal analysis of MRP made within the technical design.

4. Procedure of the MRP tests

4.1 The tests of the MRP of the reefer transport ships shall be carried out with the lighting and ventilation switched out and hatches and manholes closed down in the refrigerated cargo spaces.

The electrical heaters of capacity corresponding to the full additional heat load (i.e. $\Delta Q = \Delta Q_{var} + \Delta Q_{perm}$), shall be installed in each refrigerated cargo space and distributed uniformly throughout the space volume.

The fans of the hold air coolers shall operate in mode ensuring the air circulation ratio required for a particular cargo.

The heaters shall be switched on once the specified temperature has been reached in the refrigerated spaces and shall remain switched on throughout the whole period of tests for the maintenance of this temperature.

4.2 The tests of the MRP of the catching and processing fishing ships with a single space for the storage of particular products (e.g. with a single hold for frozen products and/or with a single hold for canned products) shall be carried out with the lighting switched on and with open arrangements for delivery of products into the refrigerated cargo spaces. Installation of the heaters and switching-on of these is identical to that specified under 4.1.

4.3 The tests of the MRP of the catching and processing fishing ships with two or more spaces for the storage of particular products shall be carried out in the following order:

1 the electrical heaters of capacity corresponding to the appropriate full additional heat load ΔQ , shall be installed in each refrigerated space and distributed uniformly throughout the space volume;

2 the electrical heaters of capacity corresponding to the variable component of the additional heat load ΔQ_{var} shall be switched on once the specified temperature has been reached in the refrigerated spaces and shall remain switched on throughout the whole period of tests for the maintenance of this temperature;

.3 the electrical heaters of capacity corresponding to the permanent component of the additional heat load ΔQ_{perm} shall be switched on alternately in each refrigerated space intended for the storage of particular products, for, about, equal periods of time (e.g. if the ship is provided with two holds for the frozen products: these heaters shall be switched on in one hold for one-half of the test duration, and also for one-half thereof – in another hold). When the heaters are switched on in the appropriate space, the lighting is switched on and the arrangements for delivery of products open, while when the heaters are switched out the lighting is also switched out and the above arrangements close.

4.4 In case where the MRP is intended to maintain in the refrigerated spaces different specified air temperatures consistent with the kind of cargo carried, the tests with simulation of the design heat load shall be conducted on board the prototype ship in two modes:

.1 in a mode with the lowest specified air temperature and appropriate additional heat load;

.2 in a mode with the highest additional heat load and appropriate specified air temperature.

On ships of a series, when no significant modifications have been introduced in the MRP design on the prototype ship (e.g. replacement of main equipment) the tests with simulation of the design heat load shall be conducted only in the mode with the lowest specified air temperature and appropriate additional heat load.

5. Evaluation of test results

5.1 The design performance of the MRP for refrigeration of the cargo spaces shall be considered as confirmed if with the heaters switched on the specified air temperatures are maintained in the refrigerated cargo spaces.

6. Documentation

6.1 The ship designer shall submit within the program (procedure) of the acceptance tests of MRP:

.1 form of the tables for the calculation of the averaged air temperature differences Δt_{av} and variable component of the additional heat load ΔQ_{var} with the filled-in columns 1, 2, 3, 4, 5, 7, 9 for each refrigerated cargo space and for each specified air temperature stipulated for these spaces;

.2 calculation of the permanent component of the additional heat load ΔQ_{perm} for each refrigerated cargo space and for each kind of cargo stipulated for the carriage in these spaces.

All the listed materials shall be handed over to each ship within the delivery documentation.

12 AUTOMATION EQUIPMENT

12.1 GENERAL

12.1.1 The provisions of this Section shall apply in technical supervision of the automation equipment listed in the RS Nomenclature.

12.1.2 The Section contains the requirements for technical supervision of the above-mentioned items of technical supervision during the construction of ships.

12.1.3 General regulations for the organization of technical supervision of the automation equipment during the construction of ships are set out in Part I "General Regulations for Technical Supervision", those concerning the technical documentation — in Part II "Technical Documentation" of the Rules for Technical Supervision.

12.1.4 When conducting mooring and sea trials of the automation equipment, in respect to the general and organisational matters, the requirements of Section 18 shall be met.

12.1.5 The scope and procedure of the Register technical supervision of the automation equipment during the construction of a ship shall be dictated by the List (refer to 13.3, Part I "General Regulations for Technical Supervision" of the Rules for Technical Supervision). The List shall be compiled by the shipyard on the basis of the RS Nomenclature and the requirements of this Section (with due account of the automation equipment installation and ship construction processes adopted at the shipyard) and agreed upon with the Register.

12.2 SURVEY PLANNING

12.2.1 Prior to commencement of survey of the fire-fighting means of the ship under construction, the RS Branch Office shall agree the examination and testing plan for automation equipment developed by the shipbuilder. The shipbuilder shall be informed about that at a kick off meeting prior to commencement of construction according to 1.7.1 and with due regard to 12.3 – 12.6.

The builder shall agree to undertake ad hoc investigations during construction as may be requested by RS where areas of concern arise and the builder to agree to keep RS advised of the progress of any investigation. Whenever an investigation is undertaken, the builder shall be requested, in principle, to agree to suspend relevant construction activities if warranted by the severity of the problem.

12.2.2 During approval and agreement of the examination and testing lists a note shall be taken of specific published Administration requirements and interpretations of statutory requirements.

12.2.3 The shipyard shall be requested to advise of any changes to the activities agreed at the kick off meeting and these shall be documented in the examination and testing plan. E.g. if the shipbuilder chooses to use or change subcontractors, or to incorporate any modifications necessitated by changes in production or inspection methods, rules and regulations, structural modifications, or in the event where increased inspection requirements are deemed necessary as a result of a substantial non-conformance or otherwise.

12.2.4 Quality standards for installation and testing of the automation equipment shall be reviewed and agreed during the kick-off meeting. The work shall be carried out in compliance with the RS rules and under the RS technical supervision.

12.2.5 Any changes to the kick-off meeting records shall be agreed and documented.

12.3 SURVEY DURING INSTALLATION

12.3.1 The automation equipment delivered for installation on a ship under construction, shall have documents confirming the Register technical supervision during the manufacture thereof.

12.3.2 It is advisable to perform a preliminary (prior to installation on board) verification and adjustment of the automation components, devices and systems on special test benches and simulators.

12.3.3 The installation of the equipment shall be carried out in full compliance with the technical documentation specifying location and arrangement thereof; in so doing, attention shall be given to the fact that the secondary units, amplifiers, sensors and alarms, logic units, connecting units, power supply units and other automation equipment shall

be grouped and installed in positions protected against penetration of dirt, fuel oil and water as well as against accidental mechanical damages.

12.3.4 Prior to connection and after the tests (refer to 12.3.5), the pneumatic and hydraulic pipes shall be carefully cleaned.

12.3.5 After installation, the pneumatic and hydraulic systems (including pulse piping) shall be subjected to hydraulic pressure tests in accordance with Section 8.

12.3.6 When performing technical supervision during the installation of the automation equipment, it is necessary to check:

.1 documents confirming the Register technical supervision at the firm (manufacturer) (prior to installation of the automation equipment);

.2 completeness, arrangement and securing of the devices;

.3 ease of access to the devices;

.4 protection of the equipment against penetration of foreign objects thereto and against accidental mechanical damages;

.5 "safe distance" to the magnetic compass (for devices installed in the wheel house) in accordance with the requirements of Appendix 2 to Section 16;

.6 quality of interior and exterior wiring;

.7 quality of protective earthing and of installation of cabling in accordance with Section 10;

.8 insulation resistance;

.9 installation of components to protect radio reception against interference;

.10 fulfilment of special requirements deriving from the design of the equipment and set forth in the RS-approved technical documentation.

12.4 SURVEY DURING MOORING AND SEA TRIALS

12.4.1 Upon finalization of the installation and adjustment work, all the automation equipment shall be subjected to mooring and sea trials according to the programs approved by the Register and in the presence of the Register representative. The equipment shall be supplied from the ship's mains.

12.4.2 During the mooring trials it is necessary to check:

proper and smooth functioning of the machinery with verification of the sequence of control operations;

agreement between the actual time of operation performance with the required one;

proper interaction between various automation systems.

12.4.3 The operability of the automation systems shall be confirmed by the tests:

.1 for operability of the automatic safety systems by means of variation of the real physical value of the parameter to be protected;

.2 for load surge and load shedding relief in the regulation systems where the static and dynamic irregularity shall be determined; along with that, the extreme values of parameters, as well as insensitivity and time of the transient processes shall not fall outside the set limits specified by the Register standards or shall be consistent with the technical and normative documentation agreed with the Register;

.3 for the capability of system functioning with the fluctuations of the power supply parameters under shipboard conditions (when powerful consumers are activated, etc.);

.4 for effectiveness of the operational and self-monitoring devices of the automation equipment (simulation of the control and monitoring channel troubles);

.5 for check of the main machinery remote control in operation with verification of the proper functioning of changeover devices of all control stations in all specified changeover modes.

Along with that, it is necessary to check the operation of the control station indicator, interlocking facility (impossibility of control from several stations simultaneously), as well as the system operation process when control is changed over from one station to another;

.6 for proper functioning of the signal passage inhibition circuits in case of starting and normal stopping of the machinery (where specified);

.7 for proper functioning of the mnemonics notifying of the execution of orders immediately before the relevant items are placed into service;

.8 for check of the manual control for the entire automated and remotely controlled equipment in operation having regard to the requirements under 4.2.3 — 4.2.5, Part XV "Automation" of the Rules for the Classification and Construction;

.9 for automatic starting of the stand-by machinery and removal of the running machinery from service by creating real conditions affecting the starting and stopping control circuits of these machinery (where provided);

.10 for redundancy of the power supply and for conservatism of the system or fail-safety in the event of loss of power supply.

12.4.4 During the sea trials of ships having the automation mark in the class notation, it is necessary to conduct tests under unattended operation conditions of the machinery spaces and, except for ships covered by the requirements of Section 5, Part XV "Automation" of the Rules for the Classification and Construction, the engine control room throughout 6 h — for the prototype ship and throughout 4 h — for the ships of a series. The requirements under 12.5.2.3 of the Guidelines shall be met.

12.4.4.1 Prior to the tests under unattended operation conditions of the engine room it is necessary to conduct tests of the automated systems and devices involved in such unattended operation.

12.4.4.2 When conducting these tests, the RS surveyor may require a check of the operability of any automation mechanisms and devices (switching-on and off of the mechanisms, operation of the sensors, etc.).

12.4.4.3 During the tests under unattended operation mode, there shall be no faults hindering the normal and safe unattended operation of the ship's machinery installation.

During the unattended operation mode, there shall be no false activation of the safety and alarm system.

12.4.5 On the ships of a series, some types of tests of the automation equipment under sea conditions may be replaced by the relevant simulation tests to be carried out during the mooring trials, which shall be stated in the program of trials (refer also to Section 18).

12.4.6 All defects of the equipment detected during the mooring and sea trials shall be corrected prior to the issuance of the ship's documents of the Register.

12.5 ADDITIONAL INSTRUCTIONS ON TESTING OF INDIVIDUAL AUTOMATION SYSTEMS AND DEVICES

12.5.1 Alarm and indication systems.

12.5.1.1 Upon finalization of the installation and prior to the mooring trials, the alarm and indication systems shall be checked for faultless of the visual display units of alarm systems and audible signalling system and for proper operation for each tested parameter.

To reach the set parameter values the most realistic simulation conditions shall be created and the test instruments used in the process shall have documents or brands to certify timeliness of the state verification, and their accuracy shall exceed that of the monitored equipment

Check of the alarm systems applied to each parameter shall be performed at least three times. In case of scatter in the obtained values falling outside the permissible limits due to sensor fault, the sensor shall be replaced.

In specific cases, instead of replacement of the sensor, the alarm set point may be readjusted on the basis of the extreme value of the parameter to the safe side.

12.5.1.2 During the mooring and sea trials it is necessary to check the proper performance of the following functions:

.1 operation of the alarm system for essential parameters of the machinery installation using an appropriate simulation involving the attainment by these parameters of values which initiate operation of the alarm system; along with that, it is necessary to check the operability of the common alarm system;

.2 digital or analogue measurement of the parameter values during the operation of the tested mechanisms by means of selective call thereof and checking them against the direct indication of local instruments;

.3 operation of the alarm warning of the alarm system fault by means of simulation of short-circuit, circuit break-off and earth fault in accordance with 2.4.1.2, Part XV "Automation" of the Rules for the Classification and Construction;

.4 operation of the audible and visual alarm to apply signals in case of failure of the power supply;

.5 possibility of safe operation of the engine with the alarm system switched off with retaining the capability of monitoring by the permanently indicating instruments.

12.5.1.3 The operability of the alarm system shall be conclusively established on sea trials, at the same time the absence of false alarms shall be checked.

During the unattended operation mode, in case of false alarms occurred, their cause shall be identified and a decision on cessation or extension of the mode shall be taken.

12.5.2 Remote automated control systems of main machinery with fixed pitch propellers.

12.5.2.1 During the mooring trials of the remote automated control system shall be checked the following:

.1 performance of the systems of starting and stopping of the engine from the wheel house without replenishing the air receivers by means of at least 12 successive starts (alternating between "ahead" and "astern") of the engine ready to start;

.2 possibility of automatic restart in the event of an ineffective attempt which fails to produce a start, that shall be simulated by shutting off the fuel supply;

.3 system response to the cancellation of the last order;

.4 reversing under conditions prescribed by the trial program of the ship; in so doing, it is necessary to measure the system characteristics specified in the technical documentation;

.5 engine emergency stop device by pressing the appropriate push-button;

.6 operability of the alarm system under alternate changeover to all available modes;

.7 minimum pressure value of the feeding medium (for pneumatic and hydraulic systems) as well as reduced voltage and frequency of electrical power supply at which control is possible (bearing in mind that the working pressure of the control air shall be always below or equal to the minimum pressure of the starting air at which the engine can still be started);

.8 adequacy between the speed set point by the control lever from the wheel house and the engine speed in steady mode (irregularity shall not exceed 2,5 % of the full speed). Setting of the speed from the engine control room shall be checked in similar manner;

.9 insensitivity of the system by establishing a minimum interval of the control lever shifting at which the speed remains unchanged, as well as maintenance of the minimum possible engine speed under automated and manual control;

.10 operation of the following alarms:

"ineffective starting attempt" — when checking automatic restarts;

"stop" — in case of normal stop of the engine and passing through "stop" when reversing;

"emergency stop";

"critical speed range" if no automatic passing of this range is provided;

"low starting air pressure" (shall be checked during the test for the number of starts according to 12.5.2.1.1);

"failure of electrical power supply" by means of simulation of the supplying feeder break-off;

"failure of pneumatic, hydraulic power supply" by cutting off the supply;

"protection activated";

"protection disabled";

.11 effectiveness of interlocking systems precluding: engine reversal with the fuel supply cut on;

engine starting with the turning gear engaged;

engine starting in the direction opposite to that set by the engine telegraph;

starting of the engine when the limiting values of the parameters have been reached, for which the engine protection is provided;

.12 automatic switching-on of the standby power supply source;

.13 proper functioning of the mnemonic boards "stand by", "control from ECR (wheel house)" and "finished with engine";

.14 transfer of control between the stations with check of alarm accompanying such transfers;

.15 conservatism of the system. When simulating faults of the remote automatic control system (in the event of the loss of power supply of the system or its individual components having safety devices) the engine shall not (unless otherwise specified) change and especially increase the speed; spontaneous starts of the engine shall not be also permitted;

.16 operation of the system in the event of de-energization of the ship and subsequent restoration of the voltage in the ship's mains.

12.5.2.2 In the course of the mooring and sea trials of the main machinery the following shall be checked:

.1 steady operation of the fresh and sea cooling water temperature, lube oil, scavenging air regulators, as well as the heavy oil temperature and viscosity regulators by changing the operational mode of the main engine in the range from the minimum to maximum load thereof through the change of the sea water temperature (readjustment of the regulator) within 10 — 30 °C. The check shall be performed with due account of the requirements under 12.4.3.2. The check on board the prototype ships shall be performed with the use of recording instruments;

.2 at the same time it is necessary to verify the possibility of the remote (from ECR) and local control by regulating devices. When performing the verification attention shall be given to the absence of the working medium leaks in the regulating devices and by-pass piping (by comparison of the time spent for the maintenance of the

regulated parameter within the set limits after engine stoppage or slowdown to the minimum load with the use of the regulator and manually operated valves shutting off the sea water flow through the relevant coolers);

.3 operability of the automatic safety system in accordance with the provisions of 12.4.3.1.

12.5.2.3 During the sea trials it is necessary to check steady unattended operation of the machinery installation during the time given in 12.4.4. Along with that, the installation shall be checked under modes of ahead and astern running and conventional reversing with subsequent putting on the full speed mode not less than two times. No in-service readjustments of the systems during these trials shall be allowed.

12.5.3 Remote automated control systems of main steam turbines.

12.5.3.1 In the course of the mooring and sea trials of the remote automated control systems (to be conducted in two steps: with and without steam supply to the manoeuvring gear) the following shall be checked:

.1 automated starting of turbine ready for use and automatic performance of the sequential starting steps including automatic performance of intermediate operations to hamper overspeed or reset under adverse conditions of preheating and vibration;

.2 steady operation of the system within the whole range of possible modes and the existence of potential zones with high vibrations by means of changing the propeller speed from the full ahead speed to the full astern speed in 5 rpm intervals;

.3 automatic performance of the intermediate operations when the operation mode is changed, including fast passage of the speed ranges with high vibrations, interruption of blowing with augmentation of the ahead power, closing of the bleed-off valves, starting or speeding-up of the circulating pump of the main turbine condenser, opening of the cut-off valve in case of reduction in the ahead power or transfer to the manoeuvring mode;

.4 required system response to the cancellation of the last order;

.5 automatic actuation of the rotor turning-over device (if any) during short-duration stoppage of the turbine;

.6 functioning of the turbine emergency stop device;

.7 shutting-off of the ahead and astern valves during the manoeuvre "full ahead" — "full astern" and vice versa, as well as change of the pressure at the inlet of the manoeuvring valves (momentary pressure drop) and water level in the steam boilers;

.8 compliance with the propeller speed in steady mode and the setting of the set-point device in the wheel house and ECR, and between the position of the manoeuvring valve lift indicator and the real lift;

.9 operation of the interlocking system precluding starting with the turning gear engaged, loading of an unready unit, as well as operation of the following alarms: "ineffective starting attempt", "rotor stoppage for more than 2 min", "unopened astern cut-off valve", "inoperative circulating pump", "unclosed bleed-off valves", "critical speed range", "inoperative blowing valves", "non-preheated turbine", "turbine is ready to start";

.10 operation of the systems and devices referred to under 12.5.2.1.12 — 12.5.2.1.15.

12.5.3.2 In the course of mooring and sea trials of the main steam turbines shall be checked the following:

.1 steady operation (with due account of 12.4.3.2) of the lubricating oil, gland-sealing steam pressure and main condenser collector (deaerator) level regulators and other parameters in the "slow astern speed", "full ahead speed" and "full astern speed" modes, as well as in case of fast alterations of mode from "full ahead" to "dead slow" and vice versa.

On board the prototype ships, the check shall be performed with the use of recording instruments;

.2 accuracy of the readings given by the indication systems for the parameters the necessity of which is prescribed by 4.2.10, 4.3.11, 4.4.6, Part XV "Automation" of the Rules for the Classification and Construction;

.3 operation of the alarm system in accordance with the requirements of 12.5.1.2 and 12.5.1.3;

.4 operability of the automatic safety system in accordance with 12.4.3.1. Along with that, check of the operation of the alarm and safety systems shall be performed:

by vacuum — changing the steam pressure at ejectors;

by axial rotor displacement — simulating the movement of the measuring device;

by lubrication system — lowering the oil level in the lubrication system;

by vibration — simulating the operation of alarm through direct mechanical action on the measuring device;

by failure of the boilers — remotely cutting off the fuel supply to the boilers.

At the same time, it is necessary to check alternately the automatic starting of the stand-by oil pump and the automatic and/or remote starting (stopping) of auxiliary machinery supporting the main turbines from ECR.

12.5.4 Remote automated control systems of main gas turbines.

12.5.4.1 In the course of testing of the alarm, safety and remote automated control systems on the running gas turbine, it is necessary to check the effectiveness of interlocking system precluding the possibility of starting, false starting and motoring during:

.1 failure of main and stand-by power supply;

- .2 turning gear engaged;
- .3 operation of any protection device of the main gas turbine;
- .4 non-conformity of the devices controlling fuel supply to the starting position;
- .5 position of the throttle quadrant which does not conform to idle running;
- .6 no pressure in the fuel supply and power supply systems of the automatic equipment;
- .7 axial displacement of rotors (simulation by the measuring device shifting);
- .8 malfunction of the alarm, safety and remote automated control systems.

12.5.4.2 In case of automated starting of the gas turbine ready for use, it is necessary to perform automatically operations for sequential starting, false starting, motoring, fuel system washing and turbine stoppage.

In so doing, it is necessary to check:

- .1 issuance and execution of orders for remote switching-on and -off of machinery and devices being part of the unit;
- .2 assignment and execution of a temporary program for any position of the gas turbine throttle quadrant within the range from the dead slow to full speed and the position corresponding to the "crush stop" mode;
- .3 execution of the program for reversals and emergency shutdown of the gas turbine, release of signals to the control system for protection disablement;
- .4 automatic changeover from the heavy oil to light oil when the power is reduced below the established level, heavy oil temperature drops below the rated one or "port" program is activated;
- .5 steady operation of the system throughout the whole range of operating modes and existence of possible zones with high vibrations when the propeller speed is changed from the full ahead to full astern in 5 rpm intervals;
- .6 conservatism of the actuator mechanisms in the event of long-duration lack of power supply and failure of the system;
- .7 operational, local and automatic monitoring of the proper performance of the remote automated control system and automatic changeover to the stand-by units in the event of failure of the main units;
- .8 operation of the alarm and safety systems which preclude, with the gas turbine running, engagement of the turning gear, starting of the serving pumps, reversing and activation of the "crush stop" mode at a load exceeding 0,5 the rated load, excess of the rotor speed above the rated speed by more than 15 %, as well as the alarm and protection for other parameters provided for by the systems.

12.5.4.3 In the course of the mooring and sea trials of the main gas turbine the following shall be checked:

- .1 agreement between the propeller speed in steady mode and the setting of the set-point device in the wheel house and ECR, as well as the position of the running control lever;
- .2 accuracy of the indication instrument readings for the parameters specified in Part XV "Automation" of the Rules for the Classification and Construction;
- .3 steady operation of the automation regulating systems and remote control systems in all modes;
- .4 performance of the alarm and safety systems, their reliability and absence of false operation for each monitored and protected parameter.

12.5.5 Remote automated control system of CPP, Voith-Schneider propellers and azimuth thrusters.

12.5.5.1 For the remote automated control systems of the propulsion plants with CPP, Voith-Schneider propellers and retractable steering propellers (with respect to the requirements applied to these systems), during mooring and sea trials it is necessary to check:

- .1 devices and functions of the remote automated control system listed under 12.5.2 — 12.5.4 and related to the plants with CPP;
 - .2 blade turning-over velocity with the use of the remote automated control system for the compliance with the requirements of the Rules for the Classification and Construction (with the propeller being inoperative);
 - .3 device limiting the CPP blade turning-over velocity in the direction of pitch increase in view of exclusion of the engine overloading under normal operation conditions;
 - .4 time of operation of the device for emergency shutdown of the engine, operate setting of the engine overspeed device;
 - .5 limitation of the load on the engine when reaches the limiting value by means of reducing the propeller pitch.
- Check may be performed by simulating the performance parameters of the engine using sufficiently reliable method;
- .6 compliance with the set and real engine speed. For the systems provided with the "Manoeuvres" program characterized by a specific combination of the propeller pitch and engine speed, it is necessary to check compliance of these combinations with the requirements of the technical documentation for each ship running;
 - .7 compliance with the zero pitch of the propeller and the position of the pitch set-point device in the ECR and on the bridge;

.8 capability of ensuring 6 starts of the engine without replenishing of air receivers. At the same time, it is necessary to determine the minimum pressure of the starting air which makes the automated start of the engine possible;

.9 conservatism of the remote automated control system of the CPP (in the event of loss of power supply to the pitch changing mechanism control system control the blades shall remain in the position which they held immediately prior to the loss of pressure, with the actuation of the relevant alarm);

.10 compliance with the readings given by the blade position indicators on the pitch changing mechanism, in the ECR and on the bridge;

.11 alarm for the parameters specified by the technical documentation on the control system;

.12 alarm or interlocking from the ECR in the event of improper manoeuvre;

.13 alarm and blocking of clutch engagement when the CPP pitch is not equal to "0".

12.5.5.2 In plants with two or more engines driving a common propeller shaft, it is necessary to check additionally:

.1 operation of the device to protect the engine remaining operative against overload. Along with that, it is necessary to check the simultaneous disengagement of the clutches between the propeller shaft and engine and automatic slowdown (reduction of the propeller pitch) to the load value safe for the engine remaining operative;

.2 accuracy of the automatic load distribution between the engines operating in parallel in static and dynamic modes;

.3 absence of the resonance zones for the engines operating in parallel;

.4 constant-error behaviour of the speed governors;

.5 dynamic tests when the CPP is reversed from the full speed ahead to full speed astern. The tests are conducted with the use of recording instruments.

12.5.6 Automation equipment of steam boilers.

12.5.6.1 In the course of the mooring trials of the boiler automation equipment it is necessary to check the boiler systems:

.1 feed water system. It is necessary to check the setting of the high and low level indicators in the boiler drum, minimum level indicator in the hot well, time delay to prevent false operation in a seaway, operation of the feed pumps in manual and automatic modes, setting of the water salimeters;

.2 fuel oil system It is necessary to check operation and setting of the pressure gauges, fuel oil viscosity (at burner inlet) and level, fuel oil temperature in the service tank, changeover from the light oil to heavy oil (if provided), automatic devices for supply of fuel oil and combustion air;

.3 fuel oil heating (setting of the maximum and minimum limits of the thermostats);

.4 supply of combustion and atomization air. It is necessary to check the time setting for pre-ventilation of the boiler after stopping, regulation of air supply depending on the mode during firing-up and burning.

Moreover, it is necessary to check the capability of shutting off the burning installation from ECR and from a place situated outside the machinery space.

12.5.6.2 In the course of the mooring trials of the automatic burner and feeding systems (with confirmation of the obtained results also on the sea trials when operating their intended services), indication, alarm, protection and interlocking devices specified in Table 4.3.11, Part XV "Automation" of the Rules for the Classification and Construction shall be checked.

In so doing, when choosing and carrying out the operating modes of the boiler plant it is necessary to be guided by the requirements of Section 9.

12.5.6.3 The trials referred to in 12.4 and 12.5.6.1 shall be conducted in the following order:

.1 check of the static and dynamic irregularities of the burning system together with the feed water system shall be combined with the check of the entire machinery installation under the appropriate modes of the ship running. Along with that, the steam pressure fluctuation range shall not cause the boiler safety valves, alarm and protection system to be actuated nor shall disturb normal operation of the steam consumers;

.2 check of the alarm and protection to be activated in the event if the flame-jet cut-off shall be checked by action upon the photocell;

.3 the alarm and protection for the air pressure before the boiler furnace shall be checked through simulation of the air pressure loss by closing down the dampers, easing off the pulse tube or in specific cases, subject to agreement with the Register, by switching off the fans; at the same time, it is necessary to check the automatic starting of the standby fan;

.4 check of the alarm and protection for the water level drop shall be performed by blowing down the boiler with the feed pumps inoperative. Check of these system for the high level (in cases where they are mandatory) shall be performed by filling the boiler with water using feed pumps controlled manually. Along with that, at the same time it

is necessary to check setting of the time relay preventing false operation of the protection device when the ship is in a seaway;

.5 check of the operation of alarm for the feed water salinity and automatic operation of the by-pass valve (if any) shall be performed by direct supply of brackish feed water or by immersing the salt gauge into a vessel containing water of high salinity.

12.5.6.4 In case of auxiliary boilers, it is necessary to check the burning system when the boiler operates at all typical loads within the range 0 – 100 %, as well as during the parallel operation of the boilers. Along with that, particular emphasis shall be placed on the capability of the system to ensure normal operation of the boiler during transfers from full and intermediate load to zero load and back. The steam pressure fluctuation range shall not initiate actuation of the boiler safety valves, alarm or protection system nor shall disturb the normal operation of the essential steam consumers, especially those which are provided with the heating steam pressure regulators.

In case of composite boilers, it is necessary to check the operation of the automatic device (if any) to change over the exhaust gas using system to the fuel oil using system — by simulating the conditions under which the changeover is performed.

12.5.6.5 It is necessary to explore the possibility of unattended operation of the automated auxiliary boiler plant to feed the permanent consumers during the time cited under 12.4.4..

12.5.7 Automation equipment of electric power plant.

12.5.7.1 Prior to test of the electric power plant during the mooring trials it is necessary the pre-check separately all the systems of automation equipment of the electric power plant specified under 4.4, Part XV "Automation" of the Rules for the Classification and Construction and by the requirements under 12.4 and 12.5.1 of the Guidelines.

To be checked during the test of the automation equipment:

.1 operation algorithm of the automated prime movers of the generators in accordance with the RS-approved technical documentation;

.2 remote and local starting and stop of the prime movers;

.3 maintenance of the hot stand-by mode (if provided);

.4 automatic starting of the standby unit in the event of overloading of the operating unit and removal thereof from parallel operation at reduced load (if provided);

.5 automatic sharing of load when the units operate in parallel (if provided);

.6 indication and alarm devices in accordance with the requirements of Table 4.4.6, Part XV "Automation" of the Rules for the Classification and Construction.

12.5.7.2 The machinery installation of the ship assigned an automation mark added to the character of classification shall be tested to determine its capability of being placed in service after de-energization.

The said test shall be carried out by stopping the generator prime movers with the running main machinery (on sea trials) and then by restoring the previous operating mode of the installation through an automatic starting from ECR the main and all auxiliary machinery needed to do this. No starting from the local stations shall be permitted for this purpose.

12.5.8 Automation equipment of bilge system.

12.5.8.1 It is necessary to check the liquid level, which initiates actuation of the alarm by filling the appropriate bilge wells with water, as well as the absence of false alarms when the ship is in a seaway.

12.5.8.2 It is necessary to check the automatic or remote starting of the bilge pumps. Along with that, it is necessary to monitor the operation of the alarm to indicate the pump operation, valve position and pressure in delivery main.

12.5.9 Remote automated or automatic control of valves of ship's service systems and machinery installation piping.

12.5.9.1 In the course of tests the following shall be checked:

.1 remote opening and closing of valves;

.2 automatic control of valves by means the appropriate shift of the operate setting;

.3 pressure value of feeding medium in pulse pipes and power pressure value on servos (also at the instant of starting);

.4 operation of "valve is open (closed)" alarm;

.5 required position of the actuating elements of the valves in the event of loss of power supply ("fail-safety");

.6 proper alarm on the mnemonics;

.7 proper functioning of the manual valve control, as well as local servo control.

12.5.10 Automation equipment of compressors.

12.5.10.1 In addition to the check of operation during the tests of the machinery installation, it is necessary to check:

- .1 pressure at which the compressor is automatically started and shut down;
- .2 operation of the alarm and protection systems for the air temperature, oil pressure and other parameters provided by the automation system depending on the compressor type;
- .3 operation of the automatic blow-out and relief valves;
- .4 proper functioning of the manual control.

12.5.11 Automated equipment of separators.

12.5.11.1 It is necessary to check the operability of the automated equipment of the lubricating oil and fuel oil separators with verification of alarm and protection system, provided depending on the separator type.

12.5.11.2 It is necessary to check the operation of alarm in the separator sludge tanks.

12.5.11.3 It is necessary to check the operation algorithm of the programmed system for the control of the separator discharge process.

12.5.12 Automated equipment of classed refrigerating plants.

12.5.12.1 In the course of tests it is necessary to check the operation algorithms of the alarm and protections systems provided depending on the plant type; in so doing, the requirements of Section 11 shall be taken into account.

12.6 ADDITIONAL INSTRUCTIONS ON TESTING OF DYNAMIC POSITIONING SYSTEMS (DP SYSTEMS)

12.6.1 Checking the proper operation of dynamic positioning systems (DP systems) components.

12.6.1.1 Position and heading sensors.

12.6.1.1.1 Differential global positioning system (DGPS):

- .1 demonstrate the operation of the GPS receivers;
- .2 demonstrate the operation of dual constellation receivers to utilize the Russian GLONASS satellites for position fixes;

.3 verify the reception of differential correction data using more than one method for redundancy;

.4 verify those headings on which some of the required GPS and differential antennae are blocked by ship structures or exhibit degraded data due to multipath reception off close by structures. Ensure that no headings exist at which all signals are lost;

.5 verify correct telegram format and rate;

.6 verify proper lightning protection has been provided for all antennas.

12.6.1.1.2 Acoustic position systems:

.1 verify acoustic system accuracy for the type of base line used to manufacturer and/or customer specifications;

.2 verify the location with respect to the ship installation reference point and vertical alignment of all hydrophones. Verify the mechanical operation and alignment repeatability of all hydrophone deployment systems;

.3 verify set up and calibration procedures exist and are proven;

.4 if redundant systems are installed, verify the independent operation each system. This is especially true for systems that use transponders as apposed to system using free running beacons. Additionally, verify that both systems can operate simultaneously without interfering with each other. If master/slave design then verify transfer;

.5 verify operation of system to simultaneously track fixed and mobile targets;

.6 verify water depth rating of transponders/beacons;

.7 perform an operational and background noise survey of ship under various thruster configurations and power levels (this can be used to determine the worst case water depth capability of the acoustic position reference system as installed on a specific ship);

.8 verify correct telegram format and rate.

12.6.1.1.3 Taut wire systems:

.1 verify water depth rating of wire and clump weights;

.2 verify proper operation of wire wench and tensioning systems and that they are suitable for the water depth rating of the system;

.3 verify ease of operation to launch and recover taut wire and adjust system tension;

.4 verify the location with respect to the ship installation reference point;

.5 verify the proper polarity and scaling of the output tilt measurements;

.6 verify correct telegram format and rate.

12.6.1.1.4 Radio/radar positioning system:

- .1 verify set up and calibration procedures exist and are proven;
- .2 verify heading limitations due to antenna blockage;
- .3 verify correct telegram format and rate;
- .4 verify proper lightning protection has been provided for all antennas.

12.6.1.1.5 Laser position systems (relative position):

- .1 verify set up and calibration procedures exist and are proven;
- .2 verify heading limitations due to line-of-sight blockage between sensor(s) and target(s);
- .3 verify system operation under manufacturer's stated limiting environmental conditions;
- .4 verify correct telegram format and rate;

12.6.1.1.6 Riser angle systems:

- .1 verify operation of both upper and lower electric riser angle sensors and data transmission especially if multiplexed through BOP control system;
- .2 verify operation of acoustic riser angle sensors including orientation, polarity and latency of the received data by the DP system;
- .3 verify correct telegram format.

12.6.1.1.7 Gyrocompasses:

- .1 ensure proper mounting of compasses to meet shock and vibration specifications;
- .2 verify correct telegram format and rate;
- .3 verify heading reference data to all DP and peripheral equipment is received correctly.

12.6.1.2 Environmental sensors.

12.6.1.2.1 Wind sensors:

- .1 ensure that sensors are located such that structural blockage is minimized. This especially true when a minimum number of sensors are used to obtain full 360° coverage with little or no overlap in coverage zones;
- .2 verify accuracy of measured speed and azimuth data;
- .3 verify that all wind velocity data is adjusted to a common plane, usually 10 m above sea surface, regardless of the vertical position of the sensors;
- .4 verify correct telegram format and rate;
- .5 verify proper lightning protection has been provided for all external sensors.

12.6.1.2.2 Vertical reference units:

- .1 verify measurement of roll, pitch, heave, roll rate and pitch rate as applicable;
- .2 ensure that sensors are located as close to the roll/pitch center of the ship to minimize lateral acceleration effects;
- .3 verify that correct location parameters are entered in the sensor for correct compensation;
- .4 verify correct telegram format and rate;
- .5 verify the alignment of individual sensors with each well as to the ship.

12.6.1.3 The DP system propulsion plants/thrusters.

12.6.1.3.1 Controller functions:

- .1 azimuth controller — proper operation of the azimuth control including rate and direction of the azimuth drive to be verified;
- .2 pitch controller — proper operation of the pitch control device including rate of change of pitch and maximum pitch. Verify that the thruster delivers 100 % thrust at the 100 % pitch command to be verified. Test pitch limiting to avoid thruster overload if included;
- .3 speed controller — proper operation of the shaft; speed control device to be verified. Verify that the thruster delivers 100 % thrust at the 100 % speed command. For fixed axis thrusters verify smooth and stable operation of direction change of rotation to reverse thrust output. Test speed limiting to avoid thruster overload if included;
- .4 power controller — some systems use either pitch or speed control as appropriate in a closed loop control system that actually controls the input power level of the thruster. This type of control is superior to simple pitch or speed control in that it keeps the power consumed from spiking and adjusts in part for current inflow degradation. Verify the operation of the power control device. Verify that the thruster delivers 100 % thrust at the 100 % power command and that the controller protects against thruster overload.

12.6.1.3.2 Commands:

- .1 verify proper operation of thruster assignment functions;
- .2 verify automatic DP and/or joy stick/manual moment calculated azimuth and/or thrust commands are correctly received by the assigned thrusters;
- .3 verify manual azimuth and/or thrust commands are received by the assigned thrusters.

12.6.1.3.3 Feedback:

azimuth angle feedback — verify calibration of the following:

azimuth angle feedback;

pitch angle feedback;

speed feedback;

power feedback.

12.6.1.3.4 Thruster drive system operation:

.1 verify protective devices (setting) and equipment operation:

thruster start protection and operation;

thruster stop protection and operation;

thruster emergency stop protection and operation;

thruster drive system protection settings;

.2 verify time needed for thrusters restart.

12.6.1.4 Power systems.

12.6.1.4.1 For redundancy, a minimum of two skids shall be on line at all times and skids shall be added to or taken off line as the average total power requirement fluctuates. In order to maintain continuous power, some level of automatic power management system is desirable.

12.6.1.4.2 Main power:

.1 buss structure — verify proper indication and data from both closed and split buss operation. Also that power limit recognized and responds correctly to split buss operation;

.2 engine/generator — verify that proper engine and generator data is transmitted to the DP system;

.3 thruster supplies — verify that all thruster power data is transmitted to the DP system. Verify that start permissive logic is properly implemented and operational.

12.6.1.4.3 UPS power:

.1 redundancy — verify distribution of equipment between various UPS systems to minimize DP system degradation on loss of any one UPS;

.2 battery life — verify stated performance on battery operation. Typically 30 min;

.3 input power selection — verify that the UPS has multiple input power sources;

.4 bypass modes — verify that the UPS can be bypassed such that the output is fed directly from the input. This is an emergency mode of operation;

.5 verify key UPS alarms to DP.

12.6.1.4.4 Operational checks:

.1 closed/split buss operation — test the operation of the power plant in all closed and split bus combinations with all combinations of thrusters to ensure safe and stable operation;

.2 black out recovery — under normal DP operations, cause a black out of the main plant and determine the time to recover to full operational DP holding station. Note the time required to get each engine and thruster back on line and operating.

12.6.2 Coming on location trials.

12.6.2.1 These are ship specific trials used primarily to verify "good working order" of the DP system. For example:

.1 restart all operator stations pertaining to the DP and the thruster control systems;

.2 simultaneously reset and restart all three DP control computers and let them re-load from an operator station. Restart independent backup controller;

.3 restart both DGPS systems and let them settle. Check setup and verify all relevant reference stations enabled and active;

.4 restart both acoustic transceivers inside bilge keels and verify transducer shafts fully extended;

.5 enable sensors and make sure there are small differences between all three compasses and between the three vertical reference sensors;

.6 verify all thrusters "running" and "ready". DP systems in "lever" mode; test responses of each thruster individually using levers. Two engines running and on the switchboard, four on standby. All busties closed;

.7 set DP in "Joystick" mode and tested all thrusters responding correctly to small joystick deflections in all three axes (surge, sway and yaw);

.8 set DP in auto mode using two DGPS inputs and let settle for 30 min;

.9 perform "box" test, i.e., moving ship 30 m to starboard, then 30 m ahead, then 30 m to port and finally 30 m astern. All moves at low speed. Done at low, medium and high gain separately. Observe position plot correct and little or no overshoot at each new position. Send position plot to hard-copy color printer for filing purposes;

.10 inform engine room of power management test (power management system). Make a 50 m transversal move at a high speed setting (~ 3,5 knots) to observe levels and timing of the autostart of each standby generator in turn. Ultimately, all generators on the switchboard. Alternate use the joystick at its high gain setting;

.11 check that independent backup system reads parameters correctly, i.e., following the main system's inputs and outputs;

.12 test emergency transfer to the independent backup system. Observe "bumpless" transfer.

.13 transfer control back to main system;

.14 reset two of the three main DP controllers and observe no change in position, heading or thruster usage on one controller. Observe proper restart of controllers. Also verify auto-switch to "live" controller;

.15 test emergency stop of each thruster in turn by using panel mounted buttons. Restart thruster after each one;

.16 move into well-head position under DP control and verify with independent surveyor. Head set at predetermined desired stack heading based on oceanographic and meteorological statistical data from nautical "pilot" charts;

.17 deploy ROV carrying four transponders. Deploy transponders, each in turn, in a predetermined array based on depth and bathymetric data (if available);

.18 activate acoustic systems and calibrate the transponder array. Then enable in the DP system. Check both systems operational and satisfactory. Check DP system and positioning stability for a while using only acoustics as position reference;

.19 restore DP system to normal operational status and set warning and alarm limits for excursions according to safety calculations done for the site;

.20 log all activity and declare ship operational and ready.

12.6.3 Failure mode and effect analysis (FMEA).

12.6.3.1 Class 2 and 3 DP-systems, which correspond by their characteristics to marks DYNPOS-2 and DYNPOS-3 in the class notation shall be checked according to the FMEA provisions.

13 LIFE-SAVING APPLIANCES

13.1 GENERAL

13.1.1 The provisions of this Section define the scope and methods of technical supervision of installation and testing of life-saving appliances listed in the Table 13.1.1 on board the ship under construction.

13.1.2 General provisions for the organization of the technical supervision are given in Section 1.

13.1.3 Technical documentation.

13.1.3.1 Installation and testing of life-saving appliances on board shall be performed under the Register technical supervision according to the RS-approved technical documentation.

13.1.4 Technical supervision of the Register.

13.1.4.1 Surveys during installation and testing of life-saving appliances shall be performed according to the examination and testing plan developed by the shipyard according to 13.2.1 based on Table 13.1.1, taking into account 13.3.

Table 13.1.1

Nos.	Item of technical supervision	Installation and mounting		Mooring trials	Sea trials
		Verification of RS certificates	Checking of installation and mounting on board the ship		
1	Launching appliances:				
1.1	launching appliances using falls and winches for lifeboats	+	+	+	¹
1.2	free-fall launching appliances for lifeboats	+	+	+	—
1.3	launching appliances for rescue boats	+	+	+	+
1.4	launching appliances for fast rescue boats	+	+	+	+
1.5	launching appliances for liferafts	+	+	+	—
2	Release mechanisms and free-fall launching appliances for lifeboats	+	+	+	—
3	Liferafts	+	+	+	—
4	Free-fall lifeboats	+	+	+	—
5	Liferafts, rescue boats, fast rescue boats	+	+	+	—
6	Containers for inflatable liferafts	+	+	—	—
7	Arrangements for launching and raising for lifeboats, liferafts and rescue/fast rescue boats	+	+	+	—
8	Hydrostatic release units	+	+	—	—
9	Weak link of liferaft	+	+	—	—
10	Automatic gas inflation system for inflatable liferafts, marine evacuation systems, means of rescue, inflatable lifejackets	+	+	—	—
11	Liferafts	+	+	—	—
12	Rescue boats	+	+	+	—
13	Fast rescue boats	+	+	+	—
14	Means for bringing lifeboats and liferafts against ship's side and holding them alongside, skates	—	+	+	—
15	Embarkation ladders, lifelines	+	+	—	—
16	Lifebuoys	+	+	—	—
17	Self-igniting lights	+	+	—	—
18	Self-activating smoke signals	+	+	—	—
19	Buoyant lifelines	+	+	—	—
20	Lifejackets	+	+	—	—
21	Immersion suits	+	+	—	—
22	Anti-exposure suits	+	+	—	—
23	Thermal protective aids	+	+	—	—
24	Lifejacket lights	+	+	—	—
25	Line-throwing appliances	+	+	—	—
26	Equipment of survival craft, rescue boats/fast rescue boats	²	+	—	—
27	Marine evacuation systems	+	+	+	—
28	Symbols for use in accordance with SOLAS-74 as amended	+	+	—	—
29	Means of rescue	+	+	+	—

¹On cargo ships of 20 000 gross tonnage and above (refer to 13.4.1).

²Equipment of survival craft, rescue boats/fast rescue boats, for which the RS certificates are required, are given in Appendix 1 to Part I "General Regulations for Technical Supervision" of the Rules for Technical Supervision.

13.1.5 Tests and checks specified in this Section are based on an assumption that the life-saving appliances have been tested at the firm (manufacturer) in compliance with the requirements of Section 13, Part IV "Technical Supervision during Manufacture of Products" of the Rules for Technical Supervision.

In case some tests were not conducted at the firm (manufacturer) and it is confirmed by an entry in the RS certificate, then these tests shall be conducted.

13.1.6 At the initial survey of life-saving appliances during construction and testing to confirm the ship compliance with the requirements of SOLAS-74, as amended, also the requirements of Section 19 shall be met.

13.2 SURVEY PLANNING

13.2.1 Prior to commencement of survey of the life-saving appliances of the ship under construction, the RS Branch Office shall agree the examination and testing plan for life-saving appliances developed by the shipbuilder taking into account Table 13.1.1. The shipbuilder shall be informed about that at a kick off meeting prior to commencement of construction according to 1.7.1 and with due regard to 13.3.

The builder shall agree to undertake ad hoc investigations during construction as may be requested by RS where areas of concern arise and the builder to agree to keep RS advised of the progress of any investigation. Whenever an investigation is undertaken, the builder shall be requested, in principle, to agree to suspend relevant construction activities if warranted by the severity of the problem.

13.2.2 During approval and agreement of the examination and testing lists a note shall be taken of specific published Administration requirements and interpretations of statutory requirements.

13.2.3 The shipyard shall be requested to advise of any changes to the activities agreed at the kick off meeting and these shall be documented in the examination and testing plan. E.g. if the shipbuilder chooses to use or change sub-contractors, or to incorporate any modifications necessitated by changes in production or inspection methods, rules and regulations, structural modifications, or in the event where increased inspection requirements are deemed necessary as a result of a substantial non-conformance or otherwise.

13.2.4 Quality standards for installation and testing of the life-saving appliances shall be reviewed and agreed during the kick-off meeting. The work shall be carried out in compliance with the RS rules and under the RS technical supervision.

13.2.5 Any changes to the kick-off meeting records shall be agreed and documented.

13.3 CHECKS AND TESTS

13.3.1 Launching appliances of lifeboats/rescue boats/fast rescue boats.

13.3.1.1 General.

13.3.1.1.1 All metal structures of decks (and other hull elements) in way of the launching appliances, including deck strengthening thereunder, shall be accessible for examination during the tests.

No cementing of foundation, installation of planking or application of mastic, as well as lining of ceiling prior to completion of the tests shall be permitted.

13.3.1.2 Loaded tests.

13.3.1.2.1 The survival craft or rescue boat, loaded with its normal equipment or an equivalent mass and a distributed mass equivalent to that of the number of persons, each weighing 75 kg or 82,5 kg, as applicable, it is permitted to accommodate, should be released by operation of the launching control on deck. The speed at which the survival craft or rescue boat is lowered into the water shall be not less than that obtained from the formula

$$S = 0,4 + (0,02H) \quad (13.3.1.2.1)$$

where S = speed of lowering, in m/s;

H = height from davit head to the waterline at the lightest seagoing condition, in m.

Thus, the maximum lowering speed established by the Administration shall not be exceeded.

13.3.1.3 Light loaded test.

13.3.1.3.1 The survival craft or rescue boat loaded with its normal equipment or an equivalent mass shall be released by operation of the launching control on deck to demonstrate that the lifeboat's mass is sufficient to overcome the frictional resistance of the winch, falls, blocks and associated gear. The lowering speed shall be as established by

the Administration. A person shall then board the survival craft or rescue boat and perform a test of the launching operation from within the boat.

13.3.1.4 The requirements of 13.3.1.2 and 13.3.1.3 do not apply to free-fall lifeboats.

13.3.1.5 Loaded lowering test (brake test only).

13.3.1.5.1 The survival craft or rescue boat loaded with its normal equipment or an equivalent mass and a distributed mass equal to that of the number of persons, each weighing 75 kg or 82,5 kg, as applicable, it is permitted to accommodate + 10 % of the working load, shall be released by the operation of the launching controls on deck. When the craft has reached its maximum lowering speed, the brake shall be abruptly applied to demonstrate that the attachments of the davits and winches to the ship's structure are satisfactory. The maximum lowering speed established by the Administration shall not be exceeded.

13.3.1.5.2 If lowering of the lifeboat is controlled from within the lifeboat by means of a control wire paid off from an auxiliary drum on the winch, the following additional points shall receive particular consideration after installation of the davits and winches:

.1 the mass on the control wire shall be sufficient to overcome the friction of the various pulleys on the control wire, when turning out the lifeboat from the stowed to the embarkation position;

.2 it shall be possible to operate the winch brake from within the lifeboat;

.3 the winch brake shall not be affected by the mass of the fully extended control wire;

.4 there shall be sufficient length of control wire available at the lifeboat, during all stages of lowering; and

.5 means shall be provided to retain the free end of the control wire in the lifeboat until the lifeboat is detached from the launching appliance by the operator.

13.3.1.5.3 If the winch brake is exposed to the weather, the lowering test shall be repeated with the braking surface wetted.

13.3.1.6 Recovery test.

13.3.1.6.1 It shall be demonstrated that the davit-launched lifeboat or rescue boat can be recovered to its stowage position by means of operating the hand gear and can be safely and properly secured.

13.3.1.6.2 For free-fall lifeboats it shall be demonstrated that the survival craft can be recovered to its stowage position and can be safely and properly secured.

13.3.1.6.3 Where davits are recovered by power, it shall be demonstrated that the power is automatically cut off before the davit arms come against the stops.

13.3.1.6.4 In the case of rescue boat launching appliances, it should be demonstrated that the fully equipped rescue boat when loaded with a mass equal to that of the number of persons it is approved to carry can be recovered by means of a winch at a rate of no less than 0,3 m/s.

13.3.1.6.5 It shall be demonstrated that the rescue boat can be recovered by means of the winch referred to in 13.3.1.6.4 using a hand gear.

13.3.1.6.6 The lower blocks of the boat tackle (long link of the suspension chains) shall be freely released when the boat reaches the water surface.

Ease of belaying the lower block of the boat tackle (eye or long link) to the boat hooks shall be checked when the boat is waterborne.

13.3.1.7 Adjustable ramp test.

13.3.1.7.1 It shall be demonstrated that adjustable ramps for free-fall launching may be adjusted satisfactorily with the free-fall lifeboat loaded to 1,2 times its related load.

13.3.2 Installation tests of liferaft launching appliances.

13.3.2.1 Static load test.

13.3.2.1.1 Each release hook shall be statically proof tested to 2,5 times the safe working load and be provided with an approved testing establishment certificate certifying that it has been so tested.

13.3.2.2 Operational test.

13.3.2.2.1 Each release hook shall be submitted to an operational test with a mass equivalent to the safe working load being applied. The release arrangements shall be demonstrated and checked with the liferaft loaded to ensure that the automatic release hook will not release while the load is still applied.

13.3.2.3 Marking.

13.3.2.3.1 Each release hook shall be checked to ensure it is permanently marked with:

.1 the manufacturer's name or the approved name of the release hook;

.2 the date of manufacture;

.3 the safe working load;

.4 the number of the test certificate required by 6.2.2; and

.5 clear, concise operating instructions.

13.3.2.4 Lowering test.

13.3.2.4.1 One liferaft ballasted to represent a 10 % overload or an equivalent mass shall be lowered from each launching appliance to establish the rate of lowering. The 10 % overload shall be 10 % of the mass of the liferaft assembly together with its equipment and full complement of persons calculated at 82,5 kg per person. It shall be jerked to ensure that the liferaft launching appliance, its fastenings and the supporting structures can withstand the associated loads.

13.3.2.5 Recording of lowering test.

13.3.2.5.1 The time shall be recorded for the sequence of preparing, loading and launching three liferafts. If so desired, persons may be used only in the preparing and loading operations and ballast substituted for the lowering and launching part of the test. This sequence test need not be carried out on every launching appliance on a ship. However, at least one example of each launching appliance type and arrangement shall be so tested on each ship.

13.3.2.6 Towing strain test.

13.3.2.6.1 A moderate towing strain shall be put on the liferaft when waterborne to check that the release arrangements are satisfactory under this condition.

13.4 LIFEBOATS AND LIFERAFTS

13.4.1 Launch test.

13.4.1.1 It shall be demonstrated that the fully equipped lifeboat on cargo ships of 20 000 gross tons or more and rescue boat can be launched from a ship proceeding ahead at a speed of not less than 5 knots in calm water and on an even keel. There shall be no damage to the lifeboat or the rescue boat or their equipment as a result of this test.

13.4.2 Check of inscriptions and marking.

13.4.2.1 Clear permanent inscriptions showing the port of registry and name of the ship, as well as the principal dimensions and capacity shall be marked externally on both sides of each lifeboat/rescue boat/fast rescue boat, as well as on each rigid liferaft and buoyancy apparatus bow.

The lifeboat number and marking permitting to identify the ship, to which the lifeboat belongs, shall be made in such a way that it is visible from above.

13.4.3 When stowing the liferafts, it is necessary to verify whether the number, capacity and location of the rafts comply with the RS-approved documentation, whether the Register certificates and firm's (manufacturer's) documents are available, whether the rafts are consistent with the documentation (by brands and marking) and their usable life, as well as technical condition (by external examination).

Note. The rafts stowed on board ship shall have an usable life to next survey not less than 9 months considering the maximum permissible period between surveys of 18 months since manufacture.

13.4.4 When securing raft in the stowage positions the following shall be checked: availability and proper installation of the hydrostatic release unit (by the firm's (manufacturer's) documents), possibility of the raft free floating when the ship sinks.

13.5 LIFEBOUOYS AND LIFEJACKETS

13.5.1 It is necessary to check the number, arrangement and securing of lifebuoys on board ship according to the RS-approved documentation, availability of the Register certificates, as well as the technical condition and completeness of these.

Attention shall be given to proper arrangement and availability of the lifebuoys for immediate use.

13.5.2 The arrangements for quick release of the lifebuoys fitted with self-activated smoke signals and lights on the ship's navigating bridge should be tested, using a dummy smoke signal, if necessary to demonstrate that the lifebuoys and their attachments will drop clear of the ship's side when released.

13.5.3 Check of lifejackets.

13.5.3.1 Subject to check shall be all lifejackets including additional number of lifejackets to be provided for one watch crew and children, availability of the Register certificates and the firm's (manufacturer's) documents, their consistency with marking on the lifejackets, technical condition, completeness (availability of the whistle, search light and sea water battery, as well as the working life of the latter), availability of inscriptions on the lifejackets.

13.5.4 Sett-igniting and light-and-smoke buoys of the lifebuoys.

13.5.4.1 It is necessary to check the number, marking (working life of the batteries), availability of the RS certificate, as well as the proper installation of their fastenings.

13.6 IMMERSION SUITS AND PERSONAL THERMAL PROTECTIVE AIDS

13.6.1 It is necessary to check the availability of the above items, compliance with the RS certificates submitted for them and their completeness. It is necessary to make sure that there are no visible damages and to examine their stowage positions in order to verify that they comply with the requirements of the manufacturer's instructions.

13.7 LINE-THROWING APPLIANCE

13.7.1 It is necessary to check the completeness of the line-throwing appliance, number of the projectiles and lines (including the working life), availability of the Register certificate and instructions for use of the appliance. Besides, it is necessary also to check the storage of the projectile, buoyant lines and pistol in a water-resistant casing (unless these items are stored in a watertight space).

13.8 ITEMS OF LIFEBOAT EQUIPMENT

13.8.1 The above items shall be checked for compliance with the RS-approved documentation and requirements of 6.13.8, Part II "Life-Saving Appliances" of the Rules for the Equipment of Sea-Going Ships¹. Subject to check shall be the availability and completeness, stowage of the items in the lifeboat and availability of the firm's (manufacturer's) documents, as well as for the items of lifeboat equipment as it stipulated by the RS Nomenclature, the availability of the relevant Register certificates.

13.9 MARINE EVACUATION SYSTEMS

13.9.1 On the installation of a marine evacuation system on a ship, at least 50 % of such systems shall be subjected to a harbour trial deployment. At least one of these systems should be deployed in association with at least two of the inflatable liferafts to establish that correct launching and subsequent retrieving, bowsing-in and inflation procedures have been correctly installed.

13.9.2 Subject to the above deployments being satisfactory, untried systems shall be similarly deployed within 12 months of the installation date.

13.9.3 For first of the above deployments, in association with the launching of the liferafts, a partial evacuation trial should be carried out to ensure that:

- .1** the system does not interfere with the launching of other life-saving equipment fitted on board; and
- .2** the system and associated liferafts are clear of all possible obstructions or dangers such as stabilizers or the ship's propellers.

¹Hereinafter referred to as "the Rules for the Equipment".

14 SIGNAL MEANS

14.1 GENERAL

14.1.1 The provisions of the present Section shall apply in technical supervision of signal means under the RS Nomenclature during construction of ships.

14.1.2 The definitions and explanations on the general terminology are given in Part III "Signal Means" of the Rules for the Equipment.

14.1.3 The general provisions concerning technical supervision of signal means are set forth in the General Regulations for the Classification and Other Activity, Part I "Survey Regulations" of the Rules for the Equipment, in Part I "General Regulations for Technical Supervision" of the Rules for Technical Supervision, for technical documentation — in Part II "Technical Documentation" of the Rules for Technical Supervision.

14.1.4 Technical documentation.

14.1.4.1 Installation and testing of signal means on board the ship shall be performed under the Register technical supervision according to the RS-approved technical documentation.

14.1.5 Technical supervision of the Register.

14.1.5.1 Surveys during installation and testing of signal means shall be performed according to the examination and testing plan developed by the shipyard according to 14.2 based on Table 14.1.5.1, taking into account 14.3.

Table 14.1.5.1

Item of technical supervision	Inspection of compliance with the approved technical documentation	Inspection of documents confirming the Register supervision; brands	External examination, checking completeness	Inspection of mounting	Control measurements	Checking operability	Supervision during mooring trials	Supervision during sea trials
Navigation lights	+	+	+	+	+	+	+	+
Flashing lights	+	+	+	+	+	+	+	+
Sound signal means	+	+	+	+	+	+	+	+
Pyrotechnic signal means	—	—	+	+	—	—	—	—
Signal shapes	+	—	+	+	+	—	+	+
Daytime signaling lamp	+	+	+	—	+	+	+	+
Radar reflectors	+	—	+	+	—	+	+	+

14.1.6 Tests and checks specified in this Section are based on an assumption that the signal means have been tested at the firm (manufacturer) in compliance with the requirements of Section 14, Part IV "Technical Supervision during Manufacture of Products" of the Rules for Technical Supervision.

In case some tests were not conducted at the firm (manufacturer) and it is confirmed by an entry in the RS certificate, then these tests shall be conducted.

14.2 SURVEY PLANNING

14.2.1 Prior to commencement of survey of the signal means of the ship under construction, the RS Branch Office shall agree the examination and testing plan for signal means developed by the ship-builder taking into account Table 14.2.1 and 14.3. The shipbuilder shall be informed about that at a kick off meeting prior to commencement of construction according to 1.7.1.

The builder shall agree to undertake ad hoc investigations during construction as may be requested by RS where areas of concern arise and the builder to agree to keep RS advised of the progress of any investigation. Whenever an investigation is undertaken, the builder shall be requested, in principle, to agree to suspend relevant construction activities if warranted by the severity of the problem.

14.2.2 During approval and agreement of the examination and testing lists a note shall be taken of specific published Administration requirements and interpretations of statutory requirements.

14.2.3 The shipyard shall be requested to advise of any changes to the activities agreed at the kick off meeting and these shall be documented in the examination and testing plan. E.g. if the shipbuilder chooses to use or change sub-contractors, or to incorporate any modifications necessitated by changes in production or inspection methods, rules and regulations, structural modifications, or in the event where increased inspection requirements are deemed necessary as a result of a substantial non-conformance or otherwise.

14.2.4 Quality standards for installation and testing of the signal means shall be reviewed and agreed during the kick-off meeting. The work shall be carried out in compliance with the RS rules and under the RS technical supervision.

14.2.5 Any changes to the kick-off meeting records shall be agreed and documented.

14.3 TECHNICAL SUPERVISION OF SIGNAL MEANS DURING CONSTRUCTION PERIOD

14.3.1 Technical supervision of signal means during construction period shall include the following:

- .1 check of compliance of signal means with the RS-approved technical documentation for the ship construction;
- .2 check of fitting of signal means on board ships;
- .3 supervision during mooring and sea trials of ships;
- .4 issue of the Register documents.

14.3.2 Check of compliance of signal means with the RS-approved technical documentation is carried out through the review of this documentation, passports, certificates and other documents, as well as by survey of signal means and conformity of their accompanying papers to the markings and brands assigned to signal means.

14.3.3 Check of fitting of signal means on board (refer to Appendix 1 to this Section) shall be carried out in way of external examination and control measurements with the purpose of determining the following:

- .1 proper arrangement of the fixed signal means in the vertical and horizontal planes, over the ship's breadth and also in relation to the centre longitudinal plane;
- .2 proper mutual positioning of signal means;
- .3 proper design of positioning and securing of signal means;
- .4 absence of any ship structures or devices obstructing the proper operation of signal means;
- .5 possibility of dismantling signal means and replacing with spare parts;
- .6 proper positioning of outboard signal means;
- .7 proper laying of electrical cables and protective earthing of signal means according to the requirements of Section 10;
- .8 availability of protection from radio interference caused by electrical signal means;
- .9 proper design of piping system conveying compressed air, steam or another media for actuation of the sound signal means;
- .10 availability of devices conveying the media for the signal means and drainage of condensate;
- .11 proper design of hoisting devices for outboard signal means;
- .12 proper construction and safely of devices and appliances for pyrotechnic signal means to be operated as well as storage lockers or boxes for them.

14.3.4 Surveys of signal means shall be carried out during mooring and sea trials of ships (refer to Appendix 2 to this Section) testing these means in operation with the purpose of determining the following:

- .1 ready preparedness of signal means for operation;
- .2 proper operation of visual and sound alarms of navigation lights;
- .3 possibility of replacing fixed navigation lights with spare ones;
- .4 availability of hoisting appliances for the navigation lights not fixed stationary;
- .5 possibility of operation of navigation lights and flashing lights from the specified power sources;
- .6 possibility of carrying of signal shapes on board required by the Rules for the Equipment.

14.3.5 In case of satisfactory results of mooring and sea trials and ultimate compliance of signal means with the requirements of the Rules for the Equipment, the RS surveyor shall duly issue the Register documents for the ship.

CHECK OF FITTING SIGNAL MEANS ON BOARD

1. Check of proper arrangement¹ of the signal means fixed stationary in the vertical and horizontal planes, over the ship's breadth and also in relation to the fore and aft centre plane.

1.1 Signal means shall be arranged in accordance with the drawing approved by the Register and in accordance with the requirements of Section 4, Part III "Signal Means" of the Rules for the Equipment.

Distance measurements shall be made with a long measure tape. Definition of the upper deck line for determining the light height shall be performed by the hose-type water level or by any other approved method. The proper arrangement of lights in the vertical plane shall be determined by an adjusting tool.

As a basic way of controlling the arrangement of sector navigation lights, the method of mounting with the help of marks along the light axis line assigned on the lantern case shall be accepted. Coincidence of these marks with the conditional fore and aft centre line or parallel fore and aft centre lines in the position where the light is fitted shall ensure the required accuracy (refer to Fig. 1.1).

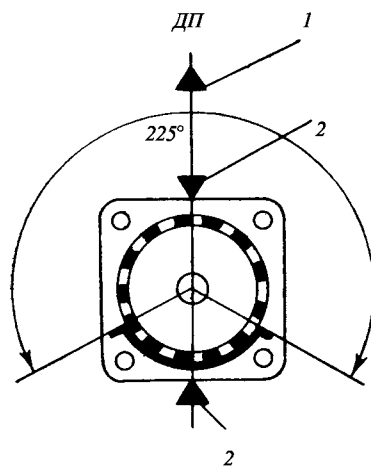


Fig. 1.1

Fitting of masthead light:

1 — centre line; 2 — marks on the lantern case centre line

1.2 Whistles shall be so fixed that the centre of the sound source is at the height of not less than 2,5 m above the uppermost deck extending from side to side and at least 0,5 m above the deckhouse and any other structures on this deck, which can obstruct the propagation of sound.

1.3 The bell shall be placed on the clear part of the forecastle deck, near the windlass or capstan and hung up in such a manner as to permit its free swinging through an angle of not less than 50° each way without touching any part of the structure or equipment of the ship.

1.4 The gong shall be placed as near the after end of the ship as possible and at such a place where nothing will intercept the propagation of the sound and be hung up so as to comply with the requirements of 1.3. A gong up to 5 kg in mass need not be fixed in a stationary position, but a special storage place shall be provided in the after part of the ship. The gong beetle shall be kept in a special pocket to be fitted close to the gong.

1.5 The ships shall be provided with proper devices (masts, stays with sufficient number of signal halyards) for hoisting the hoisting shapes. The signal shapes shall be stored near the navigation bridge or the devices for hoisting them to their regular positions.

1.6 For storing the pyrotechnic signal means, the ship shall be provided with special watertight metal lockers built into the deckhouse on the navigation bridge, or a metal box firmly secured on the bridge deck.

2. Check of proper mutual positioning of signal means.

2.1 The check shall be carried out in accordance with the drawing and requirements of Section 4, Part III "Signal Means" of the Rules for the Equipment.

¹Check of proper arrangement of signal means may be also carried out using any other method approved by the Register.

3. Check of proper arrangement of side lights.

3.1 The side lights shall be protected by inboard shields with two transverse screens (fore and aft) perpendicular to the shield. Shields shall be of such a length that the distance from the outer length of the lantern axis or cylinder to the after edge of the transverse screen will be at least 0,9 m. The forward transverse screen shall be of such a breadth as to ensure that luminous intensity shall disappear within 3° ahead (refer to Fig. 3.1). The aft transverse screen shall be of such a breadth as to mask completely the light from being seen across the stern, but not to hinder showing its light to $22,5^\circ$ abaft the beam. The height of the shield and of the screens shall not be less than that of the light case¹.

It is necessary that side lights placed on the horizontal shield or in recesses as well as the height of the fore screen ensure the vertical sector visibility required by the Rules for the Equipment. Inner surfaces of shields shall be painted matt black. The shields of the side lights shall be placed in such a position that their outer edge will not project beyond the line of the side of the ship.

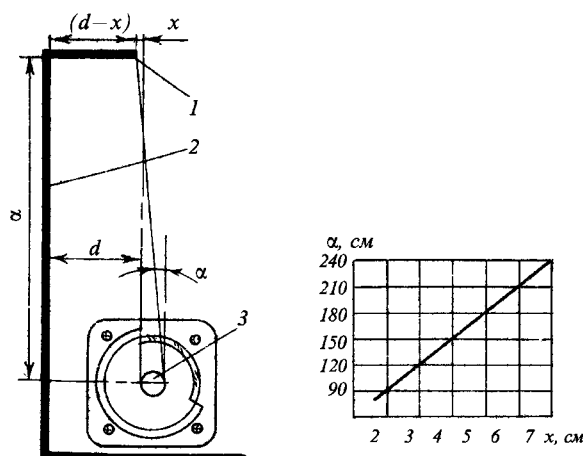


Fig. 3.1

Fitting navigation side light:

1 — screen; 2 — shield; 3 — filament of the lamp

4. Check to ascertain that there are no ship structures or hull fittings obstructing proper operation of signal means.

4.1 The masthead lights shall be placed above all other lights except for the manoeuvring light, and also above the obstructing superstructures so that each of them could be distinctly visible over the arcs of the horizon assigned to them. Horizontal shields of sufficient size shall be installed under the masthead lights so as to prevent these lights from illuminating the navigation bridge and other decks. The shield length shall not decrease the vertical visibility sector.

The all-round lights, except for anchor ones, shall be so located as not to be obscured by masts, topmasts or superstructures within sectors of more than 6° (refer to Fig. 4.1).

In case of the all-round lights located near masts obscuring the visibility sector at more than 6° , platforms for fixing all-round lights shall be made distant from the masts with the help of long brackets or other appliances. It is necessary to make sure that there are no such structures or hull fittings obstructing propagation of the sound signal means sounding.

5. Check of possibilities of removing signal means and replacing them with spare parts, where necessary.

6. Check of proper positioning of hoist-type signal means.

6.1 Availability shall be checked of suitable devices for hoisting hoist-type lights to their regular positions and lowering them onto the deck. Such devices shall be of such structure as to ensure the correct stable position of lights when hoisted to their regular positions. In this case the visibility in horizontal and vertical sectors of lights shall be ensured.

6.2 Signal shapes shall be provided with suitable devices for fixing them to halyards on which they are hoisted, and for joining with other shapes. Folding shapes shall be fitted with the devices retaining them in open position and

¹Transverse screen need not be fitted where the light design ensures that the horizontal sectors of side lights are in accordance with the requirements of the Rules for the Equipment.

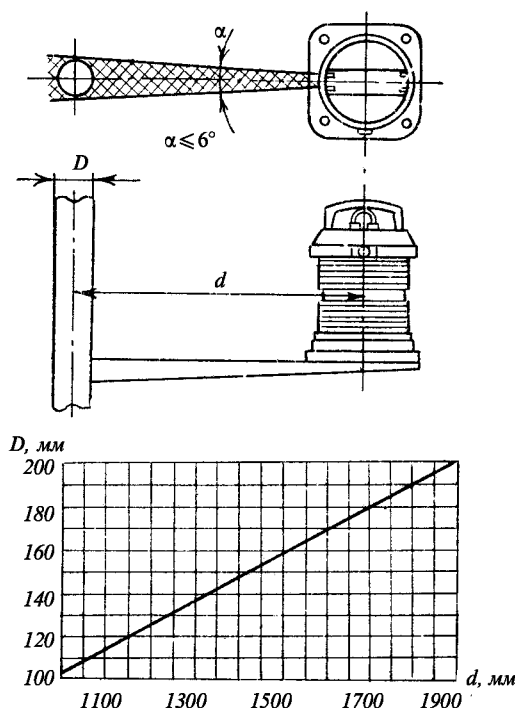


Fig. 4.1

Diagram of the minimum distance (α) at which $\alpha \leq 6^\circ$

preventing the shapes from spontaneous folding. Devices for joining the shapes to each other (except the cones) shall provide for maintaining the proper distance between them, which is not to be less than 1,5 m for ships of 20 m and over in length and not less than 1 m for ships of less than 20 m in length. The cones shall be provided with devices for joining them directly to each other at their points or bases.

6.3 The trial hoisting of signal shapes to their regular positions shall be carried out.

7. Check of proper mounting of electrical cables and protective earthing of signal means.

In this case the following shall be checked:

- .1 cable laying and its compliance with the drawings approved by the Register;
- .2 reliable securing, distance between securing devices, cable bending inner radius, cable marks and sections, no additional joints not specified by the drawing, cable lead-in;
- .3 switching on of navigation lights to the cable supply system by plug-and-socket conductor;
- .4 protection of the cable from damages at the outlet points in way of the deck and mast;
- .5 availability of protective earthing with the section suitable for the power supplying cable of shields, lights, plug-and-socket connectors.

8 Check of available protection from radio interference caused by electric signal means.

8.1 In this case the following shall be checked:

- .1 availability of screening coatings on the cables laid in the spaces where the ship equipment of radio communication and radio navigation facilities is in-stalled, as well as on the upper decks and superstructures not separated from the aerial by a metal deck or bulkhead;
- .2 continuous screening, earthing of cable coatings and devices.

9. Check of proper design of piping system conveying compressed air, steam or another media for the sound signal means to be operated with the purpose of excluding their spontaneous sounding under the action of wind, snow, icing-up, etc.

10. Check of availability of devices ensuring supply of agent for sound signal means with no condensate.

11. Check of proper construction of appliances for hoisting portable signal means (refer to Section 6 of this Appendix).

12. Check of proper structure and safety of appliances and devices for operation of pyrotechnical signal means, as well as their storage locations.

12.1 Availability on board shall be checked of special devices of sufficient size with a hole for the starting line to operate rocket parachute flares, which are permanently fixed on the bulwark or guard railings of the navigation bridge; also for the storing of the pyrotechnic signal means availability of special watertight metal lockers built into the deckhouse on the navigation bridge, or a metal box firmly secured on the bridge deck, shall be checked.

SURVEY OF SIGNAL MEANS DURING MOORING AND SEA TRIALS OF SHIPS

1. Preparedness of electric signal means for ready operation.

1.1 The navigation lights shall be fitted at their regular locations, supplied by two feeders and be at all times ready for use in accordance with their designation.

1.2 The spare set of navigation lights shall be stored in a specially equipped light storage room or in special light lockers in assembled and good condition, and be ready for fitting and use as specified.

1.3 During mooring trials, documents (certificates, form records, passports) for signal means of spare set confirming the Register technical supervision of their manufacture under RS Nomenclature shall be checked.

1.4 Provision of ships with a spare set of lights and spare parts shall be as per the ship group (refer to 1.4, 2.2.5, 2.2.6 and 2.3.4, Part III "Signal Means" of the Rules for the Equipment).

2. Proper operation of visual-and-sound signals of navigation lights.

2.1 Visual signals shall be tested with supplying devices of the shield and lights switched on.

Depending upon the accepted design, the characteristics of proper operation are as follows: burning of signal lamps, actuation of blinker relay and absence of sound signal.

2.2 With putting the switch (pressing the button) in the "control" position, sound alarms of the lights being tested shall start functioning simultaneously with visual signals.

2.3 When simulating a damage in the light circuit by removing the lamp or by disconnecting the plug-and-socket connector, the acoustic and visual signals shall start functioning indicating the circuit failure.

2.4 When simulating the failure of power supply of the navigation lights using the power circuit breaking, the sound signals shall be supplied with power and be supplied and operated from another power source.

3. Possibilities of replacing the stationary navigation lights with spare ones.

3.1 Possibilities of replacing the stationary navigation lights with spare ones shall be tested by a random replacement of lights (trial replacement of basic side lights with spare ones is required where the spare lights are not stationarily fixed). The adequate horizontal and vertical sectors of visibility of spare lights as specified in the Rules for the Equipment shall be checked.

4. Survey in operation of hoisting devices for non-stationary navigation lights.

4.1 Availability of suitable devices for hoisting and lowering navigations lights not fitted stationary shall be checked. Such devices shall be so constructed as to ensure the correct and stable positions of the lights when hoisted to their regular positions. The adequate horizontal and vertical sectors of visibility as specified in the Rules for the Equipment shall be checked.

5. Availability and possibilities of operation of basic and spare set of navigation lights and flashing lights and specified power supply sources.

5.1 During mooring and sea trials of electric navigation lights and flashing lights the following shall be checked:

.1 insulation resistance of each feeder with power supply sources switched off at the beginning and at the end of the trials;

.2 cable switching in, as specified in the drawing of connections, availability of markings;

.3 reliability of contact connections, protective and sealing coatings of cable ends, conformity of links of power safety fuse of prototype lamps;

.4 testing of the whole scheme in operation (burning of the lights from both power supply sources during the time sufficient to be convinced of the reliability of the lights in operation), operation of switches, alarms and all commutation devices;

.5 acoustic and visual alarms on the navigation light shield warning of any light failure. In this case acoustic alarms shall function automatically when switched on, warning of any navigation light failure. Power for acoustic alarms shall be supplied from a source or feeder other than the source or feeder supplying power for navigation light shield or accumulators;

.6 burning of spare navigation lights from the specified source of light. In case of power supply from accumulators, the discharge current, voltage dropping on all the feeders (for the prototype ship only) shall be checked;

.7 manoeuvring lights with manual and automatic actuation, where such actuation is specified. Stable operation of automatic controls, manoeuvring lights automatic cutting-off when changing-over the whistle mechanism to manual or automatic actuation shall also be checked;

.8 the daytime signaling lamp in operation when power supplied from the ship's mains and from the emergency source of electrical power during at least 15 min. It shall be stored in the rudder or chart house and be at all times ready for use.

6. During mooring and sea trials of whistle electric mechanisms the following shall be checked:

.1 insulation resistance of cable and equipment scheme, cable switching in, as specified in the connection scheme, availability of markings, reliability of contact connections, availability of protective and sealing coatings of cable ends, protection of feeders, protective earthing of apparatus;

.2 operation of switches, alarms, commutation devices;

.3 operation of whistle electric mechanism with manual and automatic actuation under the specified programs. Duration of signals, intervals and full cycles in automatic actuation shall be measured;

.4 possibility of providing for manual actuation of signals with automatic cutting-off of the automatic controls at the moment of manual actuation;

.5 flashes sent simultaneously with whistle electric mechanism sounding;

.6 whistle electric mechanism cutting-off at the moment of manual actuation of manoeuvring light;

.7 operation of electric heating devices.

15 RADIO EQUIPMENT

15.1 GENERAL

15.1.1 The provisions of this Section shall apply during technical supervision of the radio equipment of ships listed in the RS Nomenclature.

15.1.2 The Section contains the requirements for technical supervision of the radio equipment in the course of ship construction.

15.1.3 General provisions of organization of technical supervision of ship construction are specified in Part I "General Regulations for Technical Supervision" and of technical documentation, in Part II "Technical Documentation" of the Rules for Technical Supervision.

15.1.4 Technical documentation.

15.1.4.1 Installation and testing of radio equipment on board the ship shall be performed under the Register technical supervision according to the RS-approved technical documentation.

15.1.5 Technical supervision of the Register.

15.1.5.1 Surveys during installation and testing of radio equipment shall be performed according to the examination and testing plan developed by the shipyard according to 15.2.1, taking into account 15.3 and 15.4.

15.1.6 Tests and checks specified in this Section are based on an assumption that the radio equipment has been tested at the firm (manufacturer) in compliance with the requirements of Section 15, Part IV "Technical Supervision during Manufacture of Products" of the Rules for Technical Supervision.

In case some tests were not conducted at the firm (manufacturer) and it is confirmed by an entry in the RS certificate, then these tests shall be conducted.

Additional checks and tests may be assigned by the surveyor upon results of examination of the radio equipment in substantiated cases.

15.2 SURVEY PLANNING

15.2.1 Prior to commencement of survey of the radio equipment of the ship under construction, the RS Branch Office shall agree the examination and testing plan for radio equipment developed by the shipbuilder taking into account the RS Nomenclature and 15.3 and 15.4. The shipbuilder shall be informed about that at a kick off meeting prior to commencement of construction according to 1.7.1.

The builder shall agree to undertake ad hoc investigations during construction as may be requested by RS where areas of concern arise and the builder to agree to keep RS advised of the progress of any investigation. Whenever an investigation is undertaken, the builder shall be requested, in principle, to agree to suspend relevant construction activities if warranted by the severity of the problem.

15.2.2 During approval and agreement of the examination and testing lists a note shall be taken of specific published Administration requirements and interpretations of statutory requirements.

15.2.3 The shipyard shall be requested to advise of any changes to the activities agreed at the kick off meeting and these shall be documented in the examination and testing plan. E.g. if the shipbuilder chooses to use or change sub-contractors, or to incorporate any modifications necessitated by changes in production or inspection methods, rules and regulations, structural modifications, or in the event where increased inspection requirements are deemed necessary as a result of a substantial non-conformance or otherwise.

15.2.4 Quality standards for installation and testing of the radio equipment shall be reviewed and agreed during the kick-off meeting. The work shall be carried out in compliance with the RS rules and under the RS technical supervision.

15.2.5 Any changes to the kick-off meeting records shall be agreed and documented.

15.3 SURVEY DURING INSTALLATION AND CABLING

15.3.1 Installation and cabling of the radio equipment shall be carried out in compliance with the RS-approved technical documentation, the following shall be checked:

- .1 special spaces where the arrangement of the radio equipment is provided;
- .2 sources of power and cabling;
- .3 operational (high frequency) earthing;
- .4 arrangement and installation of the radio equipment.

15.3.2 In the course of surveys of spaces for the radio equipment and its installation the following shall be checked:

- .1 arrangement of the radio equipment, passages in the space, provision of doors, means of access and exits and also emergency ones;
- .2 main and auxiliary equipment, power and charging boards, to control stations are readily accessible;
- .3 radio equipment, power sources and auxiliary equipment are securely fastened by clamps, brackets or bolts;
- .4 lighting, ventilation and heating in spaces for the radio equipment and accumulator battery rooms.

15.3.3 In the course of surveys of the radio equipment cabling, the following shall be checked:

- .1 laying, fastening and passing of cables through watertight decks and bulkheads, provision of packing appliances;
- .2 proper cable brands and cross sections in compliance with the drawings;
- .3 proper disjunction, splicing, contact and protection terminals, connection, and jointing of cables;
- .4 compliance with the minimum internal bending radii of cables;
- .5 condition of external cable sheathings;
- .6 strength of soldering or squeezing of cable terminals to cable cores;
- .7 proper cable length available at the lead-in into the apparatus;
- .8 absence of coaxial cables in the same cable package, cable run, cable suspension, etc. with power and lighting cables;

.9 insulation resistance of every laid cable disconnected at both ends from the radio equipment shall be not less than 20 MOhm irrespective of the cable length;

.10 proper continuity screening of cables and aerial feeders and also special sheathings and pipe linings when used as means of mechanical protection or screens.

15.3.4 During surveys of operational (high frequency) earthing of the radio equipment within the interior of spaces, the following shall be checked:

- .1 reliability of electrical connection of copper busbar and aerial commutator (if any) to a metal bulkhead or deck electrically connected to the ship's hull;
- .2 compliance of the cross sectional area of copper busbars and tapplings leading to earthing terminals of transmitters with the copper busbar length run from the radio equipment to the place where connection with the bulkhead or deck is effected;

Table 15.3.4.2

Power of transmitter, in W	Busbar sectional area, in mm ²
Below 50	25
50 to 500	50
Above 500	100

.3 places of connections are thoroughly cleaned;

.4 reliable earthing of metal guards and leads-in aerials;

.5 reliable earthing of filter cases, screening cases and waveguides pipes, cases of various instruments, etc. The total resistance of all protecting connections of any earthing shall not exceed 0,02 Ohm.

15.3.5 In the course of surveys of leads-in and interior wiring of aerials, the following shall be checked:

- .1 compliance of insulators with operational voltages of the transmitters;
- .2 reliability of fastening of insulators and protective lead-in casings, inner painting of casings, ready accessibility of aerial lay-out;
- .3 possibilities of removing the condensate from protection casings or inner cavities of hollow mast-type aerials;
- .4 possibilities of easy and ready connection and disconnection of the leads-in of the transmitting aerials;

- .5 reliability of fastening all the aerial and feeder devices;
- .6 proper aerial commutation;
- .7 insulation resistance which in relation to the ship's hull under normal climatic conditions shall be not less than 10 MOhm, and under excessive humidity — not less than 1 MOhm (for MF/HF aeriels the recommended values: 50 MOhm and of 5 MOhm accordingly);
- .8 provision of aerial and feeder screening devices, commutators and change-over switches;
- .9 watertight leads-in of aerial and feeder devices;
- .10 adequate distance of aerial from metal objects;
- .11 protection from the mechanical damage likely to occur;
- .12 necessary guarding against the possibility of accidental touching of the transmitting aeriels;
- .13 proper connection of wire aeriels to down lead wire aeriels.

15.3.6 Installation and connection of radio equipment shall be, as a rule, performed on the completion all the work including welding, insulation and finishing or spaces.

15.3.7 Upon completion of the fitting and installation of the total set of radio equipment, the following shall be checked:

- .1 no mechanical damage and indents of the main and auxiliary radio equipment;
- .2 clean contact surfaces;
- .3 smooth functioning of all the controls;
- .4 smooth and efficient operation of drop and sliding frames, removable panels, doors and their reliable securing;
- .5 availability of measuring instrument or light indication for continuous monitoring of the ship's mains voltage, compliance of name plates on distribution boards with the kinds of the radio equipment connected thereto;
- .6 adequate lighting of the controls of the radio communication facilities, working place of the radio operator;
- .7 proper location of emergency lighting and switches, plug sockets, availability of markings designating the places where this equipment is fitted;
- .8 proper mounting and easy use of marine clocks;
- .9 proper arrangement of the furniture, equipment, spare parts and supplies;
- .10 provision of a plate with the call sign of the ship, the ship station identity;
- .11 noise level produced by external sources in the places where radio equipment is fitted.

15.3.8 During surveys of the radio equipment on the navigation bridge, its arrangement, convenience of maintenance, protection against harmful effects of water and extremes of temperature, sufficiency of illumination, safe distance to the magnetic compasses shall be checked.

15.3.9 The scope and procedure of surveys of the radio equipment, lighting, heating and ventilation arranged in the accumulator battery room are laid down in Sections 8 and 10.

15.3.10 The procedure of survey of the radio equipment distribution boards shall comply with Section 10.

15.3.11 The distribution board of the radio equipment shall be checked to ascertain the availability of switching and protective equipment, the compliance of their rated values with those of the voltage and current of the connected radio equipment.

15.4 SURVEY DURING MOORING AND SEA TRIALS

15.4.1 After its fitting and adjustment all radio equipment shall be subjected to mooring and sea trials under the programs approved by the Register. Main requirements for the contents and scope of the program are set forth in Section 18.

15.4.2 Mooring trials are carried out with the purpose of ascertaining the proper functioning of the radio equipment in conjunction with other apparatus.

15.4.3 In the course of testing the replacement of changeable components (fuses, signalling and lighting lamps) allowed without any repeating of the previous checks of the radio equipment unless the replacement requires its additional adjustment.

15.4.4 The list of documents to be submitted prior to trials, the procedure of trials, necessary conditions of their performance, and also the procedure of issuing the documents are specified in Section 18.

15.4.5 During mooring trials, the documentation and list of radio equipment shall be checked including:

- .1 correspondence of the serial number of a product to that indicated in the RS certificate for a serial product, availability of the RS type approval for the product or another document required by the Administration, which

confirms that the radio equipment fitted meets the requirements of Part IV "Radio Equipment" of the Rules for the Equipment and the appropriate IMO resolutions;

.2 availability on board of the valid ship station radio license issued by the Administration with the call-sign and MMSI, the date of license issue and its period of validity specified;

.3 availability on board of the contract for the shore-based maintenance by the firm possessing the RS Recognition Certificate (where the equipment operability is provided by the shore-based maintenance and repairs);

.4 inspection of tools, spare parts and testing equipment;

.5 availability on board of operating instructions for all the radio equipment;

.6 availability of service logs for the GMDSS radio equipment, in absence of these logs, the relevant equipment performance logs;

.7 correspondence of the list of the GMDSS equipment fitted on board to that specified in the RS-approved technical documentation (project) for the installation of such equipment;

.8 availability of reports on programming, mounting, and starting up and adjustment of the GMDSS equipment.

15.4.6 In addition to 15.3.2.1 – 15.3.2.4, examination of spaces where radio equipment is fitted includes checking of:

.1 availability of the clock, plans with procedures for ships' response to DSC distress signal, plates with the ship's name, its call sign, MMSI, the INMARSAT ship earth station identity, the radioteletype number fitted in a conspicuous place in the immediate vicinity of the controls of the communication facilities equipment;

.2 electric lighting of the spaces and radio installation controls;

.3 heating and ventilation.

Note. INMARSAT is the Organization established by the Convention on the International Maritime Satellite Organization (INMARSAT) adopted on 3 September 1976. Since 9 December 1994 International Mobile Satellite Organization.

15.4.7 Checking of the radio equipment functioning and operability includes the following:

.1 operational testing using the integrated control system (in so doing, operating instructions and recommendations of the equipment manufacturers shall be used);

.2 operational testing from the operator's work place;

.3 operational testing from the remote-control panels;

.4 checking of operability when supplied from the main, emergency and reserve sources of power, including the check of the transition signaling, absence of necessity of the manual restart and loss of the information stored in the radio equipment memory at transitions;

.5 checking of operability when supplied from accumulators or galvanic cells integrated in the radio equipment.

15.4.8 Visual examination in checking the radio equipment shall include the following:

.1 visual examination of the outside of the shipboard communication facilities, earthings, screening of the equipment cables;

.2 check of the condition of controls and alarms on the front panels of apparatus;

.3 check of smooth running and precise fixing of controls;

.4 internal examination of apparatus, where necessary, (condition of internal wiring, panels, connectors, etc. shall be checked);

.5 check of aerials condition and high-frequency feeders. The construction and wiring shall be free of any mechanical damages. When examining whip aerials, attention shall be drawn to the condition of base insulators and painting quality;

.6 check of reliability of connection of the precaution guards of the aerial leads-in to the ship's hull;

.7 check the sag of the wire aerial (if any), which shall not exceed 6 % of the aerial length. The aerials horizontal separation from ship's metal parts shall be at least 1 m (for the MF/HF band) and 2 m (for the VHF band);

.8 check of cleanliness of the surface of accumulator jars and racks for accumulator batteries (no rust is allowed), of the absence of oxides on clamp connections. The contacts of accumulator batteries shall be tightened up.

15.4.9 Survey of radar transponder.

15.4.9.1 Where the RS-recognized service suppliers performing the tests of radar transponders are available in the area of the RS Branch Office activities, these suppliers shall be enlisted in checking the radar transponders.

15.4.9.2 Procedure for checking the technical condition and operability of radar transponders.

15.4.9.2.1 Checking of the radar transponder documents includes the check of the following:

.1 keeping records on the technical condition of radar transponders in a service log or an equipment performance log;

.2 the availability of a report-record on checking the radar transponder by the RS-recognized firm;

.3 an entry in the product service log or the report-record on the date of the next replacement of the battery by the RS-recognized firm. The accumulators or galvanic cells used as the radar transponder power source shall have the shelf life of at least two years and be replaced when the storage time left is less than 12 months.

15.4.9.2.2 External examination includes the checks of the following:

- .1 the radar transponder location and the availability of the IMO symbol "Radar transponder", as well as its ready accessibility;
- .2 the case integrity, painting quality and absence of mechanical damages;
- .3 availability of protection of the radar transponder against an inadvertent operation;
- .4 availability and attachment of a buoyant lanyard suitable for use as a tether until the radar transponder is an integral part of a life-saving appliance;
- .5 availability and condition of a brief operating instruction on the radar transponder body;
- .6 availability of markings on the containers for storage of radar transponders or on the very transponders, which contain the entries on the date of the next replacement of the battery or on its expiry date;
- .7 availability of a pole or another means for installing the radar transponder in life-saving appliances at a height of at least 1 m above the sea level.

15.4.9.2.3 The check of the radar transponder operability comprises its check under self-testing conditions and also the check with the use of a 3 cm radar. To check the radar transponder operability, it is necessary:

- .1 to force it into a test mode using the operating instruction marked on its outside;
- .2 the ability factor of the radar transponder in the test mode: a visual and/or an audible alarm shall be activated depending on the design details of the specific type of the radar transponder. The alarm characteristics shall be defined in the technical description for the product;
- .3 to switch off the radar transponder, using the operating instruction.

15.4.9.2.4 To check the radar transponder operability with the use of the ship's 3 cm radar (the check may be ignored if the document on checking the radar transponder by a competent body possessing the RS Recognition Certificate, is available), it is necessary:

- .1 to check the range, the distance between the transponder and the ship's radar shall be 5 sea miles;
- .2 the radar transponder may be checked on board ship if placed within the zone of the directional diagram of a radar aerial (e.g. on a bridge wing). In this case, the transponder shall be held vertically overhead during tests;
- .3 to switch on the ship's radar and radar transponder;
- .4 the ability factor of the radar transponder: radar transponders replies as 12 points (arcs) shall be displayed on the radar display unit. If the number of points is not equal to 12, the range scale of the radar display unit shall be changed to the larger one to get all the 12 replies;
- .5 to switch off the radar transponder and ship's radar.

15.4.10 Survey of COSPAS-SARSAT emergency position indicating radio beacon (EPIRB-406).

15.4.10.1 After manufacture, COSPAS-SARSAT EPIRBs shall be subjected to an annual survey and shore-based maintenance (once in five years) in the RS-approved specialized firms.

Note. COSPAS-SARSAT is an international search and rescue system using polar orbitary satellite service for ships and aircraft in distress.

15.4.10.1.1 Procedure for checking the EPIRB-406 technical condition and operability. Checking of documents comprises the check of the following:

- .1 availability and the period of validity of the documents on EPIRB-406 registration;
- .2 an entry in the product service log or the report-record on the EPIRB last check by the RS-recognized firm. The EPIRB check with the measurement of main parameters shall be carried out by competent bodies, possessing the RS Recognition Certificate, at least once a year; the automatic releasing arrangements of free-floating satellite EPIRBs shall be checked at least once in two years;
- .3 an entry in the product service log or the report-record on the date of the next replacement of the battery by the RS-recognized firm. The galvanic cells used as the EPIRB power source shall have the shelf life of at least two years and be replaced when the storage time left is less than 12 months.

15.4.10.1.2 External examination comprises the check of the following:

- .1 the EPIRB-406 location and the availability of the IMO symbol "EPIRB", as well as its ready accessibility;
- .2 casing integrity, painting quality and absence of mechanical damages;
- .3 availability of the EPIRB-406 protection against an inadvertent operation;
- .4 availability and attachment of a buoyant lanyard suitable for use as a tether;
- .5 availability and condition of a brief operating instruction on the EPIRB casing;
- .6 availability of markings on the containers for EPIRB storage and on the EPIRB outside (on a nameplate), which contain the entries on the date of the next replacement of the battery or on its expiry date;
- .7 availability of markings on the date of the next replacement or on the expiry date of the automatic releasing arrangement of free-floating EPIRB-406;
- .8 availability of an identity code on the EPIRB-406 casing;

- .9 availability of a serial number on the EPIRB-406 casing;
- .10 availability of stripes of retroreflecting material on the EPIRB-406 casing.
- 15.4.10.1.3** The check of EPIRB-406 operability:

.1 check the EPIRB operability under self-testing conditions. Force it into a test mode using the operating instruction;

.2 the ability factor of the EPIRB in the test mode is a visual alarm (flashing of an indicating lamp). The flashing mode depends on the design details of the EPIRB specific type; the alarm characteristics shall be defined in the technical description for the product;

.3 following the above check, the EPIRB fitting on its bracket shall be examined assuring that the beacon is not on the air.

15.4.11 Survey of NAVTEX receiver. Procedure for checking the technical condition and operability of NAVTEX receiver:

.1 switch on the NAVTEX receiver. Self-testing conditions are activated automatically. The ability factor of the NAVTEX receiver shall be determined in compliance with an operating instruction;

.2 if the receiver has an integral loudspeaker, the latter shall be switched on for listening the receiver. The ability factor of the receiver: noise and signals heard in the loudspeaker;

.3 where a printer is available, its operability shall be checked under self-testing conditions. Select test conditions for the printer. The ability factor of the printer: the latter is printing a set of alphabetic characters;

.4 check the operability of a paper-moving device. Its ability factor: paper moving;

.5 check the functioning of a brightness control;

.6 check the list of selected stations. The list shall include at least one of the stations in each of the areas covered by the NAVTEX service messages. (The position of the stations and their operating schedule are given, e.g. in GMDSS Master Plan IMO, Annex 7. These publications are regularly updated);

.7 check the operability of software. Check the software using an operating instruction. The ability factor: a printout or an indication on a display of the check results;

.8 check the operability of an integral battery. Remove the paper from the printer. Tune the receiver to the reception of all stations. Following the receipt of messages and their retention in the NAVTEX receiver, power shall be turned off for 5 — 10 min. Insert the paper and turn on power. The ability factor: the message stored in the device memory shall be printed with the printer.

Note. International NAVTEX Service is the coordinated broadcast and automatic reception on 518 kHz of maritime safety information by means of narrow-band direct-printing telegraphy using the English language.

15.4.12 Survey of two-way VHF radiotelephone apparatus. Procedure for checking the technical condition and operability of two-way VHF radiotelephone apparatus.

15.4.12.1 Checking of documents includes:

.1 check of documents in compliance with 15.4.5.1 (an intrinsically safe enclosure of equipment confirmed by the appropriate certificate of the competent laboratories shall be checked on oil tankers, ore/oil carriers, oil/ bulk dry cargo carriers, gas carriers and chemical tankers);

.2 check of location of the two-way VHF radiotelephone apparatus and of the availability of the IMO symbol "Survival craft radio station".

15.4.12.2 External examination comprises the check of the following:

.1 the integrity of casing and gadgets for attaching the apparatus to clothes;

.2 availability of an operating instruction on the casing;

.3 painting condition (the product shall either be painted canary/orange or have a canary/orange marking stripe around it);

.4 availability of the dedicated primary battery for use in distress if the apparatus is intended for use with a power source to be replaced by user. Such primary battery shall have the storage period of at least two years, be designed so as to indicate that it was not used, and be painted or marked according to 15.4.12.2.3. The expiry date of the battery shall be indicated on its outside;

.5 if the apparatus is intended for use with a power source which is not replaced, the former shall be provided with the primary battery. In this case, the two-way VHF radiotelephone apparatus shall be de-signed so as to indicate that the battery was not used;

.6 availability of the expiry date of the primary battery on the outside of the apparatus;

.7 operation of a charging device if rechargeable batteries are used.

15.4.12.3 In order to check operability, it is necessary to:

.1 switch on the apparatus. The ability factor: light indication of switching-on;

.2 check the operability of a volume control. The ability factor: change of a loudness level;

.3 check the operability of a squelch control. The ability factor: sudden change of a noise level shall be heard with the change of a squelching level;

.4 check the operability of a channel selection switch, and the opportunity of quick selecting 16 channel. The ability factor: when switched on, the apparatus shall automatically tune in the 16 channel and the switching over of the alive apparatus to the 16th channel shall be possible with a single action pressing button "16";

.5 check the operability of the mode of the power level reduction (down to 1 W and below), and of the indication mode;

.6 check the operability of the VHF apparatus in the checking communication mode. The apparatus shall ensure the operation on the 16 channel and, at least, on one additional channel. Switch on two radio stations on the 16 channel and establish communication within a ship in a simplex mode; select another channel on the radio stations to identify the channels inoperative in the receive and transmission modes. The power level reduction mode shall be used in the checking communication.

15.4.13 Survey of INMARSAT ship earth station. Procedure for checking the technical condition and operability of INMARSAT ship earth station.

15.4.13.1 Examine the station externally according to 15.4.8.

15.4.13.2 Check of the INMARSAT ship earth station (Standard C) operability includes check of the following:

.1 the station operability and the authenticity of the information received in the loopback mode of a communication line in transmitting the checking message which shall be prepared as follows: compose the message in a text field using an operating instruction; enter the address of a message recipient taking its own station as the called one and using the identity of the ship being surveyed, and enter it in an address book. Select the transmission mode "Routine" and transmit the message. The ability factor: the reception of the message transmitted in about 5 min. Check the authenticity of the information received by comparing the transmitted and received messages;

.2 the station operability and the authenticity of the information received in the enhanced group calling (EGC) mode, which are checked by scanning the messages in an electronic log book according to the operating instruction. The next scheduled time of the NAVAREA messages transmission shall be selected (the schedule of transmissions is given, for example, in Inmarsat Safety Net Handbook; Admiralty List of Radio Signals, vol. 5; GMDSS Plan IMO, Annex 8). Program the EGC receiver in accordance with the operating instruction. The ability factor: the reception of NAVAREA messages. Scan the safety navigation messages received, which are available in the ezine, using the operating instruction;

.3 opportunity of transmitting a distress alert from the location generally used for conning, as well as from any other location intended for transmitting the distress alert;

.4 absence of necessity to manually repeatedly put the equipment in an operating mode and to retain the messages received and stored in the station memory at power supply broken off up to 60 s;

.5 the station operability with a reserve power source. In this case, a main (emergency) power source shall be switched off.

15.4.14 Survey of command broadcast apparatus. Procedure for checking the technical condition and operability of command broadcast apparatus.

15.4.14.1 The external examination shall comprise the examination of the main and remote microphone posts, remote loudspeakers. The microphone posts and commutators on the open deck shall be enclosed. Where the command broadcast apparatus is combined with the general purpose broadcasting unit intended for transmitting sound-recording programs and general radio broadcasting, the loudspeakers fitted in the ship's accommodations shall have volume controls.

15.4.14.2 Check of operability includes check of the following:

.1 the command broadcast apparatus. The communication of a wheelhouse with all posts shall be established selectively or circularly in any combination. The ability factor: the sound level of orders reproduction in all service and public spaces, as well as on open decks shall exceed the noise level by at least 20 dB, i.e. the normal speech intelligibility shall be ensured. Where the command broadcast apparatus is combined with the broadcasting unit intended for transmitting general radio broadcasting and sound-recording programs the priority of the loud-speaking communication and command broadcast shall be checked;

.2 the opportunity to control the command broadcast apparatus from any command microphone post. The ability factor: all kinds of control (starting, switching off, switching of transmission lines, starting of forced broadcasting systems) shall be carried out remotely from any command microphone post. A visual alarm shall be activated when the command broadcast apparatus is started. The acoustic monitoring of an audio quality in each transmission line shall be carried out from the main command microphone post;

.3 the apparatus operation from an emergency transitional energy source, if any. The main (emergency) power source shall be switched off.

15.4.15 Survey of VHF radio installation. Procedure for checking the technical condition and operability of the VHF radio installation.

15.4.15.1 Examine the installation externally according to 15.4.8.

15.4.15.2 Check of the VHF radio installation operability:

- .1 switch on the radio installation;
- .2 check the correspondence of the DSC number entered with the number specified in a ship station radio license;
- .3 check the input of position data in an automatic and a manual mode. The ability factor: the ship's latest position entered and the time of that positioning shall be displayed.
- .4 check the time setting;
- .5 check the set of channels and the urgent call mode on the 16/9 channels;
- .6 check the scanning of channels;
- .7 check the mode of transmitter power reducing;
- .8 check the operation of a squelcher;
- .9 check the change of display illumination;
- .10 check the operability of a DSC encoder facility and DSC watchkeeping facility in the feedback loop "DSC controller — transceiver — DSC equipment — DSC controller" under self-testing conditions using an operating instruction;
- .11 check the authenticity of the information received by controlling the VHF radio installation operability, while on air in the DSC mode, using the MENU in the "Test call" mode by means of a check session with the coast radio station from the list of the stations stored in the DSC controller or from the list of the stations in ITU List of coast stations, Admiralty List of Radio Signals.

15.4.16 Survey of MF/HF radio installation. Procedure for checking the technical condition and operability of MF/HF radio installation.

15.4.16.1 Examine the installation externally according to 15.4.8.

15.4.16.2 Check of radio installation operability:

- .1 switch on the radio installation. When switched on, the radio station shall go to a receive mode;
- .2 check the adjustment of the display illumination;
- .3 check the operability of the following transmitter controls: the aerial attenuator switching-on, mode of emission/change of power level (in this case, the power level selected is controlled by the readings of a power level indicator), radio exchange mode setting in distress (on the frequency 2182 kHz). Check the aerial current by a current indicator (checking shall be carried out on the frequency 2182 kHz or the frequency specified in an operating instruction);
- .4 carry out the internal examination of the DSC facility off the air using an operating instruction. The operability of the principal blocks of the radio installation shall be checked in this mode. The ability factor indication of the examination results on the display;
- .5 check the range and the authenticity of the information received by means of a test call to the coast radio station (if the rules of the berth permit the use of MF/ HF transmissions). In order to check the range and the authenticity of the information received in establishing communication in the HF band, select a coast radio station, located at a distance of 1000 miles and more from the ship;
- .6 check the radio installation operability, range and the authenticity of the information received in the DSC, radiotelephony and narrow-band direct printing (for HF radio installation only) modes. In order to check the MF radio installation range and the authenticity of the information received, select a coast radio station, located at a distance of up to 100 sea miles from the ship, and originate a call on the DSC frequency in the MF band (2187,5 kHz). The information on the schedule of radio stations operation may be found, for example, in Admiralty List of Radio Signals, vol. 5, Sea Area A2;
- .7 check the MF/HF radio installation operability from the reserve power source. Switch off the main (emergency) power source.

15.4.16.3 Check of radioteleprinter HF receiver operability for bringing in the information on navigational safely (if any being part of the MF/HF radio installation):

- .1 check the operability, range and the authenticity of the information received of the radioteleprinter HF receiver for bringing in the information on navigation safely;
- .2 check the operability of the receiver, signal processing unit, printing device and automatic frequency tuning device using a self-test system, if any, and an operating instruction;
- .3 check the integrity of information on servicing areas and the types of messages stored in equipment when supply voltage is lost for a time period of 6 h;

.4 check the operability of the navigational information HF receiver during tuning in the maritime safety information with the use of an operating instruction, in accordance with the schedule of radio stations operation. The information on the schedule of radio stations operation of the system for transmitting the maritime safely information may be found, for example, in GMDSS Master Plan (Annex IX). The broadcasts may be brought in with the ship's radioteleprinter HF receiver tuned to the system frequencies 4210; 6314; 8416,5; 12579- 16806 5- 19680 5- 22376 and 26100 kHz in accordance with the schedule of radio stations operation.

15.4.17 Survey of charging device and reserve source of supply. Procedure for checking the technical condition and operability of the charging device and reserve source of supply.

15.4.17.1 Examine externally according to 15.4.8.

15.4.17.2 Where accumulator batteries are maintenance-free, the date of their replacement shall be checked.

15.4.17.2.1 The equipment shall be located so that ready access for its examination and maintenance may be ensured, the equipment components (wiring and cabling inclusive) shall be arranged and laid so as to prevent their accidental damage.

15.4.17.2.2 The cases of all equipment shall have earthing terminals.

15.4.17.2.3 15.4.17.2.3 The information on a firm (manufacturer), serial number, the type of equipment shall be clearly indicated on the outside of equipment blocks.

15.4.17.2.4 To be checked are the following:

.1 reliability of accumulator batteries securing;

.2 cabling condition;

.3 condition of ventilation, heating and lighting in an accumulator battery room;

.4 availability of an operating instruction for accumulator batteries;

.5 availability of a warning on the door of the accumulator battery room;

.6 density and level of electrolyte in accumulator battery jars (cells);

.7 availability of the sufficient quantity of electrolyte and distilled water, of an areometer, a measuring tube, an accumulator tester, other inventory needed for maintaining the accumulators; documents that the net capacity of accumulator batteries was checked in port within the last 12 months, using the high discharge method, by the competent body possessing the RS Recognition Certificate.

15.4.17.2.5 Check of operability:

.1 switch off the main (emergency) source of power supply;

.2 hook up the reserve source of power supply;

.3 check the operability of an audible and visual alarm system from the general conning position on changing over to the reserve source of power supply. Switch off the main source of power supply from the GMDSS radio equipment console. The ability factor: activation of the audible and visual alarm on changing over to the reserve source of power supply. Switch off the audible alarm and check that the visual alarm is still on (the visual alarm shall fade out only when the main source of power supply is hooked up);

.4 check that all the main equipment can be switched on and is in proper condition;

.5 check the accumulator battery voltage by its measurement in compliance with the operating instruction for this type of batteries;

.6 check the functioning of the charging device. Switch on the battery for discharging via an artificial load or test it using an accumulator tester, and switch on the charging device in an automatic mode after discharging. The factor of a state of operability: the charging device shall automatically be switched on for charging and the current during that period shall not change (but may change when the charging device is functioning in a buffer mode).

15.4.18 Survey of the ship security alert system. Procedure for checking the technical condition and operability of the ship security alert system.

15.4.18.1 Check the ship security alert system for completeness (in particular, the system compliance with the items specified in the RS Type Approval Certificate, which copy shall be provided with the system at the ship's delivery).

15.4.18.2 Check the correctness of mounting in accordance with the RS-approved technical design.

15.4.18.3 Check the correctness of programming the addressees of a report which shall be carried out and submitted to the RS surveyor by the specialist of the firm fitting the system in question.

If a shipowner fails to ensure the presence of the specialist, who mounted and programmed the equipment, during surveying the system, the RS attending surveyor shall be provided with a report compiled and signed by that specialist which shall contain the results of works on mounting the equipment, as well as the report addressees, stated by the Administration, programmed by that specialist on the completion of mounting.

15.4.18.4 Check the functioning of the ship security alert system by sending a test message. In this case, using any accessible communication channel, it shall be made sure that the test message has been delivered to the programmed address.

15.4.19 Survey during sea trials.

15.4.19.1 Sea trials are carried out to finally check the operability of radio equipment in the real-life environment.

15.4.19.2 In addition to the required in 15.4.9 — 15.4.18, the check during sea trials includes check of the following:

- .1** opportunity of establishing communication with operating radio stations in all modes;
- .2** interaction of navigational devices and arrangements with radio equipment;
- .3** transition to doubling equipment if the main one fails;
- .4** the audible and visual alarm of radio equipment.

15.4.19.3 The checks specified in all paras of this Section shall be applicable to a ship.

15.4.19.4 On ships of a series, the single types of radio equipment tests under running conditions may be replaced (if agreed with the RS Branch Office in charge of the technical supervision during the ship's construction) by the RS-approved simulation tests during the mooring trials (refer to Section 18).

15.4.19.5 All the equipment deficiencies revealed during the mooring and sea trials shall be eliminated prior to issuing the Register ship's documents.

15.4.20 Completion of ship's construction.

15.4.20.1 Following the ship's construction, the technical and operational documents shall be updated and the relevant service logs and certificates shall be completed.

15.4.20.2 Where necessary, spare parts and supplies shall be replenished up to the maximum recommended by the firm (manufacturer).

16 NAVIGATIONAL EQUIPMENT

16.1 GENERAL

16.1.1 The provisions of the present Section apply in the course of technical supervision of the navigational equipment of ships listed in the RS Nomenclature.

16.1.2 The Section contains the requirements for technical supervision of the navigational equipment during ship construction.

16.1.3 General provisions on technical supervision during ship construction are specified in Part I "General Regulations for Technical Supervision", and of technical documentation — in Part II "Technical Documentation" of the Rules for Technical Supervision.

16.1.4 Technical documentation.

16.1.4.1 Installation and testing of navigational equipment on board the ship shall be performed under the Register technical supervision according to the RS-approved technical documentation.

16.1.5 Technical supervision of the Register.

16.1.5.1 Surveys during installation and testing of navigational equipment shall be performed according to the examination and testing plan developed by the shipyard according to 15.2.1, taking into account 15.3 and 15.4.

16.1.6 Tests and checks specified in this Section are based on an assumption that the navigational equipment have been tested at the firm (manufacturer) in compliance with the requirements of Section 16, Part IV "Technical Supervision during Manufacture of Products" of the Rules for Technical Supervision.

In case some tests were not conducted at the firm (manufacturer) and it is confirmed by an entry in the RS certificate, then these tests shall be conducted.

Additional checks and tests may be assigned by the surveyor upon results of examination of the navigational equipment in substantiated cases.

16.2 SURVEY PLANNING

16.2.1 Prior to commencement of survey of the navigational equipment of the ship under construction, the RS Branch Office shall agree the examination and testing plan for navigational equipment developed by the shipbuilder taking into account the RS Nomenclature, as well as 16.3 and 16.4. The shipbuilder shall be informed about that at a kick off meeting prior to commencement of construction according to 1.7.1.

The builder shall agree to undertake ad hoc investigations during construction as may be requested by RS where areas of concern arise and the builder to agree to keep RS advised of the progress of any investigation. Whenever an investigation is undertaken, the builder shall be requested, in principle, to agree to suspend relevant construction activities if warranted by the severity of the problem.

16.2.2 During approval and agreement of the examination and testing lists a note shall be taken of specific published Administration requirements and interpretations of statutory requirements.

16.2.3 The shipyard shall be requested to advise of any changes to the activities agreed at the kick off meeting and these shall be documented in the examination and testing plan. E.g. if the shipbuilder chooses to use or change sub-contractors, or to incorporate any modifications necessitated by changes in production or inspection methods, rules and regulations, structural modifications, or in the event where increased inspection requirements are deemed necessary as a result of a substantial non-conformance or otherwise.

16.2.4 Quality standards for installation and testing of the navigational equipment shall be reviewed and agreed during the kick-off meeting. The work shall be carried out in compliance with the RS rules and under the RS technical supervision.

16.2.5 Any changes to the kick-off meeting records shall be agreed and documented.

16.3 SURVEY DURING INSTALLATION AND CABLING

16.3.1 Installation of the navigational equipment on board shall be carried out in compliance with the approved technical design documentation and the equipment manufacturer technical documentation. In this case the following items shall be checked:

- .1 documents confirming the Register supervision at the firm (manufacturer) (prior to the installation of the navigational equipment);
- .2 completeness, arrangement and securing of devices;
- .3 easy access to devices;
- .4 protection of the equipment from intrusion of any foreign objects inside and from any occasional mechanical damage;
- .5 magnetic compass "safe distance" (for devices installed in the wheelhouse, refer to Appendices 1 and 2 to this Section);
- .6 quality of internal and external installation;
- .7 quality of protection earthing of apparatus cases and cable net laying in accordance with Section 10;
- .8 insulation resistance;
- .9 compliance with the special requirements specified by the equipment design as well as with the requirements laid down in the RS-approved documentation;
- .10 adjustment of the apparatus.

16.4 SURVEY DURING MOORING AND SEA TRIALS

16.4.1 After the completion of installation and adjustment work, all the navigational devices and appliances shall be made subject to mooring and sea trials under the programs approved by the Register and witnessed by a surveyor. The power supply to the navigational equipment shall be provided from the ship's mains.

16.4.2 Mooring trials shall be carried out with the purpose of ascertaining of proper functioning of the navigational equipment in cooperative operation with interfaced equipment. In the course of mooring trials, the following shall be carried out:

- .1 check of serviceability of the equipment devices and systems;
- .2 test of operation of the equipment operation control elements, alarm and interlocks systems;
- .3 tests of equipment functioning in the rated regime;
- .4 check of electric protection of apparatus in supply circuits from the ship's mains (if any) in accordance with the requirements of Section 10 "Electrical Equipment";
- .5 check of serviceability after every three breaks in the power supply from the ship's mains during 60 s. No breaking of software and no loss of essential data kept in the relevant data memory of the system shall occur;
- .6 check of electromagnetic compatibility of all the installed equipment in simultaneous operation. The most critical modes of the work of the equipment (the highest power consumed, interference; highest sensitivity, etc.) shall be chosen.

16.4.3 In addition to the above stated in 16.4.2, during mooring trials the following items shall be checked.

16.4.3.1 Magnetic compasses and transmitting heading devices.

16.4.3.1.1 At surveys during mooring trials of magnetic compasses and transmitting heading devices, the following shall be checked:

- .1 compass card is capable of free motioning in the conditions of inclination. The inclination of compass bowl at which the compass card retains horizontal position is not less than 10°, the free inclination of compass bowl with gimbal suspension is not less than 45°;
- .2 card stagnation;
- .3 serviceability of electric lighting from the main, emergency and self-contained (if any) sources of power;
- .4 transmission of readings from the main unit to repeaters (if any). The divergence shall not exceed $\pm 0,5^\circ$;
- .5 error signals for dismatching in electric remote transmission system of dial readings (if any);
- .6 two-way voice communication between the places where the standard compass is installed and the ship control station;
- .7 operation of the device for the magnetic compass deviation compensation;
- .8 operation in conjunction with other ship's devices (if any);
- .9 independent serviceability of the magnetic compass irrelevant of any source of power;
- .10 adjustment of the lightening for compass readings.

16.4.3.2 Receivers for a global navigation satellite systems or a terrestrial radionavigation systems.

16.4.3.2.1 At surveys during mooring trials of receivers for terrestrial radionavigation systems, the following shall be checked:

- .1 adjustment and operation in different modes;

- .2 operation of navigating, monitoring and signalling controls;
- .3 arrangement of aerials, non-availability of interference;
- .4 electrical protection of power supplying circuits;
- .5 insulation appliances and aerials earthing;
- .6 interface with other radio-and-navigational equipment;
- .7 operation as per direct designation for determination of the ship's position by means of terrestrial radio navigation stations.

When signals from the terrestrial radio navigation stations in the area of mooring and sea trials are not available, check of radio navigation receivers shall be carried out by the ship crew members during the ship's operation with the subsequent submission of the results received.

16.4.3.2.2 At surveys during mooring trials of receivers for a global navigation satellite systems, the following shall be checked:

- .1 such arrangement of radio navigation receivers aerials at which the reliable receipt of signals of the satellite constellation from any direction is provided;
- .2 serviceability of aerial blocks after water influence;
- .3 setting and operation in the standard and differential (if any) mode;
- .4 time of acquiring signals and acquiring coordinates;
- .5 accuracy of acquiring position in the static GPS mode and, for the combined receiver of the orbit global navigation satellite systems GPS and GLONASS:
 - in the standard mode;
 - in the differential mode;
- .6 warning of loss of position or mode indication;
- .7 frequency of position data update;
- .8 operation in conjunction with other radio and navigational equipment.

Note. Where no differential updating signals from controlling stations of marine differential subsystem are available in the area of mooring and sea trials, the check of the differential mode of receivers shall be carried out during the ship's operation with the subsequent submission of the results received.

16.4.3.3 Electronic plotting aids (EPA), automatic tracking aids (ATA) or automatic radar plotting aids (ARPA).

16.4.3.3.1 At surveys during mooring trials of radars and radar plotting aids (EPA, ATA or ARPA), the following shall be checked:

- .1 proper installation of the radar display unit and the antenna onboard;
- .2 serviceability of the radar equipment;
- .3 the radar shall be ready for operation within 4 min of being switched on (the "stand-by" position is provided after which the radar is set in the "switched-on" position within 15 s);
- .4 scan centering and fixed range marks, coincidence of variable range marker and fixed marks;
- .5 accuracy of target bearing with the help of an electronic bearing line;
- .6 synchronal and cophasal rotation of the antenna and scan on the display screen, scan rate;
- .7 operation of devices (if any) for anticlutter rain and anticlutter sea;
- .8 possibility of orientation of the display relative to the centerline of the ship and the true meridian;
- .9 functioning of the electronic plotting aids (EPA), auto tracking aids (ATA) or automatic radar plotting aids (ARPA);
- .10 operation in conjunction with other navigational equipment.

16.4.3.4 Gyrocompasses.

16.4.3.4.1 At surveys during mooring trials of gyrocompasses, the following shall be checked:

- .1 proper installation of the master compass and repeaters;
- .2 settle time: normal and accelerated;
- .3 steady state in alignment in the meridian and steady error of the master compass;
- .4 error from one run-up to another shall not exceed $\pm 1^\circ$;
- .5 divergence in readings between the master and repeaters (shall not exceed $0,5^\circ$);
- .6 operation of the course recorder;
- .7 main workstation console lighting control device ensuring the indication of readings of the master compass and repeaters;
- .8 operation in conjunction with other navigational equipment;
- .9 availability of a repeater at the emergency steering control station.

16.4.3.5 Echo sounders.

16.4.3.5.1 At surveys of echo sounders during mooring trials, the following shall be checked:

- .1 starting period of the echo sounder;
- .2 receiving and emitting surfaces with the help of a built-in control device (if any);
- .3 proper measuring the depth of water under the ship when in port (if allowed by the minimum depth under the vibrator);
- .4 coordination of depth information in the graphical form and the digital form;
- .5 actuation of alarm signals on approach to the dangerous and pre-set depths;
- .6 proper current and previously recorded information;
- .7 operation in conjunction with other navigational devices.

16.4.3.6 Relative and absolute logs.

16.4.3.6.1 At surveys of logs during mooring trials, the following shall be checked:

- .1 internal resistance of insulation of hydro-acoustic antenna to direct current (for absolute and relative hydro-acoustic logs);
- .2 starting period of the log;
- .3 receiving and emitting channel with the help of a built-in control device (if any);
- .4 initial speed sensitivity of the log (with the help of slacking or tautening the mooring lines at the berth or when the ship is adrift at the anchorage);
- .5 coordination in readings of speed and distance repeaters and the log main unit;
- .6 watertight outboard bottom equipment penetrating the hull and convenient access for the replacement when the ship is afloat (where applicable);
- .7 convenience of input of permanent, linear and non-linear log corrections into the system (where applicable);
- .8 operation in conjunction with the ship equipment.

16.4.3.7 Shipborne automatic identification system (AIS).

16.4.3.7.1 At surveys of the shipborne automatic identification system (AIS) during mooring trials, the following shall be checked:

- .1 proper installation and mounting of the apparatus (refer to Appendix 4 to this Section), including the power supply unit and the minimum display (if they are separate from the main unit);
- .2 proper installation and fastening of VHF antenna and antenna of GNSS receiver;
- .3 operation in conjunction with the navigation information sensors;
- .4 operation in conjunction with the equipment displaying graphical information;
- .5 operation in conjunction with the shipborne GNSS receiver;
- .6 operation in conjunction with the long range communication equipment (if any);
- .7 automatic switch on of the apparatus with the switch on of the ship's power supply and the 2 min starting period upon the switch on (this requirement is not applicable to the starting period for operating regime of the built-in GNSS receiver);
- .8 manual switch off of the apparatus when the ship is under repairs in port;
- .9 provision of processing of the data from the radionavigation system with the resolution within 0,0001 min in latitude and longitude WGS-84 coordinates;
- .10 automatic transfer to the built-in GNSS receiver in case of failure of the ship's (external) source of defining the position, and also appropriate indication from built-in means for the control of serviceability;
- .11 provision of alarm actuation and an indication of any alteration in the status of dynamic information sensors;
- .12 provision of displaying the necessary information on the minimum display.

16.4.3.8 Heading control system and ship's track control system.

16.4.3.8.1 At surveys of the heading control system and the ship's track control system during mooring trials, the following shall be checked:

- .1 proper installation of the system;
- .2 change-over of the modes of controls;
- .3 coordination of course and rudder indications;
- .4 rudder angle limitation;
- .5 signalling on the preset modes of control and actuation of alarms in case of failures of information sensors;
- .6 kind and amount of information displayed on the system control panel permanently and when required.

16.4.3.8.2 At surveys of the ship's track control system during mooring trials, the following shall be additionally checked:

- .1 monitoring of the ship's position received from the main radio navigation system with the data received from another independent system;

.2 alarm actuation provided about approach to the pre-set point of the course change at wheel-over, at the moment of manoeuvre starting, and also when no confirmation of the alarm signal by the watch navigator is given;

.3 alarm actuation in case of failure of the track control system as a whole and switch-over to another heading control mode.

16.4.3.9 Rate of turn indicators.

16.4.3.9.1 At surveys of the rate of turn indicators during mooring trials, the following shall be checked:

.1 starting period of the equipment for operation;

.2 check of modes of controls;

.3 capability of operating independently of gyro-compass and radar;

.4 operation with both the automatic and manual ship steering;

.5 interface with other navigational equipment.

16.4.3.10 Sound reception system.

16.4.3.10.1 At surveys of the sound reception system during mooring trials, the following shall be checked:

.1 proper installation of the receiving microphones, system loudspeakers, system display;

.2 adjustment of audibility of incoming sound signals;

.3 direction indicating period for an incoming sound (not more than 3 s).

16.4.3.11 Voyage data recorder (VDR).

16.4.3.11.1 At surveys of VDR during mooring trials, the following shall be checked:

.1 proper installation and mounting of the VDR equipment and protective capsule with the final recording medium (the document confirming installation and check of the equipment by the organization recognized by the manufacturer shall be checked);

.2 interfacing with the sensors of navigation and other operative information (refer to 3.2.6.5, Part I "Survey Regulations", as well as 5.20.64, Part V "Navigational Equipment" of the Rules for the Equipment);

.3 automatic switch-on of VDR when provided from the ship's power supply and automatic change-over to the emergency power supply in case of failure of the main power supply;

.4 operation of VDR from its own accumulator batteries and continuing to record the bridge audio for a period of 2 h with its following automatic switch-off;

.5 manual switch-off of VDR when the ship is under repairs in port;

.6 starting period of VDR before the ship sails;

.7 possibility of withdrawal the recorded information with no breaking up the protective capsule.

16.4.3.12 Electronic chart display and information system (ECDIS).

16.4.3.12.1 At surveys of the electronic chart display and information system (ECDIS) during mooring trials, the following shall be checked:

.1 proper connection of the equipment to the main and emergency power supply sources;

.2 interface of the equipment with GNSS receiver, gyrocompass, log, AIS, and, where appropriate, with the radar and ARPA;

.3 automatic checks of the equipment serviceability specified by the manufacturer and contained in the technical documentation;

.4 alarm signals of ECDIS or position determination system malfunction;

.5 correct coordinates received from the GNSS receiver,

.6 maintained serviceability in case of any interruption of the power supply for 45 s;

.7 accepting updates and preparing lists of updates. Capability of accepting updates to be entered manually.

16.4.3.13 Integrated navigation system (INS).

16.4.3.13.1 At surveys of the integrated navigation systems during mooring trials, the following shall be checked:

.1 arrangement of the system devices on the navigation bridge ensuring the monitoring of the navigational environment;

.2 operation in conjunction with the sensors of navigation information;

.3 influence of the system on the performance of the interfaced sensors of information;

.4 any impact of failures of some of the data processing units on the system serviceability;

.5 any impact of failures of some of the interfaced devices and appliances on the system operation;

.6 possibility of manual input of the data;

.7 alarm signals of failures of interfaced devices and systems, as well as in case of invalid data.

16.4.3.14 Combined ship control desks.

16.4.3.14.1 At surveys of the combined ship control desks during mooring trials, the following shall be checked:

.1 possibility for the operator to perform his duties both in the seating and in standing positions;

.2 accessibility to the internal structure and to protective means of power supply sources;

- .3 symbols and inscriptions showing the purpose and the direction of the control devices;
- .4 provision of continuous information or on call of the operator;
- .5 audible and visual alarm indicating any failure of devices, machinery and appliances.

16.4.3.15 Unified timing system.

16.4.3.15.1 At surveys of the unified timing system during the mooring trials, the following shall be checked:

- .1 proper installation of the system devices;
- .2 main clock run shall not exceed 0,5 s during twenty-four-hour operation;
- .3 variations of the main clock run during twenty-four-hour operation (not more than 0,1 s);
- .4 corrections of the system run;
- .5 transmission of current time to the controllable secondary clock;
- .6 emergency (reserve) power supply to the system.

16.4.3.16 Bridge navigational watch alarm system (BNWAS).

16.4.3.16.1 At surveys of the BNWAS during mooring trials the following shall be checked:

.1 location of all devices for alarm acknowledgement and system reset to the initial state (means of activating the reset function) — easily accessible from the conning position, the workstation for navigating and manoeuvring, the workstation for monitoring and the bridge wings;

.2 location of means of a second stage audible alarm (the master and officer's cabins), the possibility of choosing by the officer of the watch (OOW) the location for a second stage alarm actuation (in the back-up officer's location) and no possibility is available for cancellation of any audible alarm in the master's cabin from the bridge;

.3 location of means of a third stage audible alarm (in all the possible locations of crew members normally capable of taking corrective actions to steer the ship);

.4 visibility of flashing indication (first stage visual alarm) from any workstations on the bridge; variability of brilliance (although not to extinction);

.5 difference of audible alarm characteristic tone/ modulation from other signals (general alarm system, fire detection and fire alarm systems, etc.), the adequacy of the volume (on the bridge (first stage), in the officers' cabins (second stage), in all the spaces of officers' location (third stage));

.6 for ships which come under the provisions of SOLAS-74 (as amended): when activated in automatic mode, the BNWAS is always active (no matter whether the ship's heading or track control system is activated or not);

.7 whether the means of selecting the operational mode (on/off/auto) and the duration of the dormant period are securely protected against an unauthorized access (key, password);

.8 whether the BNWAS is powered from a battery (using the reserve source of electrical power of the GMDSS radio equipment is not allowed);

.9 if VDR is available: connection of the BNWAS to VDR;

.10 if the following equipment is forming part of the BNWAS: the system operability with additional reset facilities (motion sensor, etc.), other equipment on the bridge (radars, ECDIS, INS, etc.) capable of registering the OOW activity and activating a reset signal.

16.4.4 Sea trials shall be carried out with the purpose of final check of serviceability in the real operation conditions. At sea trials, the following items set forth below shall be checked in the scope laid down in 16.3.4.1 — 16.3.4.16.

16.4.4.1 Magnetic compasses and transmitting heading devices.

16.4.4.1.1 At surveys of magnetic compasses and transmitting heading devices during sea trials, the following shall be checked:

- .1 compensation of deviation (availability of the Table with values of residual deviation);
- .2 accuracy of indicating of the ship's course on permanent courses and circulation with corrections on cardinal and intercardinal points (alteration of a correction shall not exceed 1°);
- .3 error of electric remote transmission of magnetic course readings to repeater devices (if any);
- .4 proper electric remote transmission of the ship's true course readings to other shipboard devices;
- .5 interchangeability of master and reserve compasses.

16.3.4.2 Satellite radio navigation system receivers.

16.3.4.2.1 At surveys of satellite radio navigation system receivers during sea trials, the following shall be checked:

.1 generating of new output data and synchronization of the GPS receiver in the dynamic regime, and in case of combined radio navigation receivers in the GPS and GLONASS systems with the ship's various speeds: in standard regime; in differential regime;

.2 warning on failures and indication status;

.3 influence of aerial position inclination on accuracy data in the conditions of rolling and pitching motions;

.4 serviceability of equipment when communication facilities, navigational and electrical devices applied onboard are in operation;

.5 providing operation of navigational equipment using output data of the satellite radio navigation system receiver.

16.4.4.3 Electronic plotting aids (EPA), automatic tracking aids (ATA) or automatic radar plotting aids (ARPA).

16.4.4.3.1 At surveys of radar and radar plotting aids (EPA, ATA, ARPA) during sea trials, the following shall be checked:

.1 serviceability of the radar and radar plotting aids in various regimes of the ship's motion (alteration of the ship's speed and course);

.2 errors of direction measurements with the help of an electronic bearing line;

.3 errors of range measurements with the help of an electronic variable range marker;

.4 matching variable range marker with fixed range rings;

.5 simultaneous operation of the radar and radio communication facilities;

.6 operation in the modes of a relative motion display and true motion display, and operation of automatic radar plotting aids simulating the effect on all tracked targets of an own ship manoeuvre (for ARPA);

.7 radar display of graphical and letter-digital data (about parameters of target motion and approach) of radar plotting aids (EPA, ATA or ARPA);

.8 operation of the radar in conjunction with the radio beacons and transponders;

.9 possibility of displaying information of ECDIS and ATS (where appropriate);

.10 continuous operation of the radar for 24 h (with switched-on high voltage for at least 12 h);

.11 range of detection of real targets on the sea surface;

.12 minimum range of detection ("blind area");

.13 transmission of data to the voyage data recorder (if any).

After the completion of the trials at the place where the radar station is installed the diagram containing dead sectors of vision and blind area of the radar shall be posted.

16.4.4.4 Gyrocompasses.

16.4.4.4.1 At surveys of gyrocompasses during sea trials, the following shall be checked:

.1 settle time in the conditions of rolling and pitching;

.2 accuracy of course indication at cardinal and intercardinal points, and circulation. Alteration of a correction shall not exceed 1°;

.3 gyrocompass readings error in remote transfer to gyrocompass repeaters;

.4 availability of alarm on failures and recording thereof;

.5 transmission of the course data to other devices and systems.

16.4.4.5 Echo sounders.

16.4.4.5.1 At surveys of echo sounders during sea trials, the following shall be checked:

.1 steady operation, depth measuring with the help of the depth indicator and depth recorder at the ship's various cruising speeds. Checking for no interference. At the ship's full speed the depth recording shall be performed for at least every 10 min in each regime;

.2 steady echo sounder operation under rolling and pitching motion conditions (with the weather permitting);

.3 echo sounder operation when the seabed is of a sloping character;

.4 echo sounder operation when the ship is loaded or in ballast (if possible);

.5 possibility of echo sounder measuring and recording of minimum and maximum depths (if possible);

.6 alarm signal actuation on the ship's approach to the dangerous/pre-set depth;

.7 error of echo sounder measuring of shallow depths (using hand lot);

.8 echo sounder operation at the ship's circulation;

.9 echo sounder operation at the ship's slow speed astern;

.10 unambiguous indication of the data received from several transducers installed on board ship.

16.4.4.6 Relative and absolute logs.

16.4.4.6.1 At surveys of relative and absolute logs during sea trials, the following shall be checked:

.1 log errors of indicating speed and distance run in ship's various motion regimes (on the measuring line or by means of highly precise radio navigation systems);

.2 log operation in rolling and pitching motion conditions (with the weather permitting);

.3 minimum and maximum depths of the log operation (where appropriate);

.4 automatic and forced selection and indication modes of speed through the water and speed over the ground measuring;

.5 influence of the ship's static inclination and trim upon accuracy of hydro-acoustic log characteristics (where appropriate);

.6 alarm signal actuation on log operation status under conditions of water aeration (where appropriate and the weather permitting);

.7 log operation at the ship's circulation, speed astern, sway displacement under wind and current force, bow and stern thruster, pneumatic wash (used on icebreakers);

.8 log easy taring (calibration), drawing up the table on residual errors (log corrections), additional service functions;

.9 safe protrusion of log sensor from the bottom and in flush position to the bottom at the maximum speed, as well as its full replacement at the ship's maximum draught (with a sluice valve available for the log sensor).

16.4.4.7 Shipborne automatic identification system (AIS).

16.4.4.7.1 At surveys of the shipborne identification system (AIS) during sea trials, the following shall be checked:

.1 apparatus is operational and ready for transfer of pre-planned position data in the independent regime not later than 2 min after switching on (this requirement is not applicable to GNSS receiver);

.2 dynamic information transfer rate dependent on speed alteration;

.3 dynamic information transfer rate dependent on course alteration;

.4 operation in conjunction with the gyrocompass;

.5 operation in conjunction with the log.

16.4.4.8 Heading control systems and the ship's track control systems.

16.4.4.8.1 At surveys of the heading control systems and the ship's track control systems during sea trials, the following shall be checked:

.1 efficient operation of the systems using all kinds of controls during the whole of the sea trials;

.2 accuracy of keeping the ship on a preset heading and/or track with recording of amplitudes of yaw at various heading angles to a seaway for at least 1 h, and after circulation, on each control channel at the ship's speed at least 6 knots and at sea force not more than 3 (the accuracy of keeping the ship shall be not less than 1°);

.3 limitation of angles and number of the rudder activation in a seaway (the number of rudder activations shall not be more than those with the manual steering);

.4 manual and automatic (if any) adjustment of the system in various navigating environment conditions, and also alteration of the ship's speed and loading;

.5 monitoring of the ship's positions following along sequence of waypoints using the data of the independent positioning system;

.6 ship's preset heading change in the automatic mode and change-over to a new preset track with the track steering;

.7 ship's preset heading manual change from the master station and from remote stations (with and without change-over to manual steering);

.8 alarm signals and data indication on the system control panel;

.9 reliable change-over within 3 s from automatic heading control to track control and also to manual steering and vice-versa at any position of the rudder by a single easily accessible control.

16.4.4.9 Rate of turn indicators.

16.4.4.9.1 At surveys of the rate of turn indicators during sea trials, the following shall be checked:

.1 operation starting period (not more than 4 min after switching-on);

.2 clear indication of the direction and accuracy of angular speed at the ship's speed up to 10 knots;

.3 possibility of application of the rate of turn both with automatic and manual ship steering;

.4 efficiency of operation of the damping system under conditions of rolling and pitching motions.

16.4.4.10 Sound reception system.

16.4.4.10.1 At surveys of the sound reception system during sea trials, the following shall be checked:

.1 efficient operation of the system in various weather conditions, the ship's speed and direction of incoming sound signals;

.2 audibility of incoming sound signals inside the wheelhouse, the possibility of adjustment;

.3 proper indication of the direction of incoming sound signals by means of the visual bearing of the sound source.

16.4.4.11 Voyage data recorder (VDR).

16.4.4.11.1 At surveys of VDR during sea trials, the following shall be checked:

.1 automatic switch-on when supplied from the ship's power supply source and manual switch-off during the ship's long staying in port;

.2 continuous recording and storage of information for 12 h;

.3 recording of the bridge audio for a period of 2 h with no power supply from the ship's system and following automatic switch-off;

.4 steady and reliable recorder operation under various navigational conditions of the ship;

.5 actuation of alarm signals in case of an unauthorized access to recorder operation, and when a non-correctable error is detected during recording;

.6 withdrawal of a copy of the recorded information with no breaking up of the protective capsule and no damage done to the records;

.7 verification of identity and accuracy of the recorded data by means of comparison with the radar display screen photos and of generalized display of the navigational data.

16.4.4.12 Electronic chart display and information system (ECDIS).

16.4.4.12.1 At surveys of ECDIS during sea trials, the following shall be checked:

.1 continuous operation of the apparatus on the ship under way;

.2 possibility of superimposition (where appropriate) of the radar image and the ENC chart information and their matching;

.3 correct voyage documenting within previous 12 h;

.4 ship's route reckoned on the gyrocompass's and log's data;

.5 superimposition of data received from the AIS and ARPA (where appropriate), and the ENC chart information;

.6 adjustment of display brilliance in day and night conditions;

.7 recording of the voyage data and impossibility of changing thereof;

.8 automatic interchange of the ENC image when the own ship approaches the edge of the display at a determined distance;

.9 automatic actuation of alarm signals when the ship approaches the turning point, pre-set line, border determined on the chart;

.10 possibility of expanding (reducing) of the ENC chart scale.

16.4.4.13 Integrated navigation system (INS).

16.4.4.13.1 At surveys of INS during sea trials, the following shall be checked:

.1 interaction of navigational devices and equipment involved in the system, as well as their operation in the independent mode;

.2 transfer to duplicating equipment in case of failure of the main one;

.3 quality of the ship's heading and pre-set track automatic steering (for system Categories B and C);

.4 continuous automatic monitoring of the main information coming to the system by means of comparing navigational data derived independently from two different sensors;

.5 actuation of sound (with the possibility of switching off) and visual alarm signals in case of failures of interfaced information sensors and data processing system;

.6 recording of actuation of alarm signals and confirmation of alarm signals accepted by the navigator;

.7 programmed protection of the system from logical errors of the navigator in the data input;

.8 completeness and quality of the navigational information displayed on the system generalized display.

16.4.4.14 Combined ship control desks.

16.4.4.14.1 At surveys of combined ship control desks during sea trials, the following shall be checked:

.1 use of the combined ship control desks as designated and ensuring the ship's safety of navigation;

.2 operation of controls, monitoring and indication as designated;

.3 arrangement of controls, indicating and monitoring instruments designated for immediate use in extreme circumstances important for the safety of navigation of the ship under way.

16.4.4.15 Unified timing system.

16.4.4.15.1 At surveys of the unified timing system during sea trials, the following shall be checked:

.1 reliable operation in the course of sea trials;

.2 main clock daily run (not more than 0,5 s) with variations within 0,1 s;

.3 corrections against the international accurate hour's service signals;

.4 operation of the secondary clock.

16.4.4.16 Bridge navigational watch alarm system (BNWAS).

16.4.4.16.1 At surveys of the BNWAS during sea trials BNWAS operability in all three modes shall be checked (on/off/ auto, when the system operates in automatic mode — refer to 16.4.3.16.6).

16.4.5 All paras of the present Section shall be checked on prototype ships.

On series ships some kinds of tests of navigational equipment carried out under way, in sea conditions, may be replaced by simulating tests approved by RHO during mooring trials (refer to Section 18).

All equipment defects found out in the course of mooring and sea trials shall be cleared prior to issuance the ship's documents by the Register.

APPENDIX 1

RECOMMENDATIONS ON INSTALLATION OF MAGNETIC COMPASSES

1. Magnetic compasses are recommended to be so installed that the distances between the compass bowl centre and magnetic materials of the ship structures are at least equal to the values specified in Tables 1-1 and 1-2.
2. All metal magnetic materials shall be arranged, if possible, symmetrically relative to the magnetic compass.
3. Distance between the magnetic compass bowl and the deck or ceiling made of magnetic materials shall not be less than 1 m, while distances from bulkheads ends and metal deck cartings in this case shall be at least as those indicated in Table 1-1.
4. Magnetic compasses shall be installed at a distance not less than 2 m from each other. For ships of less than 60 m in length, this distance may be reduced to 1,8 m.

Table 1-1

Least distances between the magnetic compass and the ship's metal structures manufactured of magnetic materials depending on the ship length

Distance from immobile materials, in m								Distance from mobile magnetic materials with changeable magnetic field, in m								
Ship's extreme length, in m																
Not more than 30	40	50	60	70	80	83 and over	Not more than 30	40	50	60	70	80	90	100	110	120 and over
1,5	1,75	2,1	2,3	2,7	2,9	3,0	2,0	2,2	2,4	2,6	2,9	3,1	3,4	3,5	3,7	4,0
Notes : 1. Mobile materials mean boat davits, ventilator pipes, doors, cargo booms and other mobile ship structures manufactured of magnetic materials. 2. Materials with changeable magnetic field mean exhaust pipes, funnels and other heating appliances manufactured of magnetic materials. Casings of funnels are considered immobile magnetic material.																

Table 2

Least distances between the magnetic compass and the ship's metal structures manufactured of magnetic materials for fishing vessels and vessels of restricted navigation area with extreme length up to 60 m

Distance from magnetic materials, in m, depending on the ship's extreme length, in m				
Not more than 20	30	40	50	60
1,1	1,3	1,5	1,7	2,0

**RECOMMENDATIONS ON DETERMINING "SAFE DISTANCE"
FOR MAGNETIC COMPASS**

1. All navigational equipment shall be provided with inscriptions indicating the least distance at which this equipment may be installed from the magnetic compass.

This least distance is considered "safe distance" unless the magnetic fields of the equipment cause disturbances in magnetic compass readings more than $0,045^\circ/H$ where H is a horizontal constituent of the magnetic field of the Earth, O (oersted).

2. The "safe distance" shall be determined for every kind of the equipment by means of the following three methods:

.1 measurement the distance between the nearest point of the equipment and the magnetic compass centre when the magnetic compass card inclination resulting under magnetic field influence caused by the equipment is equal to the value to be determined in relation of the stated above. The equipment shall be as it is normally installed on board ship;

.2 distance measured after magnetization of the equipment in field intensity as much as 1,5 O caused by direct current and by additional superimposition of stabilizing field of alternating current with intensity 18 O (average quadrature value). In some cases super-imposition of alternating magnetic field is not permitted as it may result in damage of the equipment.

Magnetization of the equipment shall be made so as to receive the greatest result (for example, along the longest axis of the equipment made of a magnetic material);

.3 distance measured, as specified in 2.1, from the equipment which is power supplied and which is in the working condition.

3. The greatest distance which is received as a result of comparison of the three above stated measurements shall be assumed as "safe distance".

4. "Safe distances" stated in the Recommendations refer to the equipment installed near the magnetic compass on ships of unrestricted navigation area.

5. As to compasses of ships of restricted navigation area of less than 60 m in length "safe distances" may be 25 % less.

INSTALLATION OF ELECTRICAL AND ELECTRONIC EQUIPMENT ON THE BRIDGE AND IN THE VICINITY OF THE BRIDGE

1. All electrical and electronic equipment intended to be operated on the bridge or in the vicinity of the bridge, on ships constructed on or after 1 July 2002, shall be tested for electromagnetic compatibility (EMC).

2. It shall be ascertained that the electromagnetic interference created by the equipment operated on the bridge or in the vicinity of the bridge does not affect the proper function of navigational equipment and systems.

3. Portable electric and electronic equipment shall not be operated on the bridge if it may affect the proper function of navigational equipment and systems.

4. All the radio and navigational equipment to be fitted on a ship in accordance with the Rules for the Equipment shall be of a type approved by the Register (type approval of products includes the necessary EMC tests).

5. All other installed and portable electric and electronic equipment other than mandatory radio and navigational equipment shall be EMC tested (at least tests for Conducted and Radiated Emission shall be conducted).

6. The definition "bridge and vicinity of the bridge" covers the following zones:

the wheelhouse including bridge wings;

control rooms in way of bridge intended for installation of radio and navigational equipment, alarm systems, inter-communication systems, signal processing and auxiliary equipment;

areas in close proximity (not more than 5 m) to receiving and/or transmitting antennas and large openings in the metallic structure of ship's superstructure or deckhouse (windows, doors, closing appliances). Equipment beyond 5 m from the above openings need not be considered for the purpose of these requirements.

7. For the purpose of these requirements, equipment need to be tested for conducted and radiated emission only.

Test standards are specified in 5.1.16, Part V "Navigational Equipment" of the Rules for the Equipment.

The results of tests conducted in accordance with standards other than specified in 5.1.16, Part V "Navigational Equipment" of the Rules for the Equipment may be considered and taken into account. In this case, particular attention shall be paid to the level of radiated emission in the frequency band from 156 – 165 MHz and the location of the equipment.

8. Passive-EM equipment (refer to 9,10) need not be EMC tested but it shall be supplied with a manufacturer's statement confirming that the equipment is passive-EM equipment.

9. Equipment is considered a passive-EM equipment if, when used as intended, without internal protection measures such as filtering or shielding, and without any user intervention, it does not create or produce any switching or oscillation of current/voltage and is not affected by electromagnetic disturbances.

10. Passive-EM equipment covers all equipment which includes no active electronic part, in particular:

cables and cabling systems, cables accessories;

equipment containing only resistive loads without any automatic switching device (e.g. simple domestic heaters with no controls, thermostat, or fan);

batteries and accumulators, etc.

11. All electrical and electronic equipment operated on the bridge and in the vicinity of the bridge shall be listed.

The list of electrical and electronic equipment intended to be operated on the bridge or in the vicinity of the bridge shall contain at least the following information:

equipment description;

name of manufacturer;

type;

evidence of EMC which may be: Type Approval Certificate,

reports on tests for conducted and radiated emission having been conducted at a testing laboratory accredited by the Register,

reports on EMC tests conducted on the navigation bridge of a newbuilding by a testing laboratory accredited by the Register for these purposes,

manufacturer's statement (for passive-EM equipment).

12. List of electrical and electronic equipment operated on the bridge and in the vicinity of the bridge and evidence of EMC compatibility shall be kept on board at all times.

RECOMMENDATIONS ON THE INSTALLATION OF A SHIPBORNE AUTOMATIC IDENTIFICATION SYSTEM (AIS)

1 GENERAL

1.1 Technical and operational requirements for AIS are set out in 5.18, Part V "Navigational Equipment" of the Rules for the Equipment.

Installation of the AIS may be performed by the equipment manufacturer's technicians or firms recognized by the Register as capable of carrying out this type of work. Installation of AIS by ship's crew or by organizations having no recognition is not allowed.

2 AIS INSTALLATION

2.1 Interference to the ship's vhf radiotelephone station.

2.1.1 The AIS shipborne equipment, like any other shipborne transceiver operating in the VHF maritime band, may cause interference to a ship's VHF radio-telephone station. Because AIS is a digital system, this interference in the VHF radiotelephone station may occur as a periodic (e.g. every 20 s) soft clicking sound on a ship's radiotelephone. This effect may become more noticeable when the VHF radiotelephone station antenna is located near the AIS VHF antenna and when the VHF radiotelephone station is operating on channels near the AIS operating channels (e.g. channels 27, 28 and 86).

Attention shall be paid to the location and installation of different antennas in order to obtain the best possible efficiency of the AIS operation, and special attention shall be paid to the installation of AIS VHF antennas.

2.2 AIS VHF antenna installation.

2.2.1 Location.

2.2.1.1 Location of the AIS VHF antenna shall be carefully considered. Digital communication is more sensitive than analogue/voice communication to interference created by reflections in obstructions like masts and booms. In some instances, based on the results of sea trials, it may be necessary to relocate the VHF radiotelephone station antenna to minimize interference effects.

To minimize interference effects, the following guidelines apply:

The AIS VHF antenna shall have omnidirectional vertical polarisation;

The AIS VHF antenna shall be placed in an elevated position that is as free as possible with a minimum of 2 m in horizontal direction from constructions made of conductive materials. The antenna shall not be installed close to any large vertical obstruction. The objective for the AIS VHF antenna shall see the horizon freely through 360°;

The AIS VHF antenna shall be installed safely away from interfering high-power energy sources like radar and other transmitting radio antennas, preferably at least 3 m away from and out of the transmitting beam.

There shall not be more than one antenna on the same level. The AIS VHF antenna shall be mounted directly above or below the ship's primary VHF radiotelephone station antenna, with a minimum of 2 m vertical separation. If the AIS VHF antenna is located on the same level as other antennas, it is desirable that the distance apart shall be at least 10 m.

2.2.2 Cabling.

2.2.2.1 The cables shall be kept as short as possible to minimize attenuation of the signal. Double screened coaxial cables equal or better than RG214 are recommended.

All outdoor installed connectors on the coaxial cables shall be waterproof by design to protect against water penetration into the antenna cable.

Coaxial cables shall be installed in separate signal cable channels/tubes and at least 10 cm away from power supply cables. Crossing of cables shall be done at right angles (90°). Coaxial cables shall not be exposed to sharp bends, which may lead to change the characteristic impedance of the cable. The minimum bend radius of a coaxial cable shall be 5 times the cable's outside diameter.

2.2.3 Grounding.

2.2.3.1 Coaxial down-leads shall be used for all antennas, and the coaxial screen shall be connected to ground at one end.

2.3 Global navigation satellite system antenna installation.

2.3.1 AIS shall be connected to a Global Navigation Satellite System (GNSS) antenna.

2.3.1.1 Location.

2.3.1.1.1 The GNSS antenna shall be installed where it has a clear view of the sky and is not obstructed by ship's structures. The objective shall see the horizon freely through 360° with a vertical observation of 5 to 90° above the horizon. Small diameter obstructions, such as masts and booms, do not seriously degrade signal reception, but such objects shall not eclipse more than a few degrees of any given bearing.

The antenna shall be located at least three meters away from and out of the transmitting beam of high-power transmitters (radars and/or INMARSAT ship earth stations). This includes the ship's own AIS VHF antenna.

If a DGNSS system is included or connected to the AIS system, the installation of the DGNSS antenna shall be in accordance with manufacturer's recommendations.

2.3.2 Cabling.

2.3.2.1 To achieve optimum performance, the gain of the antenna pre-amplifier shall match the cable attenuation. The resulting installation gain determined as the difference between pre-amplifier gain and cable attenuation shall be within 0 to 10 dB.

The coaxial cable between the GNSS antenna and the AIS shipborne station connector shall be routed directly in order to reduce electromagnetic interference effects. The GNSS antenna cable shall not be installed close to high-power lines, such as radar or radio-transmitter cables or waveguides including the AIS VHF antenna cable. A separation of one meter or more is recommended between the above cables to avoid degradation due to RF-coupling. Crossing of antenna cables shall be done at 90° to minimize magnetic field coupling.

All outdoor installed connectors on the coaxial cables shall be waterproof by design to protect against water penetration into the antenna cable.

2.4 Power source.

2.4.1 The AIS shall receive power supply from the main and emergency sources of electrical power, for which purpose the AIS shall be connected to the navigational equipment switchboard.

2.5 Synchronization.

2.5.1 After installation, the AIS shall be synchronized properly on Universal Coordinated Time (UTC), and the position information, if provided, shall be correct and valid.

3 BRIDGE ARRANGEMENT

3.1 Minimum keyboard and display.

3.1.1 A minimum keyboard and display (MKD) shall be installed at the position from which the ship is normally operated. This can be the AIS internal MKD (integrated or remote) or a separate display system.

3.2 Pilot plug.

3.2.1 A pilot input/output port is a mandatory part of the shipborne AIS equipment. A plug connected to this port shall be installed on the bridge near the pilot's operating position so that a pilot can connect a personal computer to AIS.

The pilot plug shall be configured as follows:

AMP/Receptacle (Square Flanged (-1) or Free-Hanging (-2)), Shell size 11, 9-pin, Std. Sex 206486-1/ 2 or equivalent with the following terminations:

TX A is connected to Pin 1;

TX B is connected to Pin 4;

RX A is connected to Pin 5;

RX B is connected to Pin 6;

Shield is connected to Pin 9.

3.3 AIS display system.

3.3.1 If there is navigational equipment capable of displaying AIS information (radar display, electronic chart display and information system (ECDIS) display or integrated navigation system) installed at the position from which the ship is normally operated, the AIS shall be connected to that equipment in accordance with the requirements of the international standard "Maritime Navigation and Radiocommunication Equipment and Systems — Digital Interfaces".

The additional display system can also include the functionality of an MKD (refer to 3.1.1).

3.4 Installation of the built-in integrity test (BIIT) function.

3.4.1 The AIS requires that an alarm output (relay) be connected to an audible alarm device or the ship's alarm system, if available.

In cases where audible alarm of AIS failure is provided by an audible device built into the minimum keyboard and display, connection to an external audible alarm device or the ship's alarm system is not needed.

Alternatively, the BIIT alarm system may use the alarm messages output on another compatible ship's alarm system.

4 DYNAMIC DATA INPUT

4.1 External sensors

4.1.1 The AIS has interfaces for position, heading and rate of turn (ROT) sensors whose configuration complies with the requirements of the international standards "Maritime Navigation and Radiocommunication Equipment and Systems — Digital Interfaces" (IEC 61162-1 or 61162-2). Sensors installed in compliance with other carriage requirements of SOLAS-74, Chapter V shall be connected to the AIS¹. The sensor information transmitted by AIS shall be the same information being used for navigation of the ship.

4.2 Ship's position, course over ground (cog) and speed over ground (SOG)

4.2.1 GNSS sensors (global navigation satellite system receivers) normally have standard outputs for position, COG and SOG suitable for directly interfacing the AIS. However, it is important to note that:

the Geodetic Datum of the position data transmitted by the GNSS receiver is WGS 84 and that an IEC 61162 DTM sentence is configured;

AIS is able to process two reference points for GNSS antenna position, one for external and one for an internal GNSS sensor. If more than one external reference point is used, the appropriate information needs to be input to the AIS to adjust reference point information.

4.3 Heading

4.3.1 A compass (gyrocompass or magnetic compass) providing heading information is a mandatory sensor input to the AIS. Some ships of less than 500 gross tonnage may not carry a gyrocompass providing heading information. In such ships, heading information shall be provided to the AIS by a transmitting heading device.

4.4 Rate of turn

4.4.1 The AIS provides the rate of turn (ROT) information to other ships in order to early detect ship's manoeuvres and their rate. The following parameters indicating turning of a ship (direction and rate of turn) can be derived from two different sensors:

the heading (from a gyrocompass or transmitting heading device);

the rotation rate itself (from a rate-of-turn indicator).

In accordance with the requirements of SOLAS-74 Chapter V and IMO resolution A.526(13), the rate-of-turn indicator need not be fitted on ships of less than 50,000 gross tonnage. However, if a rate-of-turn indicator is available and it includes an interface in accordance with the requirements of the international standard "Maritime Navigation and Radiocommunication Equipment and Systems — Digital Interfaces" (IEC 61162), it shall be connected to the AIS.

If a rate-of-turn indicator complying with the requirements of IMO resolution A.526(13) is connected to the AIS, the AIS shall use the information derived from this device to broadcast both direction and value of turn on the VDL.

If valid ROT or heading data is available from another external source (Integrated Navigation System), the AIS shall use this information to broadcast the direction of turn on the VDL, if greater than 5° in 30 s (might also be implemented as 2.5° in 15 s by configuration).

If no ROT information is available, the AIS shall transmit default values indicating "not available".

ROT data shall not be derived from COG information.

4.5 Navigational status

4.5.1 A simple means shall be provided for the operator to input the ship's navigational status (e.g. underway using engine; at anchor; not under command; restricted in ability to maneuver, etc.) information into the AIS. The AIS may be connected to the ship's navigational status lights.

¹Installation of the AIS does not establish a need to install additional sensors above carriage requirements.

5 STATIC INFORMATION

5.1 In accordance with the technical and operational requirements for the AIS, certain static, dynamic and voyage-related information shall be entered manually, normally by means of the MKD, or by means of IEC 61162 sentences "SSD" and "VSD" via the presentation interface if such provisions exist.

5.1 Entered at initial installation of AIS.

5.1.1 Information that shall be entered at the initial installation of the AIS includes:

Maritime Mobile Service Identity (MMSI) number;

IMO ship number;

radio call sign;

name of ship;

type of ship;

dimension/reference for position of the GNSS antenna (refer to 5.2).

Access to "MMSI", "IMO number" and other AIS controls (like power and channel settings) shall be controlled (e.g. by password).

The "call sign", "name of ship" and "type of ship" shall be input to the AIS, either manually using the MKD or by means of IEC 61162 sentences "SSD" and "VSD" via the presentation interface. Type of ship information shall be in accordance with Table 5.1.1.

5.2 Reference point for gnss antenna position.

5.2.1 The AIS stores one "external reference point" for the external GNSS antenna position and one "internal reference point" if an internal GNSS shall be used as fallback for position reporting. The locations of these reference points shall be set during installation of the AIS using values A, B, C, D; as described in 5.3.1.

The external reference point may also be a calculated common reference position.

5.3 Ship's dimensions.

5.3.1 Ship's dimensions shall be entered using the overall length and width of the ship indicated in Fig. 5.3.1 as $(A + B)$ and $(C + D)$, respectively.

Ship's dimensions $(A + B)$ and $(C + D)$ shall be identical when entering internal and external reference points.

6 LONG-RANGE FUNCTION OF THE AIS

6.1 The AIS long-range function needs a compatible long-range communication system (e.g. INMARSAT-C or MF/HF radio installation).

If this is available, a connection between that communication system and the AIS can be made. This connection is needed to activate the long-range function of the AIS and it shall meet the requirements of the international standard "Maritime Navigation and Radio-communication Equipment and Systems — Digital Interfaces"

7 FORMALIZING THE AIS INSTALLATION RESULTS

7.1 After completion of installation and adjustment work, acceptance and sea trials shall be carried out where all the AIS equipment shall be checked in real operational conditions, including operability of signal converters, connected sensors and information users.

On completion of technical supervision of the AIS installation, Register surveyor shall draw up a report in form 6.3.10 specifying the information on the installation technical design approval, by whom, when and where the AIS was installed, the results of the acceptance and sea trials, and a conclusion regarding the possibility of further use of AIS on board the ship or remarks (if any).

In case of satisfactory results of trials witnessed by a Register representative, use of the AIS is allowed as part of shipborne navigational equipment required by SOLAS-74 Chapter V, and the AIS is included in ship's documents (Record of Equipment for the Cargo Ship Safety Equipment Certificate or the Passenger Ship Safety Certificate (forms E, P)).

Table 5.1.1

Identifiers to be used by ships to report their type

Identifier No.	Types of ships		
Special craft			
50	Pilot vessels		
51	Search and rescue vessels		
52	Tugs		
53	Port tenders		
54	Vessels with anti-pollution facilities or equipment		
55	Law enforcement vessels		
56	Spare – for assignments to local vessels		
57	Spare – for assignments to local vessels		
58	Medical transports (as defined in the 1949 Geneva Convention and Additional Protocols)		
59	Ships according to Resolution No. 18 (Mob-83)		
Other ships			
First digit ¹	Second digit ¹	First digit ¹	Second digit ¹
1 — reserved for future use	0 — all ships of this type	—	0 — fishing
2 — wing-in-ground craft (WIG)	1 — carrying dangerous goods (DG), harmful substances (HS), or marine pollutants (MP) IMO hazard or pollutant category X ²	—	1 — towing
3 — see right column	2 — carrying DG, HS, or MP IMO hazard or pollutant category Y ²	3 — vessel	2 — towing and length of the tow exceeds 200 m or breadth exceeds 25 m
4 — high-speed craft (HSC)	3 — carrying DG, HS, or MP IMO hazard or pollutant category Z ²	—	3 — engaged in dredging or underwater operations
5 — see above	4 — carrying DG, HS, or MP IMO hazard or pollutant category OS ²	—	4 — engaged in diving operations
	5 — reserved for future use	—	5 — engaged in military operations
6 — passenger ships	6 — reserved for future use	—	6 — sailing
7 — cargo ships	7 — reserved for future use	—	7 — pleasure craft
8 — tankers	8 — reserved for future use	—	8 — reserved for future use
9 — other types of ship	9 — no additional information	—	9 — reserved for future use
¹ The identifier shall be constructed by selecting the appropriate first and second digits. For example, a cargo ship not carrying dangerous goods, harmful substances, or marine pollutants, shall use identifier "70"; pleasure craft shall use identifier "37". Note that those ships, which type identifier begins with a "3" shall use the fourth column of the Table. Depending on the vessel, cargo and/or the navigational conditions, this information may be voyage related and shall therefore need to be changed before beginning or at some time during the voyage. This is defined by the "second digit" in the fourth column of the Table. ² Figures 1, 2, 3, 4, indicating categories X, Y, Z and OS, have previously indicated categories A, B, C and D.			

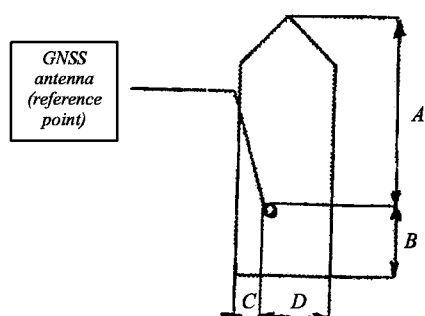


Fig. 5.3.1 Antenna position parameters:

Ship's dimensions	Distance at which the antenna is located, in m
<i>A</i>	0 – 511 (511 = 511 m or greater)
<i>B</i>	0 – 511 (511 = 511 m or greater)
<i>C</i>	0 – 63 (63 = 63 m or greater)
<i>D</i>	0 – 63

- Notes: 1. The dimension *A* shall be in the direction of the transmitted heading information (bow).
 2. Reference point of reported position not available, but dimensions of ship are available: $A = C = 0$ and $B \neq 0$ and $D \neq 0$.
 3. Neither reference point of reported position nor dimensions of ship available: $A = B = C = D = 0$ (=default).
 4. For use in the message table: *A* = most significant field; *D* = least significant field.
 5. In the rare case of a GNSS antenna installed in the portside corner of a rectangular bow, the values *A* and *C* would be zero. Should this be the case, one of these values shall be set to 1 in order to avoid misinterpretation as "not available" because $A = C = 0$ is used for that purpose.

APPENDIX 5

GUIDELINES FOR THE INSTALLATION OF A SHIPBORNE RADAR

1 GENERAL

1.1 These Guidelines reflect the provisions of IMO circular SN.1/Circ.271 "Guidelines for the Installation of Shipborne Radar Equipment".

Information provided by radar is of vital importance for navigators and the safe navigation of ships.

Special care shall be taken to ensure the correct installation of the radar, in order to improve the performance of the radar system.

The Appendix contains guidelines for shipowners, ship designers, manufacturers, installers, shipyards, suppliers and ship surveyors.

It does not replace documentation supplied by the firm (manufacturer).

2 APPLICATION

2.1 The Appendix applies to all shipborne radar installations mandated by SOLAS-74, as amended.

3 DEFINITIONS

3.1 Consistent common reference point (CCRP) is a location on own ship, to which all horizontal measurements such as target range, bearing, relative course, relative speed, closest point of approach (CPA) or time to closest point of approach (TCPA) are referenced, typically the conning position of the bridge.

4 SURVEY

4.1 Surveys of the conventional ships shall be carried out in accordance with the rules laid down in IMO resolution A.997(25).

5 DOCUMENTATION

5.1 Prior to the radar installation, the following documentation shall be made available and provided to the installer by the shipyard, shipowner or manufacturer as appropriate:

.1 scaled drawing(s) of the ship with views from the port, starboard, fore, aft and from above the vessel on which the radar and other antenna positions are indicated. Any ship structure or cargo that may obstruct or degrade radar performance shall also be shown, for example masts, funnels, superstructure and containers. The possible turning and jib range of movable objects like cranes shall be indicated;

.2 scaled drawing of the antenna arrangement including the outline drawing for the rotation radius;

.3 drawing(s) of the bridge layout showing the position of the radar display unit(s) and additional locations (for example, electronic rooms) for housing radar units;

.4 manufacturer's documentation describing the installation and interconnection of the radar system, the equipment units including radar frequency band and antenna size, and equipment type and evidence of type approval documentation;

.5 list of auxiliary equipment connected with the radar system including manufacturer, type with block diagram (interconnection diagram) and evidence of type approval;

.6 in case of retrofit installations, a document agreed by the shipowner, installer and manufacturer stating that the use of original cabling, transmission lines and auxiliary units of the radar equipment may be retained.

6 RADAR ANTENNA INSTALLATION

Correct location of the radar antenna is an important factor of the performance of the radar system. Interference, either by reflecting constructions or other transmitters, may heavily reduce the radar performance by creating blind sectors, clutter on the radar display or generation of false echoes.

6.1 Interference.

6.1.1 Due care shall be taken with regard to the location of radar antennas relative to other antennas which may cause interference to either equipment. The location of the antenna shall comply with the following:

.1 the radar antenna shall be installed safely away from interfering high-power energy sources and other transmitting and receiving radio antennas;

.2 the lower edge of a radar antenna shall be minimum of 500 mm above any safely rail;

.3 radar antennas in close proximity shall have a minimum vertical elevation separation angle of 20° and a minimum vertical separation of 1 m where possible.

6.2 Location relative to masts, funnels and other constructions.

6.2.1 Due care shall be taken with regard to the location of radar antennas relative to masts, funnels and other constructions.

The location of the antenna shall comply with the following:

.1 the antenna shall generally be mounted clear of any structure that may cause signal reflections;

.2 ensure that any support or other obstacles are clear of the rotation of the antenna (refer to specific antenna outline drawing for rotational radius);

.3 install antenna and turning unit so that the installation complies with the compass safe distance of the equipment.

6.3 Blind sectors and range.

6.3.1 To make full benefit from the radar, it is vitally important that horizontal and vertical blind sectors of the radar antennae are minimized. The objective shall see the horizon freely through 360° as nearly as possible, noting the requirement of 8 below.

For all radar systems and where practical:

.1 a line of sight from the radar antenna to the bow of the ship shall hit the surface of the sea in not more than 500 m or twice the ship length, depending which value is smaller, for all load and trim conditions;

.2 the radar antenna shall be located in an elevated position to permit maximum target visibility;

.3 blind sectors shall be kept to a minimum, and shall not occur in an arc of the horizon from right ahead to 22,5° abaft the beam to either side.

Note. Any two blind sectors separated by 3° or less shall be treated as one blind sector;

.4 individual blind sectors of more than 5°, or a total arc of blind sectors of more than 20°, shall not occur in the remaining arc, excluding the arc in the above 6.3.3;

.5 for radar installations with two radar systems, where possible, the antennas shall be placed in such a way as to minimize the blind sectors.

6.4 Lifting radar equipment

6.4.1 Where special equipment, such as cranes, hoists and jibs are required to install the radar system, consideration shall be given to ensure that the radar system(s) are located such that the required equipment can be positioned to facilitate the installation. Radar equipment shall be lifted in accordance with the information provided by the manufacturer.

7 GENERAL REQUIREMENTS

7.1 All installations shall facilitate protection of equipment, including cabling, from damage.

7.2 Safe service access shall be provided using service platforms where necessary having a minimum size of 1 m² at a suitable height and with a safety rail of suitable height.

7.3 Consideration shall be given to the compass safety distance as supplied by the manufacturer when positioning equipment units.

7.4 The design of the mounting platform for the antenna and antenna pedestal shall take into account vibration, shock and whiplash due to sea-going conditions.

8 INTERACTION WITH SEA AND FALSE ECHOES

8.1 Considerations of interaction with the sea imply that the radar antenna shall be only as high as necessary to clear major objects, and as high to be consistent with other requirements regarding acceptable horizon and target detection range.

The location of the antenna shall minimize sea clutter returns and the number of multi-path nulls.

9 CABLES AND GROUNDING

9.1 The cables and the grounding shall comply with the following:

.1 cable screens, especially coaxial cable screens, shall be installed in accordance with firm's (manufacturer's) documentation;

.2 the cables shall be kept as short as possible to minimize attenuation of the signal;

.3 all cables between antenna and radar systems units shall be routed as directly as possible, consistent with consideration for other equipment, in order to reduce electromagnetic interference effects;

.4 cables shall not be installed close to high-power lines, such as radar or radiotransmitter lines;

.5 crossing of cables shall be done at right angles (90°) to minimize magnetic field coupling;

.6 all outdoor installed connectors shall be waterproof by design to protect against water penetration into the cables (IP56 protection degree);

.7 cables and microwave transmission lines shall not be exposed to sharp bends;

.8 cables and microwave lines shall be installed with sufficient physical separation, as defined in the firm's (manufacturer's) documentation;

.9 grounding of equipment units shall be carried out according to the firm's (manufacturer's) documentation.

10 POWER SOURCES

10.1 The radar shall be connected to the main and emergency power source, as required by SOLAS-74 chapter II-1.

11 RADAR CONTROLS AND DISPLAY

11.1 If the control panel is a separate unit, the functionality of the radar controls shall be available for the mariner at all workstations where a radar display is available.

11.2 The orientation of the display unit shall be such that the user is looking ahead. The lookout view shall not be obscured and the ambient light shall cause minimum degradation on the display screen in accordance with IMO circular MSC/Circ. 982).

12 INITIAL INSTALLATION OF RADAR

12.1 Radar systems are functionally integrated with a number of instruments (refer to IMO resolution MSC.192(79)). As various systems are getting increasingly more integrated and complex, correct system settings are very important.

The installation firm shall sign an installation report that to the best of their knowledge the installation and setup has been carried out according to the firm's (manufacturer's) documentation and to these guidelines.

Information about possible performance limitations, including blind sectors, due to the radar system installation that may be of vital importance for mariners shall be stated in this documentation.

The setup of interfaces and system parameters (including CCRP position offset) shall be carried out in accordance with the firm's (manufacturer's) documentation.

This information shall be attached as an annex to the installation report.

The above mentioned installation report and the annex thereto shall be kept on board the ship.

17 ARRANGEMENTS FOR THE PREVENTION OF POLLUTION FROM SHIPS

17.1 GENERAL

17.1.1 The Section establishes the procedure of the Register technical supervision during the installation and testing of the PPS equipment and arrangements on board the ship.

17.1.2 General provisions for the organization of technical supervision during the installation and testing of the equipment and arrangements are set out in Part I "General Regulations for Technical Supervision"; those concerning technical documentation — in Part II "Technical Documentation" of the Rules for Technical Supervision.

17.1.3 Technical documentation.

17.1.3.1 Installation and testing of the PPS equipment and arrangements on board the ship shall be performed under the Register technical supervision according to the RS-approved technical documentation.

17.1.4 Technical supervision of the Register.

17.1.4.1 Surveys during installation and testing shall be performed according to the examination and testing plan developed by the shipyard according to 17.2.1, taking into account 17.3 — 17.6.

17.1.5 Tests and checks specified in this Section are based on an assumption that the PPS equipment has been tested at the firm (manufacturer) in compliance with the requirements of Section 17, Part IV "Technical Supervision during Manufacture of Products" of the Rules for Technical Supervision.

In case some tests were not conducted at the firm (manufacturer) and it is confirmed by an entry in the RS certificate, then these tests shall be conducted.

Additional checks and tests may be assigned by the surveyor upon results of examination of the PPS equipment in substantiated cases.

17.2 SURVEY PLANNING

17.2.1 Prior to commencement of survey of the PPS equipment of the ship under construction, the RS Branch Office shall agree the examination and testing plan developed by the shipbuilder taking into account Table 17.2.1, as well as 17.3 — 17.6. The shipbuilder shall be informed about that at a kick off meeting prior to commencement of construction according to 1.7.1.

The builder shall agree to undertake ad hoc investigations during construction as may be requested by RS where areas of concern arise and the builder to agree to keep RS advised of the progress of any investigation. Whenever an investigation is undertaken, the builder shall be requested, in principle, to agree to suspend relevant construction activities if warranted by the severity of the problem.

17.2.2 During approval and agreement of the examination and testing lists a note shall be taken of specific published Administration requirements and interpretations of statutory requirements.

17.2.3 The shipyard shall be requested to advise of any changes to the activities agreed at the kick off meeting and these shall be documented in the examination and testing plan. E.g. if the shipbuilder chooses to use or change sub-contractors, or to incorporate any modifications necessitated by changes in production or inspection methods, rules and regulations, structural modifications, or in the event where increased inspection requirements are deemed necessary as a result of a substantial non-conformance or otherwise.

17.2.4 Quality standards for installation and testing of the PPS equipment shall be reviewed and agreed during the kick-off meeting. The work shall be carried out in compliance with the RS rules and under the RS technical supervision.

17.2.5 Any changes to the kick-off meeting records shall be agreed and documented.

17.3 REGISTER TECHNICAL SUPERVISION

17.3.1 Prior to installation of the PPS equipment and arrangements it is necessary to make sure that all welding and assembling works on the seatings have been performed in accordance with the RS-approved technical documentation.

Table 17.2.1

Nos.	Items of technical supervision	Verification of technical documentation	Verification of Register certificates for materials and equipment, verification of brands	Verification of installation on ship	Hydraulic tests	Test in operation
1	Equipment and arrangements for the prevention of pollution by oil:					
.1	segregated ballast tanks (reg. 18 of Annex I to MARPOL 73/78);	+	—	+	—	—
.2	slop tanks (reg. 29 of Annex I to MARPOL 73/78)	+	—	+	—	—
.3	cargo tanks of oil tankers (reg. 19 of Annex I to MARPOL 73/78);	+	—	+	—	—
.4	tanks for oil residues (reg. 12 of Annex I to MARPOL 73/78);	+	—	+	—	—
.5	holding tanks for oily bilge waters (if any);	+	—	+	—	—
.6	crude oil washing system	+	+	+	+	+
	(reg. 33 of Annex I to MARPOL 73/78) (where applicable;					
.7	15 ppm separators ⁽¹⁾ ;	+	+	+	+(2)	+
.8	15 ppm bilge alarms ⁽¹⁾ ;	+	+	+	+(2)	+
.9	oil content meter intended for monitoring the discharge of oil-contaminated water from the cargo tank area of oil tankers ⁽¹⁾ ;	+	+	+	+(2)	+
.10	automatic discharge monitoring and control system for oil tankers;	+	+	+	+(2)	+
.11	oil/water interface detectors in slop tanks ⁽¹⁾ ;	+	+	+	—	+
.12	oil/water interface detectors in slop tanks ⁽¹⁾ ;	+	+	+	+	+
.13	oilily water pumping, piping and discharge arrangements including those used for oil tanker cargo areas, oil residues and segregated ballast sludge incineration installations (incinerators) ⁽¹⁾ ;	+	+	+	+(2)	+
.14	system of sludge preparation for incineration (mixing tanks, heating system, filters and homogenizing systems);	+	+	+	+(2)	+
.15	oil fuel tank protection (reg. 12A of Annex I to MARPOL 73/78);	+	—	+	—	—
.16	pump room bottom protection, where applicable (reg. 22 of Annex I to MARPOL 73/78).	+	—	+	—	—
2	Equipment and arrangements for the prevention of pollution by sewage:					
.1	sewage treatment plants ⁽¹⁾ ;	+	+	+	+	+
.2	sewage comminution and disinfection plants;	+	+	+	+	+
.3	holding tanks for the retention of sewage (reg. 9 of Annex IV to MARPOL 73/78);	+	—	+	+	—
.4	sewage disposal and discharge systems	+	+	+	+	+
3	Equipment and arrangements for the prevention of pollution by garbage:					
.1	garbage incineration installations (incinerators) ⁽¹⁾ ;	+	+	+	+(2)	+
.2	garbage processing devices;	+	+	+	—	+
.3	garbage receptacles	+	+	+	—	—
4	Equipment and arrangements for the prevention of pollution by noxious liquid substances carried in bulk:					
.1	cargo tanks (reg. 2.6 of IBC Code ⁽³⁾);	+	—	+	—	—
.2	ventilation equipment for removal of cargo residues (reg. 13.3 of Annex II to MARPOL 73/78);	+	+	+	—	+
.3	stripping system piping;	+	+	+	+	+
.4	underwater discharge outlet (reg. 6-10 of Annex II to MARPOL 73/78);	+	—	+	—	+
.5	cargo tank washing system;	+	+	+	+	+
.6	sewage disposal and discharge systems	+	+	+	+	+
5	Equipment for the prevention of air pollution:					
.1	diesel engines complying with reg. 13 of Annex VI to MARPOL-73/78 and the requirements of NO _x Technical Code ⁽⁴⁾ ;	+	+	+	—	+
.2	exhaust gas cleaning systems in accordance with the requirements of the 2015 Guidelines for Exhaust Gas Cleaning Systems, given in IMO resolution MEPC.259(68);	+	+	+	—	+
.3	equipment for bunker oil sampling	+	+	+	—	+

⁽¹⁾Availability of copy of the Type Test (Approval) Certificates drawn up in accordance with Appendix 2 to Section 17 of Part IV "Technical Supervision during Manufacture of Products" of the Rules for Technical Supervision shall be checked.

⁽²⁾Tightness tests of pipeline of above mentioned equipment in compliance with 17.5.

⁽³⁾International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk, as amended, including 2006/2007 amendments adopted by IMO resolutions MEPC. 166(56)/MSC.219(82).

⁽⁴⁾Technical Code on Control of Emission of Nitrogen Oxides from Marine Diesel Engines.

17.3.2 Installation on the seatings and securing of the equipment shall meet the requirements of the technical documentation approved by the Register.

17.4 SURVEYS AND TESTS ON BOARD SHIPS AFTER INSTALLATION OF PPS EQUIPMENT AND ARRANGEMENTS

17.4.1 General.

17.4.1.1 The installation of the PPS equipment and arrangements shall be checked in accordance with the guidelines of the approved working drawings as well as the process documentation for installation. If the technical documentation contains special requirements for the installation of particular kinds of the PPS equipment and arrangements they shall be fulfilled.

17.4.1.2 The PPS equipment and arrangements having the RS documents confirming its supervision during the manufacture and bench tests according to the RS Nomenclature shall be accepted for installation on board ship.

On agreement with the Register, the bench tests may be replaced by tests on board; and such tests shall be carried out to the full program agreed with the Register and prepared in accordance with the method specified in Part IV "Technical Supervision during Manufacture of Products" of the Rules for Technical Supervision.

17.4.2 Survey of tanks, PPS equipment and arrangements listed in Table 17.2.1.

17.4.2.1 During the survey of tanks the compliance of the arrangement, design and size (capacity) of the tanks with the requirements of the RS-approved design technical documentation shall be checked.

17.4.2.2 During the survey of the segregated ballast tanks of oil tankers it is necessary to check:

- .1 pipelines for the discharge of water ballast (reg. 30 of Annex I to MARPOL 73/78);
- .2 protective location of segregated ballast spaces (reg. 18.12 of Annex I to MARPOL), where applicable;
- .3 absence of connections to the cargo oil and fuel oil systems;
- .4 capacity of the segregated ballast tanks.

17.4.2.3 During the survey of the slop tanks of oil tankers the following shall be checked:

- .1 means for transferring the oily waters into a slop tank after cargo tank washing and, where applicable, pipelines for discharge of oily waters into the sea in compliance with reg. 34 of Annex I to MARPOL 73/78;
- .2 capacity of slop tanks (reg. 29 of Annex I to MARPOL 73/78);
- .3 position of inlets and outlets, baffles and weirs to avoid excessive turbulence (reg. 29.3 of Annex I to MARPOL 73/78).

17.4.2.4 During the survey of the cargo tanks of oil tankers the following shall be checked:

- .1 compliance of cargo tanks with the requirements of reg. 23 of Annex I to MARPOL 73/78;
- .2 protective location of cargo tanks (reg. 19 of Annex I to MARPOL 73/78).

17.4.2.5 During the survey of oil residue (sludge) and oily bilge water tanks the following shall be checked:

.1 absence of direct pipeline connections to/from oil residue (sludge) tanks with side openings, excluding standard discharge connection required by reg. 13 of Annex I to MARPOL 73/78/, as well as of the pipeline running to the incinerator service tank (where applicable);

.2 absence of pipeline connections of oil residue (sludge) tanks running to bilge water pipelines, oily bilge water holding tanks, bilge wells of machinery spaces or 15 ppm bilge separator pipelines, excluding above mentioned pipeline connections equipped with non-return valves to prevent oil residues (sludge) from discharging to oily bilge water system, as well as excluding that:

.3 these tanks may be equipped with the arrangements to discharge settled water to tanks of oily bilge water or bilge wells, the arrangements shall be fitted with manually operated self-closing valves and the visual monitoring for the discharge or with other alternative arrangements which have no direct connection with bilge water piping; and

.4 pump discharge pipeline of the oil residue (sludge) tank and oily bilge water pipeline may be connected to the common pipeline running to the standard discharge connection specified in reg. 13 of Annex I to MARPOL 73/78;

.5 equipment facilitating tanks cleaning and discharge of oil residues (sludge) to reception facilities: manholes of adequate size, heating systems (when heavy fuel oil is used), pump fit for transferring high viscosity oil sludge;

.6 heaters if the oily residues and oily bilge water holding tanks are in contact with a medium or spaces with a negative temperature, or heavy fuel oil is used on board;

.7 installation of light and sound alarms operating in case of 80 % filling of the tank.

17.4.2.6 Hydraulic tests of tanks shall be carried out in compliance with 2.12.

17.4.2.7 Structural arrangements for oil fuel tank protection shall be checked, if applicable (reg. 12A of Annex I to MARPOL 73/78).

17.4.2.8 Structural arrangements for cargo pump room bottom protection shall be checked, if applicable (reg. 22 of Annex I to MARPOL 73/78).

17.4.3 Crude oil tank washing system for oil tankers, if applicable.

17.4.3.1 During the survey the following shall be checked:

- .1 completeness of the technical documentation approved by the Register;
- .2 number and location of the tank washing machines;
- .3 installation and support attachments of the tank washing machines, pipelines, pumps and drive units;
- .4 rotation capability of the tank washing machines;
- .5 readings of the indicators external to the tank to verify the rotational speed of the tank washing machines;
- .6 possibility of isolating the steam heater (if any) for use when water washing, by double shut-off valves;
- .7 possibility of isolating each tank washing machine by means of shut-off valves;
- .8 possibility of blanking off the oil supply line to the machine and closing the tank opening when the machines need be removed;
- .9 possibility of disconnecting effectively the washing system from the cargo oil system;
- .10 availability of drain plugs to provide drainage of the piping;
- .11 possibility of changing over the pumps in the event of any one pump out of order;
- .12 availability of a relief device to prevent overpressure, which shall discharge into the suction side of the supply pump, or temperature sensors on the casings of centrifugal pumps;
- .13 availability of pressure gauges and other instrumentation the connections of which shall be provided with isolating valves adjacent to the lines;
- .14 proper storage and condition of approved flexible hoses for oil supply to the washing machines on combination carriers;
- .15 that inert gas system is installed (refer to the applicable section of STORM Checklist (form 6.1.01)).

17.4.4 15 ppm bilge separators.

17.4.4.1 During the survey the following shall be checked:

- .1 completeness of the technical and service documentation;
- .2 compliance of the related equipment with the technical documentation;
- .3 availability of certificates confirming the Register supervision during the manufacture, as well as the copy of the Certificate of Type Approval for 15 ppm Bilge Separator (form 2.4.17.1/2.4.17.2);
- .4 accessibility of the equipment items, ease of monitoring the instrument indications, possibility of replacing the filtering elements;
- .5 availability and location of the sampling arrangements. The sampling arrangements shall be fitted on pipe sections running vertically as near the separator (filter) outlet as possible;
- .6 availability of the thermometer pockets;
- .7 proper installation of piping;
- .8 availability of drip trays to collect possible leaks of oil residue the pipes of which shall be led into the holding tank;
- .9 installation of the electrical equipment and automation facilities;
- .10 availability of a fixed or portable container to supply metered oily waters into the suction pipe of the equipment during the tests (if contemplated by the design);
- .11 availability of arrangements for draining the equipment;
- .12 compliance with the requirements for installation specified in Section 6.1 of IMO resolution MEPC.107(49) as amended;
- .13 availability of re-circulating facility installed after the 15 ppm bilge separator, 15 ppm bilge alarm and automatic stopping device for their inspection with the sea opening closed.

17.4.5 15 ppm bilge alarm.

17.4.5.1 During the survey the following shall be checked:

- .1 completeness of the technical and service documentation;
- .2 availability of certificates confirming the Register technical supervision during the manufacture, as well as copy of the Certificate of Type Approval for 15 ppm Bilge Alarm (form 2.4.11.1);
- .3 availability of calibration report of the firm (manufacturer);
- .4 Installation and mounting of bilge alarms. Any electrical equipment which is part of the 15 ppm bilge alarm shall be based in a non-hazardous area, or shall be certified as safe for use in a hazardous area; self-recording devices for continuous recording of date, time and oil content in discharge;
- .5 accessibility of the system components;
- .6 availability of identification plates, rating plates, position indicators of the shut-off devices;
- .7 installation of the electrical equipment and automation facilities;
- .8 interlocks precluding discharge with the system switched off or in the event of any fault in the system;

.9 compliance with the requirements for installation specified in Section 6.2 of IMO resolution MEPC.107(49) as amended.

17.4.6 Automatic stopping device.

17.4.6.1 During survey the following shall be checked:

- .1 installation of device;
- .2 availability of shut-off valve location indicator.

17.4.7 Oil discharge monitoring and control system for oil tankers.

17.4.7.1 During the survey the following shall be checked:

.1 completeness of the technical and service documentation;

.2 availability of certificates confirming the Register technical supervision during the manufacture and copy of the Certificate of Type Approval for Oil Content Meters intended for monitoring the discharge of oil-contaminated water from the cargo tank areas of oil tankers (form 2.4.16.1);

.3 availability of record books of the equipment for the main system components;

.4 availability of the operating instruction and technical guidelines approved by the Register, which shall include technical description of the system, methods of operation and redundancy in the event of any fault or failure of the system;

.5 installation and mounting of the oil control meters of the discharge control devices, flow meters and compliance with the requirements of Part VI "Fire Protection" of the Rules for the Classification and Construction, in particular, observance of the regulation concerning passage of pipes and light conductors through the bulkheads;

.6 accessibility of the system components;

.7 availability and location of the sampling arrangements;

.8 availability of the identification plates, rating plates, position indicators of the shut-off devices;

.9 installation of the electrical equipment and automation facilities;

.10 compliance with the requirements for installation and survey of the system specified in Sections 10 and 11 of IMO resolution MEPC.108(49) as amended.

17.4.7 Oil/water interface detectors in slop tanks.

17.4.7.1 During the survey the following shall be checked:

.1 completeness of the technical and service documentation;

.2 availability of certificates confirming the Register technical supervision during the manufacture, as well as Certificate of Type Test for Oil/Water Interface (form 2.4.19);

.3 availability of a document issued by a competent organization which permits installation of the detector in dangerous spaces in accordance with Appendix 1 to Section 10;

.4 installation and securing;

.5 availability of data plates and marking (for permanently installed detectors);

.6 installation of electrical equipment including earthing jumpers (for permanently installed detectors).

17.4.7.2 Pipes of the detectors working on nonelectrical principles shall be tested in accordance with the RS-approved technical documentation.

17.4.8 Pumping, piping and discharge arrangements for oily waters, oil residues, segregated ballast.

17.4.8.1 The following pipelines shall be subjected to survey:

.1 discharge pipelines intended for the discharge of oily residues and oily waters to reception facilities with control of dimensions of flanges for standard discharge connections (reg. 13 in Annex I to MARPOL 73/78);

.2 pipelines for the discharge of oily mixtures to the sea from the cargo tank area;

.3 pipelines and arrangements for the discharge to the sea of the segregated ballast of oil tankers.

17.4.8.2 During survey of ships, including oil tankers, the following shall be checked:

.1 completeness of the technical documentation on the pipelines referred to in 17.4.8.1.1 and 17.4.8.1.2;

.2 availability and location of the pipelines referred to in 17.4.8.1.1 and 17.4.8.1.2, including dimensions of flanges for standard discharge connections (reg. 13 of ANNEX I to MARPOL 73/78), which shall ensure ease of connection of hose and fitting of blank flanges. The pipelines for the discharge of oily mixtures to sea shall be led to the open deck or to the ship's side above the waterline in the deepest ballast condition;

.3 availability of an arrangement for manual starting and stopping of the discharge arrangements;

.4 availability and fitting-out of the discharge observation and remote cut-off position or availability of the effective communication system (such as telephone or radio system) between the observation position and the discharge control position.

17.4.8.3 When surveying oil tankers, in addition to checks under 17.4.8.2.1 – 17.4.8.2.4, the following shall be checked:

.1 location, installation of the pipelines and arrangements referred to in 17.4.8.1.3;

.2 installation of the system of pipelines for the emergency cargo transfer (if any) (reg. 23.11.2 of Annex I to MARPOL 73/78);

.3 availability of valves or other closing arrangements located at a point of connection with any cargo tank: in the pipelines which run through cargo tanks in the vicinity of the ship's side or bottom (in accordance with reg. 23.11.1 of Annex I to MARPOL 73/78);

.4 possibility of draining the cargo pumps and pipelines through the use of stripping system (reg. 30.4 of Annex I to MARPOL 73/78);

.5 availability of a portable spool piece (if any) for emergency discharge of segregated ballast and of non-return valves (the Unified Interpretations to reg. 1.18 of Annex I to MARPOL 73/78);

.6 availability of reliable closing arrangements installed in the pipeline system to prevent the pipeline section between the sea-chest valve and inside shut-off valve from being filled with cargo (if applicable) (reg. 30.7 of Annex I to MARPOL 73/78);

.7 equipment for transfer of oil cargo between oil tankers at sea according to Ship to Ship Transfer Operations Plan (STS operations Plan) (for oil tankers involved in STS operations from 1 January 2011, if applicable) (reg. 41.1 of Annex I to MARPOL 73/78).

17.4.9 Sewage treatment plants.

17.4.9.1 During the survey the following shall be checked:

.1 completeness of the technical and service documentation including the Guidelines (description and instruction) for the installation and operation of the sewage treatment plants, which have been taken into consideration by the Register;

.2 availability of copy of the Certificate of Type Test/Approval for Sewage Treatment Plants (form 2.4.13.1/2.4.13.2) and a certificate confirming the Register technical supervision during the manufacture of the plant;

.3 consistency between the related equipment and the technical documentation;

.4 availability of valid documents and brands of the standard instruments put by a competent body;

.5 installation, assembly and securing of the equipment, associated pumps, arrangements, pipelines and fittings, automation, monitoring and control devices;

.6 availability of sampling arrangements. The plant shall be provided with a sampling arrangement located at the purified water outlet in accordance with the technical documentation approved by the Register;

.7 installation of the electrical equipment and automation facilities, earthing of the plant and electrical equipment insulation resistance.

17.4.9.2 Upon the finalization of the checks referred to in 17.4.9.1.1 – 17.4.9.1.7, it is necessary to conduct hydraulic tests of the plant.

The plant shall be tested by a test pressure equal to 1,5 times the water column pressure measured from the plant bottom to the lower toilet bowl not provided with a shut-off device in the discharge line, but not less than 25 kPa.

17.4.10 Sewage comminution and disinfection plants.

17.4.10.1 During the survey the following shall be checked:

.1 completeness of the technical and service documentation;

.2 availability of a certificate confirming the Register technical supervision during the manufacture of the plant;

.3 compliance of the related equipment with the technical documentation;

.4 availability of valid documents and brands of the standard instruments put by a competent body;

.5 installation, assembly and securing of the equipment, associated pumps, arrangements, pipelines and fittings, automation, monitoring and control devices;

.6 installation of the electrical equipment and automation facilities, earthing of the plant and electrical equipment insulation resistance.

17.4.10.2 Upon the finalization of the checks referred to in 17.4.10.1.1 – 17.4.10.1.6, it is necessary to conduct hydraulic tests of the plant in compliance with the requirements of 17.5.

The plant shall be tested by a test pressure equal to 1,5 times the water column pressure measured from the plant bottom to the lower toilet bowl not provided with a shut-off device in the discharge line, but not less than 25 kPa.

17.4.11 Sewage holding tanks.

17.4.11.1 During the survey the following shall be checked:

.1 completeness of the technical and service documentation including the calculation of the total capacity of the holding tanks enabling retention of all sewage, having regard to the intended area of navigation, service conditions of the ship and number of persons on board, taken into consideration by the Register and agreed with the shipowner;

.2 compliance of the size and design of the tanks with the approved documentation and the location thereof;

.3 availability of manholes and their closing appliances;

.4 availability of the arrangements for flushing and steaming;

- .5 availability of the arrangements for sediment resuspension (if contemplated by the technical documentation);
- .6 availability and condition of the corrosion protection against effect of water;
- .7 availability of the bottom inclination towards the inlet;
- .8 availability of the visual and acoustic alarm;
- .9 availability of cofferdams separating the sewage holding tanks from the tanks used for drinking, washing water and for vegetable oil, as well as from accommodation, service (domestic) and cargo spaces intended for the carriage of food-stuff;
- .10 availability of efficient means to indicate visually the amount of sewage holding tanks contents.

17.4.11.2 Upon the finalization of the checks referred to in 17.4.11.1.1 – 17.4.11.1.10, it is necessary to conduct hydraulic tests of the holding tanks in accordance with the requirements of 2.12 of the Guidelines, as well as with Appendix 1 to Part II "Hull" of the Rules for the Classification and Construction.

17.4.12 Sewage disposal and discharge systems.

17.4.12.1 During the survey, the following shall be checked:

- .1 completeness of the technical and service documentation;
- .2 availability, location and securing of the pumps (eductors) intended for sewage discharge;
- .3 availability and location of the pipelines and fittings, including dimensions of flanges for standard discharge connections (reg. 10 of Annex IV to MARPOL 73/78), which shall ensure ease of connection of hoses for discharging sewage to reception facilities;
- .4 availability of blank flanges to the discharge connections;
- .5 availability of arrangements for manual starting and stopping of the pumps (eductors);
- .6 availability and fitting-out of the discharge observation and remote cut-off position or availability of the effective communication system (such as telephone or radio system) between the observation position and the discharge control position;
- .7 availability of arrangements providing discharge of untreated sewage water at the discharge rate approved by the Register and calculation in compliance with IMO resolution MEPC.157(55), if applicable.

17.4.13 Incinerators.

17.4.13.1 During the survey the following shall be checked:

- .1 completeness of the technical and service documentation;
- .2 compliance of the related equipment with the technical documentation;
- .3 availability of copies of the certificates confirming the Register technical supervision during the manufacture, as well as Certificate of Type Approval for Shipboard Incinerators (form 2.4.12/2.4.12.1) and also brands and marking;
- .4 satisfactory installation and securing of the equipment, associated machinery, system of sludge preparation for incineration, pumps, flame arresters, pipelines and fittings, automation, alarm and monitoring devices;
- .5 condition of the incinerator interior and ash bin;
- .6 tight closure of the charging hopper covers and availability of an interlock to make their simultaneous opening impossible;
- .7 availability of plates with warning inscriptions with respect to the materials charged;
- .8 proper installation of the pipelines and quick-closing valve of the service tank;
- .9 availability of drip trays to collect possible fuel leaks, the pipelines of which shall be led into the holding tank;
- .10 installation of the electrical equipment and automation facilities including connection of the ventilator power supply feeder to the emergency switchboard (if contemplated by the design);
- .11 possibility of shutting off the burners from two positions one of which shall be located outside the space where the incinerator is installed;
- .12 availability of automatic fire alarm and detection system;
- .13 availability of a fire extinguishing system provided with a control console located in a readily accessible position outside the space where the incinerator is installed.

17.4.14 Garbage comminuters and compactors.

17.4.14.1 During the survey the following shall be checked:

- .1 completeness of the technical and service documentation;
- .2 compliance of the related equipment with the technical documentation;
- .3 availability of a document confirming the RS technical supervision during the manufacture, and the marking;
- .4 location and securing of the equipment, associated machinery, pumps, arrangements, pipelines and fittings, automation, control and monitoring devices;
- .5 installation of a garbage chute (if appropriate) which shall run above the bulkhead deck and be fitted with covers capable of being locked;

- .6 installation of the electrical equipment and automation facilities;
- .7 ensuring comminution using comminutors to grind food wastes to a particle size no greater than 25 mm.

17.4.15 Garbage containers.

17.4.15.1 During the survey the following shall be checked:

- .1 completeness of the technical and service documentation;
- .2 compliance of location, design and size of garbage containers with the RS-approved technical design documentation;
- .3 availability of distinctively marked garbage types in compliance with IMO resolution MEPC.219(63) as amended;
- .4 availability of smooth inner surfaces with no openings in the walls and bottom;
- .5 condition of the covers and their tight closing;
- .6 availability of means for safe securing of garbage containers on board the ship.

17.4.16 Cargo tanks of ships intended for the carriage of noxious liquid substances in bulk.

17.4.16.1 During the survey the following shall be checked:

- .1 completeness of the technical documentation pertaining to the tanks and their equipment;
- .2 compliance of tank location, design and size with the requirements of the RS-approved technical design documentation, including protective location of cargo tanks (reg. 2.6 of IBC Code), where applicable.

17.4.17 Ventilation equipment for the removal of gaseous residues of the noxious liquid substances.

17.4.17.1 During the survey the following shall be checked:

- .1 completeness of the technical documentation pertaining to the ventilation equipment;
- .2 availability of certificates confirming the RS technical supervision during the manufacture of ventilation equipment;
- .3 compliance of the location, design of the equipment with the requirements of the approved design technical documentation. Any alterations shall be agreed upon with the Register;
- .4 installation and securing of the equipment, accessibility for maintenance and inspection, proper installation of supply pipelines, installation of electrical equipment.

17.4.18 Tank washing system for ships carrying noxious liquid substances in bulk.

17.4.18.1 During the survey the following shall be checked:

- .1 completeness of the technical documentation pertaining to the arrangements;
- .2 compliance of the location, design of the equipment (including tank washing machines, washing water heating system) with the requirements of the approved design technical documentation. Any alterations shall be agreed upon with the Register;
- .3 the required number and location of the tank openings for portable tank washing machines which shall comply with the approved diagrams.

17.4.19 Cargo and washing water discharge pipeline systems of ships carrying noxious liquid substances.

17.4.19.1 During the survey the following shall be checked:

- .1 completeness of the technical documentation pertaining to the system;
- .2 compliance of the location, design of the systems and its components with the RS-approved technical documentation;
- .3 provision of pumps and pipelines with the required stripping quantity upon results of performance tests (Appendix 5 of Annex II to MARPOL 73/78);
- .4 compliance of underwater discharge outlet size and location with the requirements (reg. 12.6 – 12.10 of Annex II to MARPOL 73/78);
- .5 installation of electrical equipment and system automation devices.

17.4.20 Equipment for the prevention of air pollution.

17.4.20.1 Diesel engines, including those fitted with NO_x reducing devices and complying with reg. 13 of Annex VI to MARPOL 73/78 and the requirements of the NO_x Technical Code.

17.4.20.1.1 During the survey the following shall be checked:

- .1 completeness of technical documentation: approved Technical File of Marine Diesel Engine with NO_x Reducing Device;
Engine International Air Pollution Prevention Certificate (EIAPP Certificate) (form 2.4.40);
- .2 engines using parameter check method in compliance with the requirements of 6.2 of the NO_x Technical Code. For engines equipped with NO_x reducing devices, it will be necessary to check the operation of NO_x reducing device, as part of the engine parameter check method.

In cases where the engine has neither been tested on the firm's (manufacturer's) test bed together with NO_x reducing device due to impracticality of such testing nor the EIAPP Certificate (form 2.4.40) has been issued for

that engine with the NO_x reducing device, the check shall be performed in accordance with the procedure specified in 17.6.17.1.

17.4.20.2 Exhaust gas cleaning (EGC) systems for reducing SO_x emissions (if any) in compliance with the requirements of the 2015 Guidelines for Exhaust Gas Cleaning Systems, given in IMO resolution MEPC.259(68).

17.4.20.2.1 During the survey the following shall be checked:

.1 availability of SO_x Emission Compliance Certificate — Certificate of Unit Approval for Exhaust Gas Cleaning Systems (form 2.4.42);

.2 installation of EGC systems has been carried out in accordance with the requirements imposed.

17.4.20.3 Equipment for fuel oil sampling.

17.4.20.3.1 During the survey the following shall be checked:

.1 availability of approved documentation or Type Approval Certificate for the equipment for fuel oil sampling;

.2 availability of an operating instruction for the equipment for fuel oil sampling;

.3 installation of the equipment for fuel oil sampling in accordance with the requirements imposed.

17.4.21 Cargo vapour collection and discharge system of oil tankers.

17.4.21.1 During the survey the following shall be checked:

.1 completeness of the technical documentation pertaining to the system;

.2 compliance of the location, design of the equipment with the RS-approved technical documentation;

.3 satisfactory installation of the following:

piping of vapour collection system;

means for condensate removal at low points on the piping system ends;

shut-off valves of the vapour discharge manifolds;

.4 compliance of the vapour removal flanges with the IMO requirements and industrial standards.

17.5 HYDRAULIC TESTS

17.5.1 The tightness tests of pipelines of the systems referred to in items 1.1 — 1.8, 1.10, 1.11, 2.4, 3.1, 4.4 and 5.2 of Table 17.2.1, after their mounting on the ship, shall be conducted in compliance with 21.2.3, Part VIII "Systems and Piping" of the Rules for the Classification and Construction, provided that all works associated with the installation of the fittings and instruments have been completed prior to the tests.

17.5.2 The tightness tests of pipelines of sewage treatment plants or sewage comminuting and disinfecting system (refer to 2.1 and 2.2 of Table 17.2.1), shall be carried out in compliance with 17.4.9.2 or 17.4.10.2 after their mounting on the ship. The test pressure used for the tests shall be maintained within 5 — 10 min, then it shall be reduced down to the working pressure and kept constant until the inspection is completed.

17.5.3 The equipment and arrangements shall be considered as passed the tests, if no leak or sweating in the welds, no water leaks in the flared pipe joints and in the coupling flanges of the fittings and instrumentation connections are detected.

17.6 FUNCTIONAL TEST

17.6.1 General.

17.6.1.1 Functional tests of the equipment and arrangements shall be carried out during mooring and/ or sea trials of the ship according to program approved by the Register.

17.6.1.2 Tests shall be carried out using the standard equipment and instrumentation. Instruments used on the tests shall have documents of a competent body and/or brands certifying their periodic verifications if these instruments are subject to such verification.

17.6.1.3 Items the installation of which have been surveyed by the RS surveyor in accordance with 17.4 and with no remarks made thereon, which hinder such tests, shall be accepted for tests.

17.6.1.4 Ship's service systems, machinery, pumps, automatic equipment, electrical equipment, etc. operating directly or in association with the equipment and arrangements to be subjected to functional tests shall be tested in accordance with 17.1.6.

17.6.1.5 During the tests it is necessary to check operation of the safety means which shall be set to a pressure not in excess of 1,1 the working pressure.

17.6.1.6 The general test procedure is set out in Section 18.

17.6.1.7 Where necessary, revision and check-out tests shall be carried out.

17.6.2 Tank washing system for oil tankers.

17.6.2.1 The system shall be tested with pure sea water.

17.6.2.2 During the tests the following shall be checked:

.1 operation of the tank washing machines, including simultaneous action of the greatest number of the tank washing machines contemplated by the design;

.2 operation of devices installed outside the cargo tanks indicating rotation and arc of rotation of each stationary washing machine;

.3 operation of the double shut-off valves of the washing water heater if contemplated by the design;

.4 capacity of the stripping system which shall exceed by 1,25 times the total capacity of all tank washing machines to be operated simultaneously during the tank bottom cleaning;

.5 drainage of all cargo lines and pumps into the cargo or slop tanks or shore reception facilities through the use of stripping system via a special small diameter line to be connected to the ship's cargo system manifold valves;

.6 operation of the indicators and instrumentation;

.7 operation of the shut-off valves or other means enabling isolation of any tank not being stripped at that particular time;

.8 operation of safety valves of the crude oil washing system pumps;

.9 that the inert gas system was tested in compliance with the requirements of SOLAS-74/88/00.

17.6.3 15 ppm bilge separators.

17.6.3.1 Tests shall be carried out with a supply rate equal to the full throughput for which the equipment is designed.

17.6.3.2 Tests shall be performed using oily water taken directly from the engine room bilges or from a special vessel.

17.6.3.3 Prior to the test, the equipment shall be filled with pure sea water until it emerges from the sampling arrangement.

17.6.3.4 The tests shall proceed for 30 min. At the same time, samples shall be taken at effluent inlet and outlet of the 15 ppm separator at 10 min of steady condition. In case of unsatisfactory results of sample analysis at effluent outlet of the 15 ppm separator, sampling shall be repeated at effluent inlet and outlet of the 15 ppm separator at 10 min of steady condition and only at effluent outlet of the 15 ppm separator at 20 and 30 min of steady condition.

Where 15 ppm bilge alarm is fitted, 15 ppm bilge separator may be checked without sampling. In this case, cleaning capacity of 15 ppm bilge separator shall confirm readings of 15 ppm bilge alarm calibrated by the firm (manufacturer).

17.6.3.5 Samples shall be taken and analyzed in accordance with the requirements of 1.2.12 — 1.2.14 Part I of Annex to IMO resolution MEPC.107(49).

17.6.3.6 Oil content in the effluent shall not exceed that specified in the Certificate of Type Approval (refer to 17.4.4.3).

17.6.3.7 Operation of the sensors detecting the presence of oil in the oil collector and operation of the separator automatic draining valves shall be checked in compliance with the firm's (manufacturer's) instructions.

17.6.3.8 During the tests the following shall be checked:

.1 leak-tightness of connections when the equipment is in operation;

.2 operation in automatic control mode;

.3 operation of pumping units and associated systems;

.4 operation of automation, alarm and monitoring facilities;

Checks may be performed by creating extreme parameters directly at the system sensors.

17.6.4 15 ppm bilge alarm and automatic stopping devices.

17.6.4.1 Oily bilge water together with 15 ppm separator shall be tested.

During tests, the following shall be checked:

.1 zero setting of bilge alarm in compliance with 15 ppm bilge alarm operating manual;

.2 continuous recording of date, time and oil content in discharge by 15 ppm bilge alarm;

.3 automatic actuation, when the oil content of discharge exceeds the set value, accompanied by visual and audible alarm with simultaneous switching-over of automatic stopping device to prevent discharge overboard and in case of 15 ppm bilge alarm failure, warming-up and deactivation.

17.6.5 Oil discharge monitoring and control systems for oil tankers.

17.6.5.1 Tests shall be carried out with water.

17.6.5.2 The system testing shall, at least, include the tests specified in Section 12 of IMO resolution MEPC.108(49).

17.6.6 Oil/water interface detectors in slop tanks.

17.6.6.1 The detector operation shall be checked when passing from oil to water and vice versa in compliance with the firm's (manufacturer's) instructions.

17.6.6.2 Check shall be performed with the use of a tank where the oil/water interface is clearly visible. The thickness of oil and water layers shall be, at least, sufficient for the detector to be completely submerged.

17.6.7 Pumping and discharge arrangements for oily waters and oil residues.

17.6.7.1 The tests shall be carried out with oily water or sea water.

17.6.7.2 When testing the discharge arrangements for oily water and oil residues to reception facilities the following shall be checked:

.1 operation of the devices for manual starting and stopping of the discharge arrangements;

.2 operation of the system for remote cut-off of the discharge arrangements from the discharge observation position or of the effective communication system (such as telephone or radio system) between the observation position and discharge control position;

.3 operation of the visual and acoustic alarm giving a warning when the upper limiting level in the holding tanks is reached. The alarm shall be activated in case of 80 % filling of the holding tank.

17.6.7.3 When oil tankers are surveyed, operation of the systems, equipment and fittings specified in 17.4.8.3 is additionally checked.

17.6.8 Sewage treatment plants.

17.6.8.1 The plant shall be tested with water. During the test the following shall be checked:

.1 free flow of the influent to the plant;

.2 operation of the maserator to provide for comminution of the sewage particles (if forms a part of the plant set);

.3 operation of the pumping and blower units;

.4 operation of the level detectors situated in the plant chambers;

.5 operation of the metering arrangements to supply coagulant solutions and disinfectants;

.6 operation under manual and/or automatic control modes;

.7 operation of the automation, monitoring and alarm facilities (simulation method may be accepted);

.8 operation of the electrical drives and auxiliary machinery (by external inspection);

.9 operation of the submersible pumps (if form part of the plant set);

.10 operation of the ventilation system of the space if the plant is installed in a separate space.

17.6.8.2 Then the sewage treatment plant shall be tested using the sewage formed under normal operating conditions together with sampling in compliance with the sewage treatment plant operating manual.

The plant treatment capacity shall be evaluated based on the following parameters:

sewage sample transparency after treatment;

content of activated sludge;

aerated mixture oxygenation, etc.

Upon unsatisfactory results of the above mentioned check, the plant shall be tested with the sewage sampling and analysis performed by the recognized laboratory.

Conclusion of recognized laboratory shall be attached to the Register survey report.

17.6.9 Sewage comminution and disinfection plants.

17.6.9.1 The tests shall be carried out in accordance with 17.6.8.1, as applicable.

17.6.10 Sewage holding tanks.

17.6.10.1 Tests may be carried out with sea water.

17.6.10.2 During the tests the following shall be checked:

.1 free flow of the sewage influent;

.2 washing from the water fire main and steaming from the steam heating system;

.3 drainage by pump or eductor with discharge to the sea;

.4 operation of the visual and acoustic alarm giving a warning when the upper limiting level in the holding tanks is reached. The alarm shall be activated in case of 80 % filling of the holding tank;

.5 efficiency of means to indicate visually the amount of sewage holding tanks contents.

17.6.11 Sewage disposal and discharge systems.

17.6.11.1 The functional test shall be carried out together with tests referred to in 17.6.8 — 17.6.10, depending on the item actually fitted on board the ship.

17.6.11.2 During the test the following shall be checked:

.1 operation of devices for manual starting of the discharge arrangements;

.2 possibility of pumping out the sewage from the holding tanks to the reception facilities;

.3 operation of the system for remote cut-off of the discharge arrangements from the discharge observation position or of the effective communication system (such as telephone or radio system) between the observation position and discharge control position;

.4 devices providing discharge of untreated sewage with the RS-approved rate of discharge (where applicable) in compliance with IMO resolution MEPC.157(55).

17.6.12 Incinerators.

17.6.12.1 The test shall be conducted with wastes specified in the documentation on the incinerator.

17.6.12.2 Water content of the oil wastes and/or sewage sludge (if the incinerator is intended to burn them) shall be not lower than that given in the documentation.

17.6.12.3 The tests shall be carried out in modes contemplated in the documentation on the incinerator. The sequence of the modes, time of operation in each mode, as well as the priority of tests shall be defined by a program approved by the Register.

17.6.12.4 The incinerator testing shall include the tests specified in Section 7.3 of Standard Specification for Shipboard Incinerators in IMO resolution MEPC.244(66).

During the tests the following shall be checked:

.1 operation of the space ventilation if the incinerator is located in a separate space;

.2 operation of the interlock of the charging hopper covers (if any) which shall make their simultaneous opening impossible when garbage is charged;

.3 operation of the interlock of the fuel burner when the burner is in the operating position and the combustion air is fed to the furnace;

.4 operation of the automatic device which cuts-off fuel supply to the burner within not more than 5 s in the following cases:

loss of air flow to the furnace;

flame failure in the torch;

failure of electric power supply;

.5 operation under manual and automatic control modes;

.6 operation of the automation, alarm and monitoring facilities;

.7 condition of the space during the incinerator operation;

.8 no spark ejection to the atmosphere from the exhaust gas system.

17.6.13 Garbage processing devices.

17.6.13.1 During the test the following shall be checked:

.1 operation of the space ventilation if the plant is located in a separate space;

.2 operation of the garbage charging machinery;

.3 operation of garbage comminuters providing the required comminution of particles (not exceeding 25 mm in size);

.4 operation of garbage compactors in compliance with the Operating Manual;

.5 operation of the automation, alarm and monitoring systems.

17.6.14 Ventilation equipment for removal of the residues of noxious liquid substances.

17.6.14.1 The equipment shall be checked by an accessible method (e.g. by putting the equipment and air conduits into operation with simulation of the presence of the noxious liquid substances in the tanks or by testing the equipment and pipelines only for functional performance). The method of checking shall be agreed with the Register.

17.6.14.2 It shall be checked that removal of cargo residues from tank is performed by ventilation in compliance with Appendix 7 of Annex II to MARPOL 73/78 and approved Procedures and Arrangements Manual.

17.6.14.3 The effectiveness of tank ventilation shall be checked.

17.6.14.4 Operation of the ventilation system in way of the tank manholes when these are located in the space shall be checked.

17.6.15 Tank washing equipment.

17.6.15.1 The equipment may be checked by putting the equipment and pipelines into operation and by testing the tank washing machines for functional performance.

17.6.16 Cargo and washing water discharge systems of oil tankers carrying noxious liquid substances in bulk.

17.6.16.1 The cargo vapour discharge system shall be tested in compliance with Section 3, Appendix 5 of Annex II to MARPOL 73/78 to determine the system cleaning capacity according to regulation 12 of the above mentioned Annex. Compliance with the procedure for cargo tank stripping given in the approved Procedures and Arrangements Manual shall be verified.

17.6.16.2 When testing the system for washing water discharge through the underwater discharge outlet, operation of the system equipment and piping shall be tested. Tests shall be performed using the water free of noxious substances.

17.6.16.3 The equipment and pipelines forming part of the system shall be tested for functional performance.

17.6.16.4 During performance test of the system, its stripping ability shall be checked in compliance with reg. 12 of Annex II to MARPOL 73/78.

17.6.17 Equipment for the prevention of air pollution from ships.

17.6.17.1 Diesel engines complying with regulation 13 of Annex VI to MARPOL 73/78 and requirements of the NO_x Technical Code.

The onboard confirmation tests of marine diesel engines to confirm that the engine continues to comply with the applicable NO_x emission limit contained in reg. 13 of Annex VI to MARPOL 73/78 may be conducted in accordance with the on board NO_x verification procedures provided in the engine's NO_x Technical File.

In cases where the engine has neither been tested on the manufacturer's test bed together with a NO_x reducing device (refer to 17.4.20.1) nor the EIAPP Certificate has been issued for that engine with the NO_x reducing device, the pre-certification of that engine and the NO_x reducing device shall be performed. Where the selective catalytic reduction (SCR) system is used as NO_x reducing device, the 2011 Guidelines Addressing Additional Aspects to the NO_x Technical Code 2008 with Regard to Particular Requirements Related to Marine Diesel Engines Fitted with Selective Catalytic Reduction (SCR) Systems given in IMO resolution MEPC.291(71) shall be considered. The engine's Technical File shall be approved and the EIAPP Certificate (form 2.4.40) shall be issued upon the pre-certification results. However such onboard recertification of engine fitted with NO_x reducing device may be accepted for an individual engine or for an engine group represented by the parent engine only, but it shall not be accepted for an engine family certification.

17.6.17.2 During tests in operation of an exhaust gas-SO_x cleaning system (if any), in order to reduce SO_x emission, the means for automatic recording are checked. Such recording shall, as a minimum, include the following parameters:

- washing water pressure and rate at the system inlet;
- water alkalinity (pH) at the system inlet and outlet;
- exhaust gas pressure difference and maximum exhaust gas pressure at the exhaust gas cleaning system inlet;
- exhaust gases temperature at the exhaust gas system inlet and outlet;
- loading of a fuel oil combustion unit.

17.6.17.3 The operation of arrangements for engines change-over to low sulphur fuel oil (if any) is checked in accordance with the procedure for ship's fuel-oil system preparation in a SO_x emission control area developed by the shipowner.

17.6.18 Instrumentation

17.6.18.1 When the systems and equipment referred to in 17.6.14 — 17.6.17 are subjected to tests in operation, operation of the instruments shall be checked simultaneously.

Documentation and/or brands of the instruments certifying that the mandatory periodical verifications have been performed by a competent body shall be checked.

17.6.19 Cargo vapour collection and discharge systems of oil tankers.

17.6.19.1 During the survey the following shall be checked:

- .1 operation of the means for condensate removal at low points on the piping system ends;
- .2 operation of shut-off valves of the vapour discharge manifolds;
- .3 marking of the vapour discharge pipeline outputs.

18 MOORING AND SEA TRIALS

18.1 GENERAL

18.1.1 The provisions of the present Section specify the procedure of technical supervision during mooring and sea trials of ships, machinery, arrangements, systems and equipment based under valid Rules for the Classification and Construction, Rules for the Equipment, as well as under the provisions of Part I "General Regulations for Technical Supervision" and of Part II "Technical Documentation" of the Rules for Technical Supervision.

For the purpose of defining the scope and methods of conducting trials, the provisions of appropriate sections of the Guidelines shall be followed accordingly.

18.1.2 The provisions of this Section shall be followed when considering programmes of mooring and sea trials when performing the trials, as well as when considering normative and technical documentation for trials of ships, machinery, arrangements, systems, equipment and outfit.

18.1.3 The Register technical supervision during trials of ships and equipment shall be carried out with the purpose of checking their compliance with the RS-approved (RS-agreed) technical documentation, rules and norms of the Register and also with the provisions of the international conventions applicable to a ship under construction.

18.1.4 The period of trials shall include the following stages of work:

- .1 mooring trials;
- .2 sea trials.

18.1.5 Preparation and trials shall be carried out by the shipyard. The results of this work, namely: entries in ship forms dealing with deslushing of the equipment, measurements tables of adjustment and alignment works shall be requested, where necessary, by the RS surveyor from the shipyard in advance of the commencement of mooring trials of relevant equipment.

18.1.6 Technical supervision of mooring and sea trials of ships, machinery, arrangements, equipment and outfit required by the relevant sections of the Guidelines shall be carried out by the surveyors of either the RS Branch Office supervising ship construction or another RS Branch Office as authorized by RHO.

18.1.7 Mooring and sea trials programme shall be developed, agreed and approved in compliance with the valid requirements of the Rules for the Classification and Construction, Rules for the Equipment, Rules for Technical Supervision and RS-approved technical documentation.

The programme shall be approved by the Register in compliance with the provisions of Part II "Technical Documentation" of the Rules for Technical Supervision.

18.1.8 Mooring and sea trials shall be carried out under the mooring and sea trials programme approved by the Register; meanwhile, programmes for special purpose or design or type ships under construction in the countries where no RS Branch Offices available shall be considered by RHO; in all other cases, programmes shall be considered by the RS Branch Office.

18.1.9 In the programme for any kind of ship machinery, arrangements, systems and equipment the following technical requirements shall be indicated and necessary explanations, descriptions and methods shall be specified:

- .1 conditions under which the tests shall be performed;
- .2 scope of tests;
- .3 duration of modes of operation;
- .4 list of measured parameters;
- .5 frequency of measurements;
- .6 sequence of tests;
- .7 applied devices and apparatus;
- .8 loading appliances;
- .9 other auxiliary equipment necessary for trials.

Additional requirements for the contents of the programme for mooring and sea trials of internal combustion engines are given in Appendix 1 to this Section.

18.1.10 The programme for mooring and sea trials shall specify the technological requirements relative to integrated trials of machinery, arrangements, systems and equipment, relative to use of simulating and instrumental methods of checks, relative to use of special power sources, etc. In this case the possibility of using simulating methods of trials and special power sources shall be agreed with the Register upon submission of the relevant technical background.

When testing the shipboard equipment, which consists of a number of machinery, arrangements, systems and apparatus (for example, propulsion plant (PP))¹, the programme shall specify simultaneous trials on preset modes of all machinery, systems, arrangements and apparatus contained in this system.

18.1.11 The programme for mooring and sea trials shall take into account the requirements of standards and technical documentation relative to delivery, and also the requirements of the firm's (manufacturer's) programmes for trials of the delivered equipment.

When there are methods available for trials agreed with the Register, the programme for mooring and sea trials shall contain references thereto.

The shipyard's documents issued upon the results of mooring and sea trials shall include measurements, regulated by the relevant sections of the Guidelines.

18.1.12 The shipyard constructing the ship shall provide for all necessary conditions for technical supervision by the RS surveyor in the course of mooring and sea trials in compliance with the requirements of 13.10, Part I "General Regulations for Technical Supervision" of the Rules for Technical Supervision, and ensures the following:

- .1 ship and shipyard communication facilities;
- .2 transport means.

18.1.13 Controls of the equipment, which is provided by the firm (manufacturer) in the course of trials, shall be carried out in compliance with the regulations of technical supervision and its maintenance instructions.

The RS surveyor is not authorized to operate the equipment by himself or to interfere into actions of the attending personnel. In case actions of the personnel might cause an accident or damage to the equipment, the RS surveyor is entitled to require via the control body and responsible representative of the manufacturer to eliminate breaches (up to his refusal from further participation in the trials under way).

18.1.14 In the course of the trials any works disturbing the normal procedure of trials or being of any danger for participants shall be excluded. The equipment under trials, as well as the space around shall be clean and free of any obstacles; provision shall be made of proper illumination and ventilation of the spaces.

18.1.15 The items of supervision, the testing results of which do not meet the requirements of the Rules for the Classification and Construction, Rules for Technical Supervision or RS-approved documentation shall be retested upon elimination of causes of unsatisfactory test results.

18.1.16 Elimination of deficiencies and retesting shall be agreed upon with the RS surveyor. Retesting shall not affect further tests or interfere with there safely.

18.1.17 Measurements which are taken by the technical control body and which determine proper operation of the item of supervision shall be processed by the technical control body on the completion of the tests of the item of supervision and submitted to the RS surveyor.

In case of satisfactory results the RS surveyor signs the shipyard's document on the completion of tests of items of supervision, which in certain cases shall be appended with tables of measurements.

18.1.18 A break in the trials of the item of supervision in continuous modes is specified in the programme of trials and the question of resuming the trials and their conditions (increase of the duration and scope) shall be agreed with the RS surveyor, with due regard to the reasons, which have caused the interruption of the trials.

18.1.19 Trials of items of supervision shall be interrupted in the following cases:

- .1 where faults or defects of items of supervision are found;
- .2 where the item of supervision is in emergency condition;
- .3 in case the meteorological conditions get worse and it interferes with further performance of the tests, distorts the test results, affects safety of first performance and safely of the ships.

Decision about suspension of the trials depending upon the causes shall be taken by the RS surveyor or shipyard (as agreed with the RS surveyor).

Irrespective of the person who has taken such a decision, the item of supervision is subject to re-testing the duration and scope of which shall be agreed with the RS surveyor.

18.1.20 In case of suspension of tests of the item of supervision at the RS surveyor's request or on agreement with the RS surveyor, the report is drawn up wherein the causes of such suspension of tests, requirements for correction of the stated causes prior to re-testing and re-testing conditions shall be contained.

18.1.21 The ship may have such items of supervision installed on board, which have not been tested in full scope by the firm (manufacturer), provided that they shall be tested under special programme agreed with the Register, with subsequent tests under the programme of mooring and sea trials.

The above requirement applies to the prototype ships and to ships of a series.

18.1.22 The RS surveyor shall not participate in the ship commissioning work of the acceptance commission.

¹This shall include main engines, shaftings and propellers with gears, bearings, and couplings, as well as auxiliary machinery, systems, arrangements, boilers, pressurized vessels, etc.

18.2 MOORING TRIALS

18.2.1 Mooring trials shall be carried out in order to check the following:

.1 arrangement, completeness, quality of installation, adjustment and serviceability of the propulsion and auxiliary machinery, arrangements, systems, equipment and outfit as well as compliance of their parameters with the requirements of the RS-approved technical documentation;

.2 readiness of the ship, its propulsion and auxiliary machinery, arrangements, systems and equipment for the sea trials.

18.2.2 Fulfillment of the requirements for separate items of technical supervision may be transferred, as agreed with the RS surveyor, (in exceptional cases) to the period of sea trials or some other time unless these requirements prevent from carrying out sea trials and affect the safety of the ship and people on board.

18.2.3 In case the RS Branch Office is of the opinion that the ship is not ready for sea trials, the RS Branch Office, prior to sea trials, shall send an application addressed to the shipyard which contains the impartial justifications for such an opinion.

18.3 SEA TRIALS

18.3.1 Sea trials shall be conducted with the following purpose:

.1 checking of basic parameters of ship main propulsion plant and their compliance with the specification characteristics;

.2 checking of operation of the main propulsion plant in the ship's ahead and astern manoeuvring;

.3 checking reversing properties of the main propulsion plant;

.4 checking of serviceability of the main propulsion plant in the conditions approximate to the operating ones;

.5 checking of serviceability of the deck machinery and arrangements;

.6 comprehensive checking of the ship's automation equipment (if any) under the conditions approximate to the operating ones;

.7 final tests of items of technical supervision, other than those subject to the inspection and subsequent check tests;

.8 checking of serviceability of navigational, radio and electrical equipment under the conditions approximate to the operating ones;

.9 measurements of torsional vibration of the "main engine — shafting — propeller" system, measurements of vibration;

.10 confirmation of the possibility to assign the ship the Register class provided in the design to the ship according to its purpose, and the possibility to issue the Register documents.

18.3.2 In case the Register confirmation of the ship readiness for sea trials is required by port authorities to issue a sea trial permit, the Register may issue an appropriate confirmation, on the shipyard's request, in which preparation the following shall be considered:

.1 confirmation shall be drawn up in an arbitrary form on the RS official letter form (using form 6.3.10 or form 3.1.11, or on the letter form upon agreement with the shipyard);

.2 confirmation shall include the statement that in accordance with a specific contract on technical supervision, RS has performed all the due surveys of a ship under construction and, in the opinion of the Register, the ship may be considered ready for sea trials.

18.3.3 Prior to the commencement of sea trials the shipyard shall submit to the RS surveyor the following documentation:

.1 programme for sea trials approved by the Register;

.2 technical documentation necessary for surveys and trials;

.3 Stability Booklet and Damage Stability Booklet for the ship with flooded compartments, corrected, if required, as per results of previous inclination (for the ship of a series);

.4 designed Stability Booklet and Damage Stability Booklet for the ship with flooded compartments, inclination report (for the prototype ship).

18.3.4 Upon completion of sea trials or trials in the rate of speed with no ship's speed using simulation methods, the RS surveyor shall inform the shipyard of his comments pertaining the work that shall be done before the ship's documents may be issued by the Register.

18.3.5 Necessity of the trial voyage shall be agreed with the RS surveyor and, generally, shall be determined by the following conditions:

.1 where the parameters determining proper operation of the item of technical supervision can be received in the course of the trial voyage only;

.2 where, as a result of mooring and sea trials and/or inspection, the replacement of the whole item of supervision or some of its essential parts is required which serviceability may be confirmed only in the course of the trial voyage;

.3 where it is impossible to attain the required rates by means of simulation, or where such means are not available.

18.3.6 Satisfactory results of the surveys performed under the List, no violation of the RS requirements upon results of the patrols, mooring and sea trials as well as the trial voyage (if performed) shall be the basis for issuing the RS documents to the constructed ship.

18.4 PARTICULARS OF TECHNICAL SUPERVISION OF TRIALS OF THE PROTOTYPE SHIPS

18.4.1 Trials of the prototype ship shall be carried out under the comprehensive programme including verification of characteristics and determination of parameters which may be used for ships of a series with no such verifications.

18.4.2 The comprehensive programme of trials of the prototype ship shall contain the following:

.1 measurements of torsional vibrations in the "engine — intermediate unit (shafting, reduction gear, couplings) — propeller system";

.2 measurements of vibration of separate machinery and hull structures;

.3 experience of inclination;

.4 checking operation of the propulsion plant with one main ICE with regard to provision of the ship speed at which the ship steering is maintained with failure of one turbocharger (as to emergency mode of the main engine refer to 2.5.1, Part IX "Machinery" of the Rules for the Classification and Construction;

.5 increase of duration of testing modes.

18.4.3 Where necessary, allowing for the ship's purpose, where prototype materials, products, machinery and equipment are used, the Register documents shall specify operational tests under the RS-approved programme (refer also to 1.8, Part IV "Technical Supervision during Manufacture of Products" of the Rules for Technical Supervision).

18.5 TRIALS OF SHIP MACHINERY AND EQUIPMENT USING SIMULATION METHODS AND MEANS

18.5.1 Scope of application.

18.5.1.1 The provisions of this Chapter shall apply in trials of the ship's machinery and equipment using simulation methods and means permitting sea modes that shall be conducted in the shipyard water area or on the slip.

18.5.1.2 Simulation means or methods of trials suggested for the first time or not adequately verified in technical supervision practice, and also not complying with the requirements of this Chapter to the full extent shall be agreed with the Register in each particular case upon submission of the relevant technical background.

18.5.1.3 The provisions of this Chapter do not apply to the prototype ships and prototype specimens (prototype batches) of machinery, equipment and other products.

Note. Adjustment of simulating methods and means and comparison tests (refer to 18.5.3.13) may be conducted for the prototype ships of a series, unless it is further expressed otherwise.

18.5.1.4 Simulation tests shall be carried out both for separate kinds of ship machinery and equipment, and for the whole set of the ship's equipment.

18.5.2 Definitions and explanations.

18.5.2.1 Simulation tests are trials in sea modes/regimes (in the modes of full-scale conditions) in the water area of the shipyard or on the slip replacing the equivalent sea trials specified by the RS rules.

Simulation methods and means are methods and means permitting in the water area of shipyard or on the ship the conditions appropriate to the routine tests to be reproduced (to the maximum extent or to the sufficient extent recognized by the Register).

Routine tests are tests specified by the RS rules which are not simulating ones.

Comparison tests are checking of compliance of loadings and parameters of the ship's equipment operation received from the simulation tests with those of the same equipment received in the conditions of sea trials at the voyage on board the same ship.

18.5.3 General.

18.5.3.1 Expediency and methods of simulation tests shall be determined by the shipyard and designer.

18.5.3.2 Matters of tests not specified in this Chapter shall be settled in compliance with the provisions of relevant sections of the Guidelines.

18.5.3.3 In the course of simulation tests special arrangements, benches and proving grounds, appliances, apparatus, special devices and other means may be applied, and calculating methods and graphical diagrams are used as well.

18.5.3.4 Simulation methods and means shall be in conformity with standards agreed by the Register and RS-approved technical documentation.

Application of non-standard methods and means shall be agreed with the Register in each particular case upon submission of the relevant technical background.

18.5.3.5 Where necessary, a diving examination shall be performed with issuance of the adequate report.

18.5.3.6 Ship's preparation for trials including its placing in the shipyard water area or on the slip, manufacture, mounting (dismounting) of simulation arrangements, as well as appliances and equipment relevant thereto are subject to the shipyard responsibility, and not within the Register technical supervision.

Methods of simulation tests shall be approved by RHO or on its behalf by the RS Branch Office.

18.5.3.7 Simulation tests shall ensure verification of the ship's operation in the course of sea trials in the scope within the requirements of the RS rules and the provisions of appropriate sections of the Guidelines.

Where simulation methods and means ensure such conditions which more comprehensively reproduce features of real service than the routine tests, it is necessary that the test scope and modes shall be, as practicable and reasonable, extended as compared with those specified in this Part (for example, with the purpose of verifying designed parameters or specifications).

18.5.3.8 Simulation appliances, their securing means and influence caused by them (vibration, temperature, etc.) shall not have harmful influence upon the tested item or on the ship's structures. Where necessary, measures protecting from harmful influences shall be provided.

18.5.3.9 When carrying out simulation tests, parameters of the tested item shall be verified in the scope not less than that one specified for routine tests.

Where simulation tests are carried out not for the whole set of the ship's equipment or where in the course of these tests only some of their parameters are defined, the rest of the equipment (the remaining parameters) shall be verified by routine parameters.

The accuracy of the tests under way shall be not less than one assumed in routine tests and recognized by the Register as satisfactory.

18.5.3.10 Standard programmes (methods) of simulation tests are subject to the approval either by RHO or the RS Branch Office when authorized.

Programmes (methods) of a particular ship developed on the basis of the standard ones shall be agreed with the RS Branch Office (surveyor).

18.5.3.11 The Register, where necessary, may require routine tests that shall be carried out on board any ship under the approved programme irrespective of results of simulation tests.

18.5.3.12 Prior to the simulation tests comparison tests shall be carried out.

18.5.3.13 Comparison tests.

18.5.3.13.1 Comparison tests shall be carried out by the shipyard under the RS-approved programme (methods) supervised by the RS surveyor.

These tests consist of the tests using simulation methods and means as well as sea trials at the voyage conducted on board the same ship.

Comparison tests aim at verification of compliance of loadings and/or parameters of the ship's equipment operation received by simulation methods and means with the loadings and parameters of this equipment's operation received in the course of sea tests under real navigation conditions, as well as compliance with the requirements in 18.5.3.8.

18.5.3.13.2 The programme (methods) of comparison tests shall include the following:

explanation part containing theoretical basis of assumed simulation method (drawings) of simulation arrangements and other appliances and their securing to tested items, schemes of proving grounds, information about the number of ships that shall be subject to comparison tests;

provisions on checking of quality of mounting of simulation means, where necessary, indications on preliminary tests by simulation methods in the course of mooring modes;

indications on the simulation stage of comparison tests including indications on control and measurements of parameters as well as concerning values of controlled parameters;

indications on the stage of routine tests carried out for the comparison, including indications on control and measurements of parameters;

indications on the comparison of the required convergence of parameters received at the stages of simulation and routine tests.

18.5.3.13.3 In the course of comparison tests special attention shall be drawn to the received values of compared parameters and the ship's equipment operation characteristic during two stages of the tests, also the extent of their convergence shall be analyzed.

The tests are considered satisfactory if the operation of the ship's equipment during the two stages of the tests is in compliance with the Register requirements, criteria and norms laid down in the RS-approved technical documentation and the compared results are, to the sufficient extent, convergent.

18.5.3.13.4 On the basis of results of the comparison tests the surveyor shall prepare the Report (form 6.3.29) where necessary data on the conducted tests are contained and make his conclusion about the possibilities of simulation tests on board ships of subsequent construction as a whole or some particular kinds of ship equipment. In lieu of issue of the Report, the shipyard document may be agreed upon.

18.5.3.13.5 Generally comparison tests shall be carried out at least on board two ships. Where results of the comparison are unsatisfactory though at one of the stages or the comparison of results show no required convergence, the comparison tests shall be considered unsatisfactory.

18.5.3.13.6 Results of comparison tests are not applicable to items of another type (type and size) or the same type but installed on board ships of other series, as well as on board ships of the same design but being constructed by different shipyards. The question of possible application of testing results to ships of various modifications of the same base design, which are under construction in the same shipyard shall be agreed with the Register in each particular case.

18.5.3.14 Simulation tests.

18.5.3.14.1 Simulation tests shall be carried out under the RS surveyor supervision under the programme (methods) prepared on the basis of comparison tests and approved by the Register.

18.5.3.14.2 Methods of simulation tests shall contain the following:

general provisions;

requirements for technical condition of the item submitted to tests;

requirements for technical condition of simulation means and other supporting equipment;

method indications on preparation for tests and their performance including the control and measurements of parameters which shall be attained with the help of simulation methods and means;

diagrams of simulation arrangements and proving grounds;

indications on control comparison tests and their frequency (refer to 18.5.3.16).

Note. The appropriate provision for control comparison tests and frequency shall be introduced in the ship's testing programme when updated.

18.5.3.14.3 Prior to simulation tests it is necessary to get assured that the ship's equipment has successfully undergone mooring trials, and nothing prevents from simulation tests.

The RS surveyor also shall inspect the following: availability of the document from the shipyard technical control body concerning the condition of simulation means;

availability of the RS-approved programmes (methods) of simulation tests or indications on simulation tests in the ship's approved programmes of mooring or sea trials and compliance with the requirements specified therein as to the preparation for tests.

18.5.3.14.4 In the course of simulation tests the RS-approved program (methods) and indications laid down in this Chapter as to the kind of the ship's equipment shall be followed.

Attention shall be drawn to the reliability of operation of simulation means. Adjustment and setting of simulation means not specified by the testing programme (methods) shall not be allowed.

18.5.3.15 Inspection and trial voyage.

18.5.3.15.1 Where routine tests are provided with the purpose of check of a part of the equipment and its separate modes (refer to 18.6.3.9), the inspection of the ship's equipment which has passed simulation tests shall be carried out and certified by the RS surveyor prior to the ship's voyage, and the control check of the equipment shall be exercised during its operation as per the direct designation.

18.5.3.15.2 In the course of simulation tests of the whole set of the ship's equipment inspection may be carried out and certified by the RS surveyor on completion of the simulation tests with the subsequent verification of the equipment operation during the ship's trial voyage.

In technically grounded cases (with the Register agreement) the ship's trial voyage may be replaced by simulation tests of the ship's equipment. In this event it is those simulation methods and means shall be used that have been applied for the verification of sea modes.

18.5.3.16 Check comparison tests.

18.5.3.16.1 On ships of serial production being tested by simulation methods check comparison tests shall be regularly carried out as specified in 18.5.3.13.1.

The tests shall be carried out on each fifth ship under the shipyard annual acceptance programme for up to 10 ships, and on each tenth ship under the manufacturer's annual acceptance programme 10 ships and over.

18.5.3.16.2 During the two stages of check comparison tests the RS surveyor shall carry out surveys and inspections in the scope not less than those specified for routine tests of ships of a series. Results of check comparison tests (refer to 18.5.3.13.3) shall be analyzed and compared with the results of the previous ship of the series, conclusion is drawn about the possibility of simulation tests on ships of subsequent production.

The requirements in 18.5.3.15 and 18.5.3.16.1 are reflected in the ship's testing programme.

18.5.4 Propulsion plants.

18.5.4.1 Indications as per tests.

18.5.4.1.1 Simulation tests of propulsion plants may be carried out on ships of all types and purposes (except for ships with air propulsion) in case when performances of the main engine on the mode of nominal (full) power and frequency of rotation may be reproduced with the immobile ship with the help of simulation means and methods.

18.5.4.1.2 Simulation tests of propulsion plants may be carried out with the help of simulation methods and means both with the ship afloat in the water area of the shipyard and on the slip.

18.5.4.1.3 Simulation arrangements shall ensure reproduction of the preset power and rotation frequency of the main engine on all modes of operation specified in the programme of simulation tests, and stable operation of the main engine on all modes.

18.5.4.1.4 Comparison tests of propulsion plants shall specify the following:

simulation tests on loadings and parameters propulsion plants received in the course of sea trials of the prototype ship carried out under the Register-approved programmes;

sea trials of the same ship at sea with maximally attained loadings of the main engine.

Results of comparison tests are considered satisfactory where parameters of propulsion plants under the loadings being similar, have sufficient convergence, and their operation is considered satisfactory.

18.5.4.1.5 The scope of surveys conducted by the RS surveyor in the course of simulation tests including the list of measured parameters, frequency and accuracy of measurements, methods and scopes of the control of technical condition and operation of propulsion plant, its auxiliary machinery, arrangements and systems, as well as the stern tube and shafting is similar to the scope of surveys in the course of routine tests which is indicated in appropriate chapters of this Section.

18.5.4.1.6 With the Register agreement the main engines may not be subject to mooring trials in compliance with the requirements of this Section unless their structural features and structural features of components involved in the propulsion plant require mooring trials prior to simulation ones; in this case, however, after completion of adjusting and setting works and until simulation tests the main engines shall be previously tested on the 100 % mode for 4 h at least (depending upon the main engine type and output).

18.5.4.1.7 In the course of simulation tests divergence from given values of power and rotation frequency is not to exceed: as to power — $\pm 5\%$, as to rotation frequency — $\pm 3\%$. On the mode of nominal and maximum loadings the power divergence is admitted in the reducing direction down to 5 % of the rating.

18.5.4.1.8 In the course of simulation tests of propulsion plant in the shipyard water area the ship's draught shall be constant on each testing mode.

The ship's inclination is admitted to be not more than 5° — for single-screw ships, 1° — for double-screw ships.

18.5.4.1.9 The ship shall be fitted with all necessary system of power supply (gas line, electric power supply, heating, lining and piping of cooling water, water supply to the ship's fire-extinguishing system), as well as technical service of tests shall be performed by the shipyard.

18.5.4.1.10 Upon the agreement with the RS surveyor, for receipt of the required data in the course of simulation tests it is admitted to adjust the simulation arrangement without stopping the propulsion plant, mode adjusting time is not taken into account.

18.5.4.1.11 In the course of simulation tests the load of main engines operating the fixed-pitch propellers shall change in propeller characteristics $N_c = f(n)$, $M_{tm} = f(n)$, and operating controllable pitch propellers and generators shall change in loading characteristics like as follows: $N_c = f(H/D)$, $N_c = f(M_{tm})$ where $n = \text{const}$ rated power, N_c is a rated power; M_{tm} is nominal engine torque; n is engine shaft rotation frequency; H/D is controllable pitch propeller ratio.

Modes of engine loadings in this case shall comply with those indicated in Table 18.5.4.1.11 (refer also to the Appendix to Section 5).

Table 18.5.4.1.11

Mode No.	Engine torque, in % from nominal value	Rotor shaft rotation frequency, in % from nominal value	Duration of tests, in h
1	39	63	0,5
2	63	80	0,5
3	83	91	0,5
4	100	100	4,0
5	107	103	1,0
6	Speed astern	Complying with rated power of speed astern	0,5
7	—	Minimally stable	0,25

18.5.4.1.12 Upon completion of simulation tests, inspection of machinery, arrangements and systems shall be carried out. The scope of inspection and list of units subject to dismantling and examination shall be determined upon the RS surveyor agreement.

After completion of inspection and elimination of deficiencies revealed during the previous stages of tests and during the inspection the propulsion plant shall be checked in the course of check tests on the modes indicated in Table 18.5.4.1.12; in this case, generally, the operation of all components of the propulsion plant shall be checked in its operation as designated, however, where necessary, essential thermal parameters of the plant shall be controlled. Parameters of the propulsion plant in its 100 % power shall attain stable values.

Table 18.5.4.1.12

Mode No.	Rotor shaft rotation frequency, in % from nominal value	Duration of tests, in h
1	100 (full speed)	2,0
2	Speed astern	0,25

18.6.4.1.13 Check tests of the propulsion plant may be carried out both in the course of the ship's sea trials in open water (trial voyage) and with the help of simulation methods if they provide the check of reverses and also astern speed modes in accordance with Tables 18.5.4.1.11 and 18.5.4.1.12.

18.5.4.1.14 Check tests of propulsion plants, which simulation tests have been carried out on the slip, shall be conducted on the ship under way in open water or, when agreed with the surveyor, in mooring mode in the shipyard water area; in this case particular attention shall be drawn to the serviceability of sea-water pumps and ship systems servicing the propulsion plant.

18.5.4.1.15 Specified in 18.5.4.1.13 reverse verifications in the course of check tests using simulation methods are recognized as adequate in the event of reversing from the local control station or by means of the remote control.

Checking of reverses by means of the remote automatic control system shall be carried out with the ship under way.

18.5.4.2 Simulation methods and means of loading.

18.5.4.2.1 The place of testing, type of rudder-propeller system, ship's aft draught, rotation power and frequency of the main engine are basic factors, which determine the choice of simulation methods. The following possibility shall be allowed for:

reproduction of the given power and frequency of rotation with the preset characteristics of propeller, stern counter structure and aft draught changing range;

mounting and dismantling of the loader on the slip or the ship afloat;

accepting of the propeller thrust by the hull structure, mooring appliances, etc.;

duration of operation with full loadings without any choking of engine cooling systems.

18.5.4.2.2 The following simulation methods and facilities of loading may be applied:

.1 partially submerged propeller, if there is a possibility to vary deepening of the propeller axis of ships with insufficiently submerged propellers ($H < 0,6D_p$) afloat (H is distance from the propeller axis up to the water surface, D_p is propeller diameter);

.2 varied blade pitch of controllable pitch propeller— for ships with the controllable pitch propeller afloat when the propeller axis is deepened not less than $0,6D_p$;

.3 supply of air to the propeller by means of air supplying arrangements of different design — for ships with deepened propeller axis not less than $0,6D_p$ afloat with not restricted power;

.4 regulated volume of air suctioned to the water flow coming to the propeller — for ships afloat with ring propellers and deepened propeller axis not less than $0,6D_p$;

.5 regulated restriction of ambient air to the propeller from the water surface — for ships afloat having insufficient deepening of the propeller axis (within $0,3 — 0,6D_p$) and with main engine not more than 3680 kW;

.6 loading arrangements reducing operated propeller disk area by means of blades tips excluded from operation — for ships with sufficiently deepened propeller axis (not less than $0,6D_p$), free-positioned propeller of diameter not more than 3,5 m and main engine power not more than 2944 kW afloat;

.7 hydrochamber distributing and regulating water flows coming to the engine and thrown by it — for ships of not more than 12 m long with propellers and water-jet propulsion installations of 220,8 kW on the slip;

.8 hydroloaders fitted instead of the propeller and providing rated loadings affecting operated bearings, axial thrust and deformation of shafting — for ships with propeller power from 73,6 to 736 kW on the slip;

.9 breaking bench connected to the propeller and providing rated loadings affecting shafting bearings, its deformation and axial thrust — for ships with propeller power not more than 73,6 kW on the slip;

.10 other simulation methods and loading facilities, which may be admitted by the Register on special agreement.

18.5.5 Arrangements.

18.5.5.1 Rudder and steering gear.

18.5.5.1.1 In the course of simulation tests of rudder and steering gear the rudder blade or steering nozzle¹ shall be subjected to loadings resulting in rudder torque on the rudder stock, equal to those occurring in the course of sea trials with different helm angles and the ship appropriate speeds.

18.5.5.1.2 Loadings on the rudder may be created by the following:

.1 water jet thrown by the propeller;

.2 special loading arrangements;

.3 combined actions of the above stated factors.

18.5.5.1.3 In the course of simulation tests the indications specified in 3.4.3 shall be satisfied taking into account the information set forth below.

The main, auxiliary and emergency gears shall be subjected to tests when running ahead and astern. Where the rudder and steering gear is of such a design that the rudder torque at the rudder stock when run astern is more than ahead, the tests shall be carried out with the characteristics of the speed astern. Concerning the automatic pilot, refer to 18.5.6.3.6.

18.5.5.1.4 In the course of comparison tests of rudder and steering gear in accordance with 18.5.3.13 the rudder torque shall be measured directly at the rudder stock.

Measurement and comparison of the pressure in hydrocylinders for hydraulic (electrohydraulic) steering gears or the current intensity for electric gears may be allowed; in this case the varying character of the pressure and current intensity depending on helm angles and turning time at the stage of simulation tests shall be corresponding to the data proceeding in the course of routine tests.

Convergence of results (difference of parameters values at the stages of simulation and routine tests) shall not exceed the following:

As to oil pressure — 5 %, as to current intensity 10 %, as to turning time — 10 %.

18.5.5.1.5 Water jet tests shall be conducted by means of hydrodynamic forces applied to the rudder which are caused by the propeller in the main engine operating conditions, and in case of the controllable pitch propeller with the help of blades turning.

18.5.5.1.5.1 Prior to the tests of rudder and steering gear the main machinery, shafting and propellers shall be surveyed in the scope of sea trials.

18.5.5.1.5.2 The ship shall be positioned in the shipyard water area and reliably secured. Among the materials stated in 18.5.3.14.2 the scheme of the ship's position and calculations of its securing are available.

18.5.5.1.5.3 If under the testing conditions the rudder loading is not sufficient, it shall be increased up to that of the sea trials. With this purpose the rudder area may be increased by means of a temporary additional attachment placed thereon. The width of temporary attachment shall not exceed 0,25 width of the rudder blade, and the coefficient of the rudder compensation shall not exceed more than 25 — 30 %.

18.5.5.1.6 Tests with the help of loading arrangements may be carried out both on the ship afloat and on the slip. Loading arrangements shall provide the change of the rudder stock depending on the angle of helm turning by means of appropriate mechanical forces applied to the rudder.

Structure of loading arrangements shall exclude the possibility of rudder deformations in way of the applied forces equivalent to water pressure. The applied forces shall be distributed over the area, if possible.

¹Hereinafter referred to as "the rudder".

18.5.5.1.7 Where loading arrangements in the form of hydraulic loaders are applied, and rudder forces are transferred by hydrocylinders piston rods, the pressure and, accordingly, the force to the rudder shall be adjusted by the hydraulic system relief valve in compliance with the conditions of tests or by any other way.

Pressure of the service liquid in hydraulic cylinders of the loading arrangement shall be determined by calculations for each of the testing conditions proceeding from the rudder stock designed moment when operated by the main and emergency gears. Calculations shall be introduced among the materials stated in 18.5.3.13.2. The pressure final value may be ascertained in the course of comparison tests.

18.5.5.1.8 In case of loading arrangement operated by the effect of cargoes determination of cargoes mass and rope-and-block system scheme shall be reproduced among the materials stated in 18.5.3.13.2. The final cargo mass may be ascertained in the course of comparison tests. Prior to the commencement of tests the shipyard shall submit the Report of Compliance of the Cargo Mass with the Indications of Testing Methods. Preference is given for application of monolithic cargoes.

Mild steel ropes shall be used for the arrangement. Beams, frames, shackles, swivels and other components of rope-and-block system shall be in conformity with each other and comply with the requirements of standards.

18.5.5.2 Anchor arrangements.

18.5.5.2.1 Simulation tests of anchor arrangements may be conducted on the anchor arrangements with the chain diameter not more than 50 mm having no remote control.

Application of simulation tests to anchor arrangements with chain diameter equal to 50 mm and over, as well as those having remote control system shall be agreed with the Register in each particular case upon submission of the relevant technical background.

18.5.5.2.2 During simulation tests the indications specified in 3.5.4 shall be met allowing for the following factors set forth below.

18.5.5.2.3 With the help of methods and facilities of simulation the following factors occurring in routine tests shall be reproduced:

- stresses in the anchor chain;
- speeds including anchor chain paying out speeds when releasing the anchor;
- kinetic energy in the "anchor-anchor chain" system when releasing the anchor.

18.5.5.2.4 The kinetic energy ensuring the check of the band brake shall be reproduced with disconnected drive of anchor machinery from the sprocket by its maximum values corresponding to the condition when the anchor chain is released to the depth specified in 3.5.4.1 of the Guidelines and in motion with the speed specified in 6.3.3.3, Part IX "Machinery" of the Rules for the Classification and Construction.

18.5.5.2.5 During comparison tests of the anchor arrangements in accordance with 18.5.3.13 the comparison of stresses in the anchor chain at the stages of simulation and in routine tests shall be made by the way of correlation of current intensity of the electric drive and paying out speeds of the anchor chain. Convergence of results shall not exceed: as to the current intensity — 8 %, as to the speeds — 5 %. Determination of parameters by means of which the kinetic energy shall be correlated, shall be provided by the operator developing the comparison tests programme; the documents grounding that these parameters correlation ensure reproduction of the kinetic energy under the conditions of comparison tests shall be submitted to the Register.

18.5.5.2.6 Loading arrangements used for simulation tests shall provide the following operations:

- free release of anchors;
- haulage of anchors in succession;
- haulage of two anchors from a depth of not less than 45 m;
- breaking the anchor out the ground from a depth not less than 82,5 m;
- check of braking operation including automatic brakes of the drive (if available).

18.5.5.2.7 Where loaders are applied with chain sprockets and braking arrangements, as loading elements, the sprockets shall correspond to the anchor chain diameter, and the sprocket wrapping angle shall be not less than that required for the anchor machinery by the Rules for the Classification and Construction. The pull on the sprocket shall be adjusted and ensure anchor chain paying out speed up to 200 m/min.

Braking of sprocket by means of a brake shall be smooth and be adjusted so that the braking forces shall correspond to the mass of anchor chain and anchor overboard.

18.5.5.2.8 When constructing ships of large series productions with gross tonnage less than 100, not engage in international voyages, except for the ships for carriage of passengers or combustible or other hazardous cargoes, as well as towing boats simulation tests of anchor arrangements specified in 18.5.5.2.9 and 18.5.5.2.10 may be applied with the Register special agreement. Such tests are possible provided if the Register has ascertained that anchor arrangements are manufactured with high quality, and this has been proved by routine tests of at least ten ships of the serial production.

18.5.5.2.9 Tests by means of hung over loads shall be carried out on the maximum depth of the shipyard water area, however not less than 10 m.

18.5.5.2.9.1 Tests under 3.5.4.1, 3.5.4.5 and 3.5.4.6 shall be carried out using anchors with loads attached thereto that compensate insufficient mass of anchor chains and anchors corresponding to the necessary depth of the place.

For each operation not less than 8 — 10 anchor releases-and-haulages shall be carried out.

18.5.5.2.9.2 Average speed of chain paying out, m/min, shall be determined by the formula

$$\gamma = 6nL/t \quad (18.5.5.2.9.2-1)$$

where n = sprocket torque frequency of the anchor arrangement, in min^{-1} ;

L = chain cable length passed for the sprocket's one turn-round which is determined by the formula

$$L = 2d(4z + 1)10^{-3} \quad (18.5.5.2.9.2-2)$$

where d = anchor chain diameter, in mm;

z = number of cams in a sprocket.

18.5.5.2.9.3 In the course of tests, apart from that specified in 3.5.4, the hung over loads mass and also easy operation of all elements of the loading arrangement shall be controlled.

18.5.5.2.10 In the course of tests with the anchor chain tensed by the ship's running, stresses and speeds occurred in the units and elements of anchor arrangements, including anchor machinery, are aroused by the speed astern operated propeller. The loading shall be adjusted by varying of the rotation frequency of the propeller or by means the controllable pitch propeller. During tests of anchor arrangements on non-self-propelled ships towing boat or any other loading methods may be used.

18.5.5.2.10.1 Apart from the above stated in 3.5.4, it is necessary to be convinced of the following.

Anchor release shall be carried out at speed astern with subsequent anchor pay out at the full length and (after the anchor reliably grounded) with periodical braking by means of the anchor machinery brake. With clamped brake for 1 — 2 min the operation shall be maintained with the propeller. The last braking shall be performed with the clamped brake at the beginning of the last shot and with the stress of tensed chain corresponding to the mass of fully paid out anchor and chain free in water. Chains haulage shall be performed by the anchor machinery concurrently with the ship's running speed astern (the anchor is reliably moored aground) by means of forces corresponding to the mass anchors and anchor chains at the conditional depth of the ship's lying. Simulation of anchor breaking out of the ground shall be carried out at the largest speed of paying out at speed astern and with holdine for 3 – 5 s and subsequent transfer of speed to "stop".

18.5.5.2.10.2 The ship's speed (frequency of shaft rotation or position of blades of controllable pitch propeller) at which a loading is created equal to that one during routine tests shall be determined by means of comparison tests; in this case, amendments may be introduced allowing for current speed, wind direction and force.

18.5.6 Radio and navigational equipment.

18.5.6.1 In the course of simulation tests the appropriate provisions in Sections 15 and 16 for routine tests shall be followed and the requirements of this Chapter shall be complied with.

18.5.6.2 Preparation for tests and maintenance in the course of the tests shall be carried out by the manufacturer in compliance with the maintenance manual for the tested apparatus and approved methods of its testing, and in case of the RS-approved standard — in accordance with it.

18.5.6.3 Radio and navigational equipment may be tested at the special proving ground.

18.5.6.3.1 Proving grounds for tests of radar stations and gyrocompasses shall be recognized by the Register as satisfactory for these tests with issuance of the Recognition Certificate in accordance with Section 8, Part I "General Regulations for Technical Supervision" of the Rules for Technical Supervision.

For issuance of the Recognition Certificate the survey of proving ground shall be carried out including its compliance with the requirements, and comparison tests shall be conducted under the approved programme in accordance with 18.5.3.13.

18.5.6.3.2 The proving ground for testing the equipment with the help of simulation shall meet the following requirements:

- .1 metal masses shall be at least 30 m distant from the ship;
- .2 no industrial interference in the course of tests;
- .3 the competent organization's permission for the transmitter to be operated in live air shall be available;
- .4 correspondents for communication shall be designated within the designed ranges;
- .5 navigational range and direction finding objects shall be fixed on the map of the proving ground by specialists of geodesic and hydrographic services;

.6 leading beacons of the proving ground, objects for the direction finding shall be visible from the position of taking bearings (upper bridge, navigation bridge wings); for proving ground reflecting objects their radar visibility shall be provided;

.7 ship shall be reliably and securely moored at the place of her lying; in the course of tests moorage of other floating craft at the tested ship is not admitted;

.8 with the purpose of higher quality of checking of radars and gyrocompasses as to their accuracy of determining of directions proving grounds shall have a few (six are recommended) reference points situate, as possible, in various directions at an interval about 60° and distant over 2 miles.

18.5.6.3.3 The proving ground's Recognition Certificate is subject to annual confirmation, and in this connection it shall be surveyed by the surveyor where the results of simulation and comparison tests which have been conducted under the RS technical supervision may be taken into account.

18.5.6.3.4 Dynamic pressure logs may be calibrated without arrival at the measuring line, and for this purpose devices ensuring dynamic pressure in the log sylphon apparatus similar to that existing in the ship's running with different speeds.

18.5.6.3.4.1 The device simulating the pressure in the sylphon apparatus shall ensure the log accurate adjustment in which residual corrections shall not exceed those admitted by the technical specifications for the log.

18.5.6.3.4.2 Upon results of comparison tests a table or diagram of changes of dynamic pressure in the sylphon apparatus depending on the ship's speed shall be prepared and agreed with the RS surveyor.

Two sets of devices shall be prepared one of which shall be used in simulation tests, and the other shall be a control one.

18.5.6.3.5 Echolots and navigational stations of horizontal sonar may be tested by means of instrumental method.

Acoustic parameters of vibrator transducer (of an aerial): sound pressure and sensitivity of the receiving path shall be measured with the help of hydrophones, oscillographs and other instrumentation devices; in this case, necessary precision and stability of readings shall be ensured.

18.5.6.3.5.1 In the course of comparison tests the RS surveyor shall compare acoustic parameters measured by means of instruments with those received during routine tests and with the norms of technical specifications which enables him to ascertain reliability of instrumental measurements and the hydroacoustic apparatus depth and range determined on the basis of those data.

18.5.6.3.5.2 In the course of simulation tests the surveyor shall check the identity of measurements of sound pressure with regard to fulfillment of the following conditions:

depth under the transducer shall be not less than 3 m;

no extraneous reflecting objects and noise sources shall be in the vicinity the area of acoustic measurements (distant 10 — 15 m);

measurements shall be made when the main engine is idle;

mooring method shall ensure easy installation of the measuring hydrophone;

fitting and fastening method for the hydrophone shall secure reliability and accuracy of its installation so that the hydrophone shall be fixed in a certain position relative to the transducer axis at a given distance from the latter;

measurement devices for instrumental testing shall be in proper working condition and calibrated prior to measurements in accordance with the Maintenance Manual;

cables connecting the devices shall be reliable screened;

measurements shall be conducted in all frequency bands, depth emitting ranges with narrow and broad directivity diagrams;

instrumental testing of hydroacoustic apparatus is required to be carried out in strict compliance with the requirements of testing methods and the maintenance manual of tested apparatus.

18.5.6.3.6 The ship's heading or track control systems may be tested when the ship is not at sea but by means of simulation of the ship's running mode or by the instrumental method.

18.5.6.3.6.1 The ship's running simulation shall be performed by means of the main engine full speed ahead thrust in conjunction with steering gear and gyrocompass operated.

For testing of the ship's heading or track control systems the following conditions shall be met, the fulfillment of which shall be controlled by the RS surveyor:

the ship's bows shall be moored at the hinged lug;

the ship's stern shall be enable to shift over the arc from the middle position to left and right as much as 35° — 45°;

availability of disturbing factors such as forces applied to the ship running it off the given course: tow boat operated, water jet caused by the propeller and ship, current, etc.

18.5.6.3.6.2 Testing methods shall allow for all checking complex of the ship's heading or track control systems in the running conditions with the purpose of checking of parameters and defining of operating characteristics under all kinds of control: simple, tracking and automatic in accordance with indications in Section 16.

18.5.6.3.6.3 Instrumental method for checking parameters of the ship's heading or track control systems in the automatic mode with idle main engines may be admitted by the Register in cases where rudder and steering gears and the ship's heading or track control systems showed full reliability on a number of ships of series production either in the course of routine tests or in service practice.

18.5.7 Auxiliary machinery and equipment.

18.5.7.1 In the course of simulation tests of the ship's main propulsion installation in lieu of sea and control ones driven engines, auxiliary machinery, systems, boilers, vessels under pressure and equipment shall be checked like in routine tests.

18.5.7.2 Parameters of operation of driven engines of auxiliary machinery, systems, boilers, vessels under pressure and other equipment shall be in compliance with those of bench tests and specified to the extent not less than in the course of routine tests in accordance with the indications of appropriate Sections.

18.5.7.3 The ship's devices of automation, control, signals, communication and navigation which, prior to installation on board, have precedently undergone checking of serviceability and adjustment for working parameters on specially equipped test benches, under sea-going conditions they shall be checked within the scope agreed with the Register.

Testing of serviceability and adjustment shall be carried out on bench tests under the conditions simulating the ship's ones to the extent recognized by the Register and sufficient in all parameters.

18.5.7.4 Use of driven and auxiliary machinery, as well as any other equipment tested by simulation methods shall not require their additional adjustment.

18.6 MEASUREMENT OF VIBRATION ON BOARD SEA-GOING SHIPS

18.6.1 Provisions of this Chapter shall apply in the course of vibration measurements on board of displacement metal sea-going ships in the course of acceptance trials and also in service conditions.

In performing the measurements requirements of 1.5, Part II "Hull" and Section 9, Part VII "Machinery" of the Rules for Classification and Construction and Technical Requirements (Specifications) for vibration measurements on board sea-going ships (refer to Appendix 2 to this Section).

18.6.2 Vibration measurements of the hull, machinery and equipment shall be carried out on board all prototype ships of the series, on the first ship of modified design, on ships of single construction and subjected to conversion.

Vibrations of machinery and equipment may be measured in the course of acceptance trials on all ships of serial production, as well as after repairs and replacement of machinery and equipment where such a requirement has been put forward by the shipowner.

18.6.3 Vibration measurements on sea-going ships shall be carried out in the course of mooring and sea trials and/or a trial voyage under the programme approved by the Register. In well grounded cases (refer to 18.6.6) measurements may be postponed until the first service voyages.

18.6.4 In the course of mooring trials measurements of vibration parameters of machinery (except for main engines) and ship equipment are carried out at their specification running regimes.

18.6.5 During sea trials vibration measurements of the ship's hull and superstructure as well as main engines are conducted. Within the same period measurements of separate machinery and equipment specification power of which cannot be attained in the conditions of mooring trials shall be conducted.

18.6.6 Vibration measurements of the hull, superstructure and main engines of transportation ships are carried out at specification running — slow, half and full ahead for two values of displacement:

- ballast displacement;
- loaded displacement.

In case when in the course of sea trials or trial voyage the ship's condition in full load cannot be ensured, measurements of vibration may be postponed to the first service voyages with the Register agreement.

Where results of calculations of the general vibration for the loaded displacement performed by the RS-approved methods show reduction of vibration parameters as compared with the ballast displacement condition, measurements in the loaded condition may not be conducted.

18.6.7 On passenger and special purpose ships vibration measurements of hull, superstructure and main machinery shall be carried out at the same displacement (close to the designed one) at the specification rate of speed.

For special purpose ships, as required by the Register, additional measurements under service conditions typical for such ships including speed astern, towing (for tug boats, icebreakers, salvage ships), trawling (for catcher boat), etc. In this case, available results shall be submitted to the Register for agreement. For ships designated for service on shallow water areas (under keel clearance less than the ship's two draughts), vibration measurements shall be conducted both on deep water (refer to 4.1 in the Appendix) and shallow water.

18.6.8 Effectiveness of arrangements elaborated and developed on the basis of results of vibration measurements and aimed at reducing its parameters down to admissible values shall be checked by control measurements. Scope of these measurements shall be established in accordance with 4.3 — 4.12 of Appendix 2 to this Section.

REQUIREMENTS FOR SHIPBOARD TRIALS OF INTERNAL COMBUSTION ENGINES

1. Safety precautions

1.1 Before any test run is carried out, all relevant equipment for the safety of attending personnel shall be made available by the shipyard and shall be operational.

1.2 This applies especially to crankcase explosive conditions protection, but also to over-speed protection and any other shut down function.

1.3 The overspeed protective device shall be set to a value, which is not higher than the overspeed value that was demonstrated during the type test for that engine. This set point shall be verified by the RS surveyor.

2. General

2.1 Before any official testing, the engines shall be run-in as prescribed by the engine manufacturer.

2.2 All fluids used for testing purposes such as fuel, lubrication oil and cooling water shall be suitable for the purpose intended, e.g. they shall be clean, preheated if necessary and cause no harm to engine parts. This applies to all fluids used temporarily or repeatedly for testing purposes only.

2.3 Engines shall be inspected for:

jacketing of high-pressure fuel oil lines including the system used for the detection of leakage;

screening of pipe connections in piping containing flammable liquids;

insulation of hot surfaces by taking random temperature readings that shall be compared with corresponding readings obtained during the type test. This shall be done while running at the rated power of engine. Use of contact thermometers may be accepted at the discretion of the attending surveyor. If the insulation is modified subsequently to the type approval test, the Register may request temperature measurements as required by 8.9 of Appendix 6 to Section 5 of Part IV "Technical Supervision during Manufacture of Products" of the Rules for Technical Supervision.

3. These inspections normally shall be made during the works trials (factory acceptance test — FAT) by the manufacturer and the RS attending surveyor, but at the discretion of the Register parts of these inspections may be postponed to the shipboard testing (refer to 2.5 of Appendix 7 to Section 5 of Part IV "Technical Supervision during Manufacture of Products" of the Rules for Technical Supervision).

4. Shipboard trials

4.1 Objectives.

The purpose of the shipboard testing is to verify compatibility with power transmission and driven machinery in the system, control systems and auxiliary systems necessary for the engine and integration of engine/shipboard control systems, as well as other items that had not been dealt with in the FAT.

4.2 Starting capacity.

Starting manoeuvres shall be carried out in order to verify that the capacity of the starting media satisfies the required number of start attempts.

4.3 Monitoring and alarm system

Monitoring and alarm systems shall be checked to the full extent for all engines, except items already verified during the works trials (refer to Appendix 7 to Section 5, Part IV "Technical Supervision during Manufacture of Products" of the Rules for Technical Supervision).

4.4 Test loads.

4.4.1 Test loads for various engine applications are given in this Chapter. In addition, the scope of the trials may be expanded depending on the engine application, service experience, or other relevant reasons. Besides, the tests for confirmation of compliance with the requirements of IMO resolutions, international conventions, Maritime Administrations and other legislative acts may be requested.

4.4.2 The suitability of the engine to operate on fuels intended for use shall be demonstrated.

4.4.3 Propulsion engines (main engines) driving fixed pitch propeller or impeller:

A) 100 per cent engine power (rated maximum continuous power (MCR)) at rated engine speed n_r : at least 4 h;

B) 110 per cent power at engine speed $1,032 n_r$, if engine adjustment permits (refer to 3.3.1 of Appendix 7 to Section 5, Part IV "Technical Supervision during Manufacture of Products" of the Rules for Technical Supervision): 30 min;

C) at approved intermittent overload (if applicable): testing for duration as agreed with the manufacturer;

D) minimum engine stable speed to be determined;

E) the ability of reversible engines to be operated in reverse direction shall be demonstrated. Refer also to 4.5.1.

4.4.4 Propulsion engines (main engines) driving controllable pitch propellers (CPP):

A) at rated engine speed n_r with a propeller pitch leading to engine power MCR (or to the maximum achievable power if 100 per cent cannot be reached): at least 4 h;

B) at approved intermittent overload (if applicable): testing for duration as agreed with the manufacturer;

C) with reverse pitch suitable for manoeuvring, refer to 4.5.1 for additional requirements in the case of a barred speed range.

4.4.5 Engine(s) driving generator(s) for electrical propulsion and/or main power supply:

A) at 100 per cent power (rated electrical power of generator): at least 60 min.;

B) at 110 per cent power (rated electrical power of generator): at least 10 min.

Note. Each engine shall be tested 100 per cent electrical power for at least 60 min and 110 per cent of rated electrical power of the generator for at least 10 min. This may, if possible, be done during the electric propulsion plant test, which is required to be tested with 100 per cent propulsion power (i.e. total electric motor capacity for propulsion) by distributing the power on as few generators as possible. The duration of this test shall be sufficient to reach stable operating temperatures of all rotating machines or for at least 4 h. When some of the generator set(s) cannot be tested due to insufficient time during the propulsion system test mentioned above, those required tests shall be carried out separately;

C) demonstration of the generator prime movers' and governors' ability to handle load steps as described in 2.11.2, Part IX "Machinery" of the Rules for the Classification and Construction.

4.4.6 Propulsion engines (main engines) also driving power take off (PTO) generator:

A) 100 per cent engine power (MCR) at rated engine speed n_r : at least 4 h;

B) 100 per cent propeller branch power at rated engine speed n_r (unless already covered in A): 2 h;

C) 100 per cent PTO branch power at rated engine speed n_r : at least 1 h.

4.4.7 Engines driving auxiliaries:

A) 100 per cent power (MCR) at corresponding speed n_r : at least 30 min;

B) approved intermittent overload: testing for duration as approved.

4.5 Torsional vibrations.

4.5.1 Barred speed ranges.

Where a barred speed range (*bsr*) is required, passages through this *bsr*, both accelerating and decelerating, shall be demonstrated (refer to 6.6.3, Section 6 of the present Part). The times taken shall be recorded and shall be equal to or below those times stipulated in the approved documentation, if any. This also includes when passing through the *bsr* in reverse rotational direction, especially during the stopping test.

The engine shall be put into a steady operation mode (by the fuel rack setup index parameter), for both the bottom or top boundaries of the restricted range. Deviation of the fuel rack setup index shall not exceed ± 5 per cent.

TECHNICAL REQUIREMENTS FOR MEASUREMENT OF VIBRATION ON SEA-GOING SHIPS

1. Purpose and scope of application

1.1 These Technical Requirements establish the procedure of vibration measurements taken in the course of final acceptance tests (during construction and after repairs) and in working conditions, and they apply to all metal displacement ships subject to technical supervision of the Register.

1.2 The provisions of these Technical requirements are the basis for operational methods of taking vibration measurements which shall form a constituent part of the testing programme for ships subject to the Register approval. Operational methods of taking vibration measurements shall take into consideration specific features of measurements on board separate ships of various types.

1.3 Establishment of vibration parameters for the ship's hull, superstructures, structures, main machinery and auxiliary equipment is provided with the following purposes:

assessment of vibration admitted in compliance with the standards of its parameters contained in 1.5, Part II "Hull" and Section 9, Part VII "Machinery Installations" of the Rules for the Classification and Construction;

ascertainment of causes (sources) of increased vibration and of development of arrangements for reducing its parameters down to the admitted values proceeding from the analyze of measurement results.

2. Measured parameters

2.1 Measured vibration parameters root-mean square values of vibration rate or vibration-acceleration and in necessary cases, average square or peak values of vibration-movement.

2.2 Vibration parameters shall be measured in absolute (vibration rate V_e , mm/s; vibration acceleration a_e , m/s²) or logarithmic units (decibels, dB) relative to standard threshold values of vibration rate $(V_e)_0 = 5 \times 10^{-5}$ mm/s vibration-acceleration $(a_e) = 3,2 \times 10^{-5}$ g. For re-calculation relative and absolute vibration parameters the following equations are used: $L = 20 \lg(V_e/(V_e)_0)$, dB; $L = 20 \lg(a_e/(a_e)_0)$, dB or the nomograph given in Fig. 2.2.

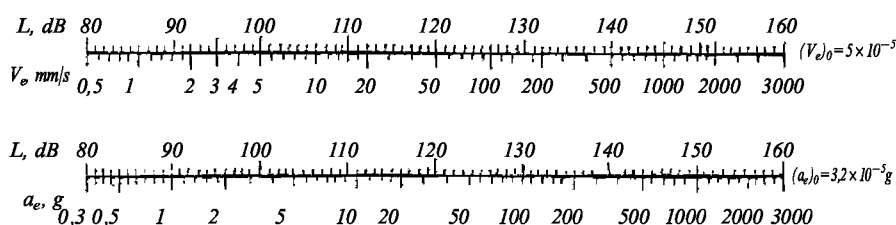


Fig. 2.2

Nomograph for re-calculation of absolute and relative vibration parameters

2.3 Root-mean square values of vibration parameters shall be measured in the three octave frequency bands. Vibration measurements in octave frequency bands are admitted.

2.4 Measurements are performed in the following frequency bands:

1,6 to 80 Hz — in control of the ship's hull, superstructure and structures vibrations;

1,6 to 500 Hz — in control of machinery and equipment vibrations.

2.5 Limit of errors in vibration measurements of parameters shall not exceed the following:

± 20 per cent — in value;

± 2 dB — in logarithmic level, including the measuring section (refer to 3.2).

3. Requirements for measuring means

3.1 To control vibration on board ships, the following apparatus ensuring the measurements of normalized parameters in three octaves or octave frequency bands shall be used:

vibration meters-analyzers;

vibration diagnostic systems ensuring measurements, treatment, storage, spectral analyze of vibration parameters.

3.2 Essential characteristics of apparatus:

frequency band — not lower than that specified in 2.4;

minimum sensitivity of measuring section — not higher than that specified:

for vibration rate, 0,1 mm/s;

for vibration-acceleration 0,1 m/s²;

dynamic range — not less than 70 dB;

main error of measuring section (transformation, analyze, and registration) — not more than:

± 10 per cent as to value;

± 1 dB as to logarithmic level.

3.3 To reveal the causes (sources) of increased vibration the apparatus ensuring frequency narrow band analyze by means of additional filters with the bandwidth less than 15 per cent. may be used.

3.4 Measuring apparatus shall provide calibration of all measuring section (built-in calibration device is desirable).

3.5 Apparatus having certificates on checking (calibration) may be admitted for taking measurements.

4. Scope and conditions of vibration measurements

4.1 Measurements of running vibration shall be taken when complying with the following conditions of navigation:

running speed ahead (with the rudder deviated not more than ± 3°);

water depth not less than the ship's double width;

sea force not more than 3 for ship displacement of 5,000 t and 4 for ship displacement of more than 5,000 t.

In separate cases, when required by the Register, vibration measurements may be specified non-normalized conditions of the ship's running: with the rudder efficiently putting over (on circulation), with the engine (propeller) reversed, with shallow depths under the keel (less than two draughts), on sea force above 3 — 4, etc.

4.2 In well-grounded cases, with the purpose of revealing unfavourable resonance conditions of the ship's running vibration measurements may be taken during smooth and gradual changes of rotation frequency of the propeller or working conditions of the main engine, as well as special frequency tests using vibration-generators may be conducted.

4.3 Frequency tests of the ship's hull in general, using vibration-generators, shall be carried out in the course of acceptance sea trials of the ship adrift under the conditions specified in 4.1.

Frequency tests of superstructures, separate hull structures, machinery and apparatus may be carried out on board the ship lying at the berth.

4.4 Vibration parameters on board ships shall be measured at all points in three mutually perpendicular directions: vertical, horizontal-transverse perpendicular to the centerline and horizontal-longitudinal (parallel to the centerline). In well-grounded cases measurements for separate points in two or one of the indicated directions.

4.5 Control measurements of hull general vibration in the conditions running and loading indicated on 18.7.6 and 18.7.7 of this Section shall be taken on the main or upper deck in way of the stern section and on the after peak bulkhead.

4.6 In the course of measurements taken in the resonance conditions in accordance with 4.2 in order to determine hull oscillations, measuring points shall be ascertained along the whole its length on the main transverse bulkheads both in the centerline and on the sides.

4.7 Vibration in the superstructure shall be controlled on the navigation bridge level at the fore bulkhead in the centerline.

In case of exceeding the admitted values of vibration parameters at the indicated point the measurements shall be taken in the conditions indicated in 4.2 on all decks and bridges of the superstructure, as well as on the ship's main or upper deck at the places of support of end bulkheads on the superstructure (or deck house).

4.8 Exact points of control measurements of local vibration in hull structures (grillage, bulkheads, foundations, frame components, sheathing plates, etc) do not generally specified. These measurements shall be taken in those cases, where the equipment installed in close vicinity to the indicated components of the equipment is characterized by vibration parameters exceeding the standards recommended by the supplier of this equipment in the event of visual detection of the increased vibration, or when required by the Register.

4.9 Vibration of main and auxiliary combustion engine shall be measured in the upper part of their framework and at three points along the length.

Vibration measurements of other main and auxiliary machinery and equipment shall be taken on the bearing housings or other components which to the maximum extent react to dynamic forces and characterize mechanism vibration condition.

Equipment vibration is measured at the rigid elements of their fastening to hull structures (foundations).

4.10 Measurement points of vibration parameters for machinery and equipment shall be contained in the manufacturer's recommendations.

In case of no available recommendations typical schemes of measurement points of machinery vibration shall be followed (refer to Fig. 4.10).

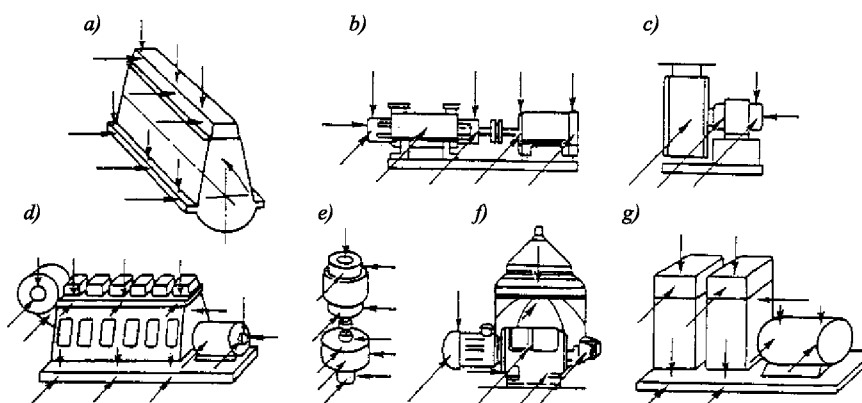


Fig. 4.10

Points of machinery vibration:

a — combustion engine; *b* — horizontal pump; *c* — ventilator; *d* — diesel-generator;
e — vertical pump; *f* — separator; *g* — piston-type compressor

4.11 Machinery vibration condition shall be assessed by the maximum measured parameters value.

With exceeded admissible vibration values measurements it shall be taken at the engine frameworks and surrounding structures, and in case of combustion engines, additionally, general vibration measurements of the ship's hull, additionally, at the level of the double bottom in way of transverse bulkheads boundaries of the machinery compartments.

4.12 Assessment of the effect of vibration caused by surrounding sources upon controlled machinery shall be made on the proceeding results of changes in the stopped machinery during sea trials. If the measured parameter value in the stopped machinery exceeds the half of the admitted value during routine service (the category B upper limit refer to 9.1.1, Part VII "Machinery Installations" of the Rules for the Classification and Construction), it is necessary that measures shall be taken so that this effect might be reduced.

5. Taken measurements. Measures ensuring the results of reliability

5.1 Measurements shall be taken in compliance with the programme approved by the Register.

5.2 Prior to commencement of measurements and upon their completion the calibration of the measurement section shall be carried out.

5.3 Fitting of vibration-transducer shall not distort the vibration character of an object. Method of securing of vibration-transducer shall not introduce an error in measurements.

5.4 In the course of multi-point synchronized measurements it is more preferable the rigid securing of vibration transducers (vibration sensors) to special platforms placed at the measurement points.

5.5 Measurements are carried out under settled operation conditions of the ship's main engines, machinery and equipment.

5.6 Temporary interval in vibration measurement may vary depending on frequency bands and in case of single measurements shall be not less than 10 s for frequencies up to 5,6 Hz; 2 s — within 5,6 to 22,4 Hz; 1 s — over 22,4 Hz.

5.7 During vibration parameter measurements taken by analogue devices with the time constant not more than 0,5 s, the initial number of measurements at the selected point and direction shall be not less than 3. The readout shall be performed according to the mean reading of the device.

With the variation of measurements more than in 1,5 (3 dB) times, the number of measurements shall be twice as much.

6. Treatment of measurements results and assessment of indices and accuracy of measurements

6.1 The result of a single measurement is considered reliable provided that the requirements described in 3 and 5.1 to 5.6 are met.

6.2 When measurements are taken as required in 5.7, values determined for each frequency band depending on the variation of results as indicated in 6.3 and 6.4 shall be considered measurement results

6.3 With the variation of results less or equal to 3 dB, the maximum value received in initial number of measurements shall be taken.

6.4 With the variation of results more than 3 dB, the value determined for each of the frequency bands shall be taken as a final result in accordance with the following formula:

$$X = \bar{X} + KS \quad (6.4-1)$$

where X = arithmetical mean value determined according to the following formula:

$$\bar{X} = \frac{\sum_{i=1}^n X_i}{n}; \quad (6.4-2)$$

S = mean square deviation determined according to the following formula:

$$S = \sqrt{\frac{\sum_{i=1}^n (X_i - \bar{X})^2}{n-1}}; \quad (6.4-3)$$

X_i = result of measurements expressed in absolute units;

n = number of measurements ($n \geq 6$);

$K = t/\sqrt{n}$;

t = Student coefficient.

(6.4-4)

Dependence of coefficient K on number of measurements n :

n	6	8	10	12
$K = t/\sqrt{n}$	1,05	0,85	0,72	0,62

6.5 In the course of vibration measurement of vibration motion such measurements shall be transformed into vibration velocity or vibration acceleration values in accordance with the following formulae:

$$V_e = 2\pi f_c S_e; \quad (6.5-1)$$

$$a_e = 2\pi f_c S_e V_e \times 10^{-3} = 4\pi^2 f_c^2 S_e \times 10^{-3}; \quad (6.5-2)$$

$$S_e = S_p / \sqrt{2} \quad (6.5-3)$$

where V_e , a_e and S_e = mean square values of vibration rate, in mm/s, vibration acceleration, in m/s², and vibration motion, in mm, respectively;

f_c = geometrical mean frequency analyze band, in Hz;

S_p = peak value of vibration motion, in mm.

7. Requirements for development of vibration measurements programme on ships

7.1 Measurement programme shall contain the following information:

.1 scope and tasks of measurements;

.2 general and specific conditions of different stages of measurements stipulated by the particulars of the hull construction, the ship's purpose, conditions of its service, etc.;

.3 measured parameters;

.4 apparatus and its errors;

.5 fitting methods for vibration transducers;

.6 list of structures and/or machinery subject to control;

.7 points and directions of measurements;

.8 ship running conditions and/or machinery operating conditions;

.9 duration of recording of measured parameters and time of taken measurements;

.10 methods of treatment of measured results and form of records.

7.2 The above stated information shall be contained in the four sections of the programme as follows:

.1 general provisions, in compliance with 7.1.1 to 7.1.5;

.2 measurements in the course of mooring trials, in compliance with 7.1.2, 7.1.6 to 7.1.9;

.3 measurements in the course of sea trials, in compliance with 7.1.2 and 7.1.6 to 7.1.9;

.4 results of measurements and their assessment, in compliance with 7.1.10.

7.3 Where necessary, the programme may additionally include sections reflecting obligations of the participants of tests supplying apparatus, testing equipment and materials required for preparation work, provision of testing conditions, safety measures and other arrangements arising from measurements on ships.

[illegible]

Measurements of vibrations of hull, superstructure and hull structures

[illegible]

19 INITIAL SHIP SURVEYS DURING CONSTRUCTION AND TRIALS WITH THE PURPOSE OF ISSUING CERTIFICATES REGULATED BY INTERNATIONAL CONVENTIONS AND CODES

19.1 GENERAL

19.1.1 The provisions of this Section regulate the scope of the initial survey of the ship during its construction and trials with the purpose of confirmation of the ship's compliance with the following international conventions and codes and issue of the relevant certificates in the scope specified in the STORM Checklist that is generated at the initial stage of technical supervision during construction:

International Convention for the Safety of Life at Sea, 1974, as amended, and as modified by the Protocol of 1988, as amended (hereinafter — SOLAS-74);

International Code for Systems of Fire Safety adopted by IMO resolution MSC.98(73) (hereinafter — FSS Code);

International Convention on Load Lines, 1966, as amended, and as modified by the Protocol of 1988, as amended (hereinafter — LL-66);

International Convention for the Prevention of Pollution from Ships, 1973, as amended, and as modified by the Protocol of 1978, as amended (hereinafter — MARPOL 73/78);

Technical Code on Control of Emission of Nitrogen Oxides from Marine Diesel Engines, as amended (hereinafter — NO_x Technical Code);

International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (IBC Code);

International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk, as amended (hereinafter — IGC Code);

Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk, as amended (hereinafter — BCH Code);

International Code of Safety for Ships Operating in Polar Waters (Polar Code);

International Life Saving Appliances Code adopted by IMO resolution MSC.48(66) (hereinafter — LSA Code);

Code of the Safety for Special Purpose Ships, 2008 (hereinafter — SPS Code);

International Convention on the Control of Harmful Anti-Fouling Systems on Ships, 2001 (hereinafter — AFS-Convention), and EC Regulation 782/2003 of the European Parliament and EU Council, 2003 (hereinafter — EC Regulation 782/2003);

International Convention for the Control and Management of Ships' Ballast Water and Sediments, 2004 (hereinafter — BWM Convention).

The scope of the initial survey of MODU, high-speed craft, manned submersible apparatus and diving systems regulated by international codes is specified in the guidelines on technical supervision during construction of the appropriate items.

The scope of initial survey of the ship with the purpose of confirming their compliance with the International Convention on Tonnage Measurements of Ships, 1969, taking into account the IMO resolutions and circulars relating to the tonnage measurements of ships is specified in the Register Rules for the Tonnage Measurement.

19.1.2 As to the form, procedure and methods of surveys of the items of technical supervision listed in this Section, the appropriate requirements of Sections 2 —18 of the Guidelines may be applied (and in separate cases, of Sections of the appropriate Rules set forth below) which apply as a whole in the course of the initial survey of the ship to confirm its compliance with the requirements of the Rules for the Classification and Construction, Rules for the Equipment, Load Line Rules, Rules for the Classification and Construction of Ships Carrying Liquefied Gases in Bulk, Rules for the Classification and Construction of Ships Carrying Compressed Natural Gas; Rules for the Classification and Construction of Chemical Tankers.

19.1.3 Fulfillment of the requirements of this Section taking into account provisions of 19.1.2 enables to confirm, by appropriate international certificates, fulfillment of the requirements of the conventions and codes listed in 19.1.1.

19.1.4 The initial survey of the ship, as specified in this Section, complies with the requirements of the following:

SOLAS-74 (Chapter 1, Regulations 7(a)(i), 8(a)(i) and 8(b)(i), 9(a)(i) and 9(b)(i), 10(a)(i) and 10(b)(i);

LL-66 (Article 14(l)(a);

MARPOL 73/78 (Annex I, Regulation 6.1.1, Annex II, Regulation 8.1.1, Annex IV, Regulation 4.1.1, Annex VI, Regulation 5.1.1);

BWM Convention (Regulation E-I);

IBC Code (Regulation 1.5.2.1.1);

IGC Code (Regulation 1.5.2.1.1);

BCH Code (Regulation 1.6.2.1.1);

SPS Code (1.6, 1.7);

IMO resolution MEPC.195(61) "2010 Guidelines for Survey and Certification of Anti-Fouling Systems on Ships";

as well as provisions of IMO resolution A.1120(30).

19.1.5 Each of the chapters of this Section relates to surveying with the purpose of issuing a certain International Certificate (with lists of equipment where necessary).

19.1.6 The initial survey in the course and upon completion of ship construction includes the full inspection (with required tests) of the ship's structure, machinery and equipment so as to confirm that the relevant requirements for the ship and her elements relative to each International Certificate are complied with, and that the ship's structure, her machinery and equipment are in proper condition in conformity with the service conditions of the ship.

19.1.7 The initial survey consists of the following:

.1 review and approval of the ship's design documentation (drawings, specifications, descriptions, calculations, etc.) serving to confirm that the ship's structure, her machinery and equipment are in compliance with the requirements relative to any particular International Certificate;

.2 inspection of the ship's structure, her machinery and equipment so as to ascertain that materials of the structure, machinery and equipment, their structural dimensions, arrangements, installation and mounting are in compliance with the approved technical documentation, and their executive quality (of manufacture, mounting) is in all respects satisfactory, and machinery and equipment are operable;

.3 checking the availability onboard of all necessary Certificates for materials, machinery and equipment, manuals, information, ships log books and other documents stated in the requirements relative to each international certificate.

Note. Surveys shall be carried out taking into account IACS UI SC249 (Rev.1 Feb 2013).

IACS UI mentioned above shall be found in the Supplement to Rules and Guidelines of Russian Maritime Register of Shipping "IACS Procedural Requirements, Unified Interpretations and Recommendations" (published in electronic form as a separate edition).

19.1.8 Results of the initial survey shall be recorded in the Survey Report of the established form. On the basis of the Survey Report recommendations, a relevant certificate shall be issued for the ship as stated in the Chapters of this Section.

19.1.9 In the course of technical supervision during ship construction in compliance with the present Section and, simultaneously, with the purpose of the ship classification the appropriate surveys, inspections, tests shall be concurrent. In this case, review of the ship's technical documentation (refer to 19.1.7.1) and of the ship design for its classification are concurrent.

19.1.10 When the surveys are carried out for confirming compliance with the provisions of SOLAS-74, as amended, and MARPOL 73/78, one shall be guided by IMO circular MSC-MEPC.5/Circ.4 dated 16 December 2008 "Unified Interpretation of the Application of Regulations Governed by the Building Contract Date, the Keel Laying Date and the Delivery Date for the Requirements of the SOLAS and MARPOL Conventions".

19.1.10.1 Under certain provisions of SOLAS-74 and MARPOL 73/78, the application of regulations to a ship is governed by the dates:

.1 for which the building contract is placed on or after dd/mm/yyyy; or

.2 in the absence of a building contract, the keel of which is laid or which is at a similar stage of construction on or after dd/mm/yyyy; or

.3 the delivery of which is on or after dd/mm/yyyy.

Note. For the purpose of determining the application of mandatory requirements of the SOLAS-74 and MARPOL 73/78 to a new ship, the date of "delivery" means the completion date (day, month and year) of the survey on which the certificate is based (i.e. the initial survey before the ship is put into service and certificate issued for the first time) as entered on the relevant statutory certificates.

19.1.10.2 For the application of such provisions, the date on which the building contract is placed for optional ships shall be interpreted to be the date on which the original building contract to construct the series of ships is signed between the shipowner and the shipbuilder provided:

.1 the option for construction of the optional ship(s) is ultimately exercised within the period of one year after the date of the original building contract for the series of ships; and

.2 the optional ships are of the same design plans and constructed by the same shipbuilder as that for the series of ships.

19.1.10.3 The application of regulations governed as described in 19.1.10.1, shall be applied as follows:

.1 if a building contract signing date occurs on or after the contract date specified for a particular set of regulation amendments, then, that set of regulation amendments applies;

.2 only in the absence of a building contract does the keel laying date criteria apply and, if a ship's keel laying date occurs on or after the keel laying date specified for a particular set of regulation amendments, then, that set of regulation amendments applies; and

.3 regardless of the building contract signing date or keel laying date, if a ship's delivery date occurs on or after the delivery date specified for a particular set of regulation amendments, then, that set of regulation amendments applies except in the case where the Administration has accepted that the delivery of the ships was delayed due to unforeseen circumstances beyond the control of the shipbuilder and the shipowner.

19.2 INITIAL SURVEY FOR ISSUE OF THE CARGO SHIP SAFETY EQUIPMENT CERTIFICATE (SOLAS-74)

19.2.1 Scope of the ship survey shall be determined in compliance with IMO resolution A.1120(30).

19.2.2 Upon satisfactory completion of the initial survey, the Cargo Ship Safety Equipment Certificate (form 2.1.10) and its associated Record of Equipment (form E) (form 2.1.15) shall be issued.

19.3 INITIAL SURVEY FOR ISSUE OF THE CARGO SHIP SAFETY CONSTRUCTION CERTIFICATE (SOLAS-74)

19.3.1 Scope of the ship survey shall be determined in compliance with IMO resolution A.1120(30).

19.3.2 Upon satisfactory completion of the initial survey, Cargo Ship Safety Construction Certificate (form 2.1.9) shall be issued.

19.4 INITIAL SURVEY FOR ISSUE OF THE CARGO SHIP SAFETY RADIO CERTIFICATE (SOLAS-74)

19.4.1 Scope of the ship survey shall be determined in compliance with IMO resolution A.1120(30).

19.4.2 For the radio installations, including those used in life-saving appliances, of cargo ships the initial survey shall be completed as follows.

After completion of the radio equipment installation (or the ship's construction), the firm, which carried out installation and commissioning works, submits the equipment to the RS surveyor and/or provides the relevant reports filled in per the form stipulated by the firm. The firm shall be recognized by the Register for performance of installation and commissioning works (kind of activity code 22006003 specified in Table 8.1.1, Part I "General Regulations for Technical Supervision" of the Rules for Technical Supervision).

Based on the results of the survey performed and the reports submitted, the RS surveyor fills in a Check List on Examination of the Radio Facilities of the Cargo Ship (form 6.1.22) or STORM Check List (form 6.1.01).

Based on the recommendations of this Check List, satisfactory results of the survey and absence of comments or non-conformities, the Cargo Ship Safety Radio Certificate (form 2.1.12) and the associated Record of Equipment (form R) (form 2.1.20) shall be issued.

19.5 INITIAL SURVEY FOR ISSUE OF THE PASSENGER SHIP SAFETY CERTIFICATE (SOLAS-74)

19.5.1 Scope of the ship survey shall be determined in compliance with IMO resolution A.1120(30).

19.5.2 Upon satisfactory completion of the initial survey, Passenger Ship Safety Certificate (form 2.1.11) and the associated Record of Equipment (form P) (form 2.1.14) shall be issued.

**19.6 INITIAL SURVEY FOR ISSUE OF THE INTERNATIONAL LOAD LINE CERTIFICATE
OR THE INTERNATIONAL LOAD LINE EXEMPTION CERTIFICATE (LL-66)**

19.6.1 Scope of the ship survey shall be determined in compliance with IMO resolution A.1120(30).

19.6.2 Upon satisfactory completion of the initial survey, the Record of Conditions of Assignment of Load Lines (form 6.7.3), International Load Line Certificate (form 2.2.3) or International Load Line Exemption Load Line Certificate (form 2.2.4) shall be issued.

For ships of river-sea navigation flying the flag of the Russian Federation, having the Register class **R2-RSN**, **R2-RSN(4,5)**, **R3-RSN** as well as the Russian River Register class **M-CII**, in addition to the International Load Line Certificate, the Register issues the Supplement to the International Load Line Certificate (form 2.2.3-1), where in section containing the information about permanently restricted areas of navigation, the restrictions are indicated for ships operating only in restricted areas, for example: "River-sea navigation at seas with a wave height of 6,0 m (or 5,0 m) with 3 % probability with ships proceeding from the place of refuge in open seas not more than 50 miles and with an allowable distance between the places of refuge not more than 100 miles in enclosed seas not more than 100 miles and with an allowable distance between the places of refuge not more than 200 miles".

Note. This practice is approved by IMO and does not require any agreement or issue of the International Load Line Exemption Certificate. However, when issuing the above Supplement to a ship it is necessary to present on board a hard copy of the circular letter of the MO Maritime Safety Committee (MSG) No. 2014 of 31 October 1997, to avoid possible claims of the Port Authorities (refer to Annex 16 to the Guidelines for Technical Supervision of Ships in Service).

**19.7 INITIAL SURVEY FOR ISSUE OF THE INTERNATIONAL OIL POLLUTION PREVENTION CERTIFICATE
(IOPP CERTIFICATE) WITH SUPPLEMENTS "A" OR "B" (MARPOL 73/78)**

19.7.1 Scope of the ship survey shall be determined in compliance with IMO resolution A.1120(30).

19.7.2 Upon satisfactory completion of the initial survey, an IOPP Certificate (form 2.4.5) with Supplement A (form 2.4.20) or B (form 2.4.26) (reg. 7 of Annex I to MARPOL 73/78) shall be issued.

**19.8 INITIAL SURVEY FOR ISSUE OF THE INTERNATIONAL POLLUTION PREVENTION CERTIFICATE
FOR THE CARRIAGE OF NOXIOUS LIQUID SUBSTANCES IN BULK (MARPOL 73/78)**

19.8.1 Scope of the ship survey shall be determined in compliance with IMO resolution A.1120(30).

19.8.2 Upon satisfactory completion of the initial survey, an International Pollution Prevention Certificate for the Carriage of Noxious Liquid Substances in Bulk (form 2.4.7) (reg. 9 of Annex II to MARPOL 73/78) shall be issued.

**19.9 INITIAL SURVEY FOR ISSUE OF THE INTERNATIONAL SEWAGE POLLUTION PREVENTION CERTIFICATE
(MARPOL 73/78)**

19.9.1 Scope of the ship survey shall be determined in compliance with IMO resolution A.1120(30).

19.9.2 Upon satisfactory completion of the initial survey, an International Sewage Pollution Prevention Certificate (form 2.4.9) (reg. 5 of Annex IV to MARPOL 73/78) shall be issued.

**19.10 INITIAL SURVEY FOR ISSUE OF THE INTERNATIONAL GARBAGE POLLUTION PREVENTION CERTIFICATE
(MARPOL 73/78)**

19.10.1 Scope of the ship survey shall be determined in compliance with IMO resolution A.1120(30).

19.10.2 Upon satisfactory completion of the initial survey, a Certificate of Compliance of Equipment and Arrangements of the Ship with the Requirements of Annex V to the MARPOL 73/78 Convention (form 2.4.15) shall be issued.

**19.11 INITIAL SURVEY FOR ISSUE OF THE INTERNATIONAL CERTIFICATE OF FITNESS
FOR THE CARRIAGE OF DANGEROUS CHEMICALS IN BULK (IBC CODE)**

19.11.1 Scope of the ship survey shall be determined in compliance with IMO resolution A.1120(30).

19.11.2 Upon satisfactory completion of the initial survey, a Certificate of Fitness for the Carriage of Dangerous Chemicals in Bulk shall be issued.

**19.12 INITIAL SURVEY FOR ISSUE OF THE INTERNATIONAL CERTIFICATE OF FITNESS
FOR THE CARRIAGE OF LIQUEFIED GASES IN BULK (IGC CODE)**

19.12.1 Scope of the ship survey shall be determined in compliance with IMO resolution A.1120(30).

19.12.2 Upon satisfactory completion of the initial survey, an International Certificate of Fitness for the Carriage of Liquefied Gases in Bulk (form 2.4.22) shall be issued.

**19.13 INITIAL SURVEY FOR ISSUE OF THE INTERNATIONAL AIR POLLUTION PREVENTION CERTIFICATE
(IAPP CERTIFICATE) (MARPOL 73/78)**

19.13.1 Scope of the ship survey shall be determined in compliance with IMO resolution A.1120(30).

19.13.2 Upon satisfactory completion of the initial survey, an IAPP Certificate (form 2.4.6) (reg. 6 of Annex VI to MARPOL 73/78) shall be issued.

19.14 INITIAL SURVEY FOR ISSUE OF THE SPECIAL PURPOSE SHIP SAFETY CERTIFICATE (SPS CODE)

19.14.1 Survey of the ship in compliance with SPS Code is required by 2.1.6, Part III "Survey of Ships in Compliance with International Conventions, Codes, Resolutions and Rules for the Equipment of Sea-Going Ships" of the Guidelines for Technical Supervision.

19.14.2 Upon satisfactory completion of the initial survey, a Special Purpose Ship Safety Certificate (form 2.1.27) and Safety Certificate in compliance with SOLAS-74 (Cargo Ship Safety Certificate or Passenger Ship Safety Certificate depending on number of persons on board) and, where necessary, Exemption Certificate shall be issued.

**19.15 INITIAL SURVEY IN COMPLIANCE WITH THE INTERNATIONAL CONVENTION ON THE CONTROL
OF HARMFUL ANTI-FOULING SYSTEMS ON SHIPS, 2001 (AFS-CONVENTION) AND REGULATION (EC) No. 782/2003
OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL, 2003 (REGULATION (EC) No. 782/2003)**

19.15.1 Initial survey of a ship during construction is carried out within the scope required by 2.4.3, Part III "Survey of Ships in Compliance with International Conventions, Codes, Resolutions and Rules for the Equipment of Sea-Going Sips" of the Guidelines on Technical Supervision.

19.15.2 The International Anti-Fouling Systems Certificate (form 2.4.30/2.4.30ec)/Statement of Compliance of Anti-Fouling System (form 2.4.30.1) and the Record of Anti-Fouling System (form 2.4.31/2.4.31ec/2.4.31.1) are issued in compliance with 2.4.2.1 — 2.4.2.5, 2.4.2.7, 2.4.2.8, with due regard to the requirements of 2.4.1, Part III "Survey of Ships in Compliance with International Conventions, Codes, Resolutions and Rules for the Equipment of Sea-Going Sips" of the Guidelines on Technical Supervision.

**19.16 INITIAL SURVEY FOR ISSUE OF THE INTERNATIONAL BALLAST WATER MANAGEMENT CERTIFICATE
(BWM CERTIFICATE) (BWM CONVENTION)**

19.16.1 International Ballast Water Management Certificate (BWM Certificate) (form 2.5.4) may be issued to any ship of 400 gross tonnage and above.

19.16.2 Scope of the ship survey shall be determined in compliance with IMO resolution A.1120(30).

19.17 INITIAL SURVEY FOR ISSUE OF THE POLAR SHIP CERTIFICATE (POLAR CODE)

19.17.1 Scope of the ship survey shall be determined in compliance with IMO resolution A.1120(30).

19.17.2 Upon satisfactory completion of the initial survey, a Polar Ship Certificate (form 2.1.29) and Record of Equipment (form 2.1.30) shall be issued.

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